Essays on the Effects of Fiscal Policy:

Impact of Government Spending in the UK

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Declaration

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Abstract

This thesis investigates the economic effects of government spending in the UK, examining if the size of spend and what the government buys play a role in the reported effects. This is done by examining the disaggregated effects of aggregated and disaggregated government spending at sectoral, industry and firm level. The first original contribution extends the simple income and expenditure model to highlight the importance of appropriately accounting for imports in sectoral government spending. The second contribution investigates the output and price effects of industry-specific government spending using a newly constructed measure of industry-specific government demand. The final contribution provides micro-level evidence by mapping firm-level central government expenditure to firms' financial accounts to report firm-level employment and wage effects of government demand. The general conclusion reached by the thesis is that not only is what the government buys important, but the size of government demand is also a key factor in the multiplier effect of government spending for the UK. All three contribution chapters emphasise the importance of what the government buys, while the importance of government demand size is explored in chapters three and four.

Keywords: fiscal multiplier, fiscal policy, government spending, employment, real wages, durable goods, nondurable goods, input-output tables.

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Introduction and Scope

The financial crisis of 2008 and the subsequent fiscal stimulus actions of governments around the world reignited the debate on the merit of such fiscal actions. The motivation for the path of empirical investigation taken by this thesis is the view that regions, sectors and industries are impacted differently by fiscal policy, yet the headline effect that is commonly reported is the aggregate effect. While evidence suggests expansionary government spending has favourable effects on the economy, digging deeper by using appropriate data might actually reveal the opposite of such a claim given the different fortunes of regions, sectors and industries. In addition, the view that fiscal policy is ineffective is easily challenged when we consider recent regional United States (US) empirical evidence even though there is still an ongoing debate of how regional effects are aggregated. The unavailability of appropriate data to carry out regional-, sectoral- and industry-level analysis can be credited with the lack of empirical investigation in this area of research for the United Kingdom (UK); however, by combining datasets from multiple data sources, this thesis aims to shed some light on the disaggregated effects of fiscal policy in the UK, using sectoral-, industry- and firm-level data.

This thesis will investigate three research questions: (1) What do we currently know about the effects of government spending? (2) What are the output effects of sectoral government expenditure? and (3) Are there heterogeneous effects of government spending across industries and firms the industry- and firm-level effects of government spending. To answer the first question, I provide a review of the theoretical debate and current empirical evidence on the impact of government spending. By answering the first reason question, it became evident that the focus of the academic literature on the macroeconomic effects of government spending tends to be on aggregate effects, with considerable evidence-gaps on the disaggregated effects. This gap motivates the original contributions of this thesis. Working with available empirical data and exploiting information from the input-output tables for the UK, this thesis will respond to the second research question by attempting to show that the output effects of government spending is dependent on the types of sectoral government spending. By creating a new industry-specific government demand to estimate output and price elasticities of industries, this thesis will respond to the third research question by attempting to show that the estimated elasticities are heterogenous and dependent on key industry characteristics. In addition to these results, I use a novel firm-level government procurement dataset to report the firm-level effects of government spending.

The dissertation is comprised of four chapters on the effects of fiscal policy; more specifically, it is an investigation into the disaggregated effects of government spending. The first chapter provides a brief literature review while the remaining three chapters are empirical investigations on the effects of fiscal policy through government spending. Chapter one focuses on the theoretical debate, the empirical evidence and developments in empirical methods. As expressed below, the conclusions from the review chapter motivate the three empirical chapters; the question is not if government spending has an impact on the economy, but rather how big these impacts are and how they vary by industry, firm size, and by what the government actually buys.

The general conclusion reached by the thesis is that not only is what the government buys important, but the size of government demand is also a key factor in the multiplier effect of government spending for the UK. Chapters two, three and four emphasise the importance of what the government buys, while the importance of government demand size is explored in chapters three and four.

The theoretical debate on the short-run effects of government spending is examined in chapter one, a debate that is traditionally framed around a *multiplier* effect. As shown in the chapter, the debate is quite complex, with the conclusion reached unsurprisingly similar to other review papers in that the short-run effect of government spending is very much dependent on the adopted macroeconomic perspective. While there was a sense of general agreement on the major route with which crowding out[1] could occur (interest rates) in the early debate, such agreement is not present in recent contributions as the *Ricardian equivalence*[2] is not accepted by all, so the lack of a general consensus on the short-run effects of government spending should not come as a surprise, but as presented in the chapter, a few points are worth highlighting. When there is general acceptance of prerequisites such as an accommodative monetary authority and slack in the economy, then government spending can be effective in stimulating the economy, and as shown in the empirical literature discussions, the state of the economy becomes even more important when distinction is made between negative or positive government spending shocks.

Due to fiscal instrument data suffering from reverse causation or endogeneity problems with other macroeconomic variables like gross domestic product (GDP) means a major debate in the empirical literature is the identification of a truly exogenous unanticipated fiscal shock, and capturing the economic reaction to it in an unbiased manner. Thus, the empirical literature discussion is focused on discretionary government spending as this component of government spending is readily accepted to address the endogeneity issue. Unsurprisingly, just like the theoretical frameworks discussed, competing empirical methods provide varying sizes of multiplier

[1] This is based on the view that there is competition between the government and the private sector for the same pool of money, with expansionary fiscal policy seen as asserting upward pressure on interest rates and in doing so *crowds out* private consumption and investment.

[2] The *Ricardian equivalence* suggests that how the government finances its spending does not matter: the total level of demand in the economy remains the same regardless of whether the government spend is by borrowing or increasing taxation, because by borrowing to finance a deficit, you are merely postponing taxes (Bernheim, 1989).

estimates. I discuss the main identification schemes utilised in the literature, presenting not only estimates of output multipliers, but also reported effects on the other macroeconomic variables discussed in the theoretical literature. I show that while there is still no consensus on the size of the effect (i.e. the size of the government spending multiplier), there is growing acceptance that the size is 'context-dependent', with context not just taking into account the state of the economy and monetary policy stance, but also the structural characteristics of the economy in question and sign of fiscal impulse. The time-varying nature of the government spending multiplier suggests the size of the multiplier in the 1980s was different from those in the 1990s, and the multiplier during the downturn of the early 1970s was different from those in the late 2000s, which could be due in part to time-varying structural characteristics of an economy and the stance taken by the monetary authority during the mentioned periods. More research is needed to understand these characteristics at both country and sector/industry level given that 'the incremental effect of structural factors on multipliers is, to a large extent, unknown' (Batini et al., 2014, p.9), which motivates the three empirical chapters in this thesis.

The first original contribution, chapter two, extends the simple Keynesian income-expenditure model to highlight the importance of appropriately accounting for imports in sectoral government spending. The model presented in this chapter builds on Palley (2009) by providing a framework that appropriately accounts for imports in sectoral government expenditure, differentiating between government spending on durable goods, nondurable goods, and services. Using data for the UK economy, the estimated multiplier in this paper shows that the government spending multiplier can be as high as 1.76 and as low as 0.46, with the differences in import content across sectors responsible for this variation. This chapter contribution differs from existing literature by taking advantage of information from the input-output tables of the UK to construct a measure for sectoral government expenditure. Although the differentiation was between government spending on durable goods, nondurable goods, and services, the approach taken in this chapter is also applicable to other strands of the literature that differentiate between, for example, traded and non-traded sectors (e.g. Bénétrix and Lane, 2010). In addition, while the results from this chapter are similar to those presented by Boehm (2016) in a New Keynesian model set-up, the role of imports in explaining the different effects of sectoral government expenditure as shown in the chapter is quite different from the crowding out argument presented by Boehm (2016). The role given to import in this chapter is also related to the recent contribution of Charles (2016) who endogenized imports in a Kaleckian post-Keynesian model of distribution and growth to offer an explanation why the size of the multiplier is state-dependent.

The focus of academic literature on the macroeconomic effects of government spending tends to be on aggregate effects, with considerable evidence-gaps on the disaggregated effects. This focus is evident in chapter two of this thesis given that although I disaggregated government expenditure, the output multiplier effects I reported were at the aggregate level. I help to fill some of this gap with the contributions in chapter three and four by examining the industry-and firm-level effects of government spending in the UK.

In chapter three I investigate the output and price effects of industry-specific government spending using a newly constructed measure of industry-specific government demand. Building on the ideas of Nekarda and Ramey (2011) and Perotti (2008), I use information from the input-output tables to create industry-specific demand for 87 manufacturing and service industries, contributing to the literature by extending the ideas beyond just manufacturing industries as done by the aforementioned papers. Estimating industry output and price elasticity to government demand using this new measure, the results presented in this chapter show that there is heterogeneity across industries, with this heterogeneity correlated to imports and the proportion of industry output that is consumed by the government. Results presented show that the majority of industries in the UK do not seem to respond significantly to government demand. This has important implications for the output multiplier effects of government spending as it not only confirms a held view that aggregated effects are not necessarily replicated across industries, but that the story of the government spending multiplier is one that not only needs to take into account the input-output linkages in the economy, but also the initial responses of industries. These results indicate there is room for improvement in more recent multi-industry general equilibrium models that account for the input-output structure of the economy as presented by Acemoglu et al. (2016). The common assumption in these models is that an industry will always respond one for one by changing output quantity to reflect the change in government demand, this which is not the case as shown with the estimated elasticities presented in this chapter. In an addition, this chapter contributes to the list of industry characteristics that can play a role in an industry's response to fiscal policy. The reported heterogeneity is also consistent with those reported by Aghion et al. (2014) who provided evidence which suggests the growth effects of fiscal policy are greater in *financially constrained* industries because such policy reduces aggregate volatility. In the case of this chapter, *imports* and the *proportion of industry output that is consumed by the government* are key industry characteristics. Using the estimated industry output elasticities, the chapter suggests output multipliers ranging between 0.74 and 1.44.

While chapter three does a good job in addressing an important evidence-gap in the literature, another such evidence-gap it didn't address was the effects government spending has on firms within these industries. Chapter four goes a step further by using more granular data to provide micro-level evidence for the UK, mapping firm-level central government expenditure to firms' financial accounts to report firm-level employment and wage effects of government demand. As explained earlier, the literature on the effects of government spending tends to be focused at aggregate effects, and this extends also to variables such as employment and wages (e.g. Pappa, 2009b; Tagkalakis, 2006), with very few papers attempting to investigate the direct employment or wage impacts of government spending, i.e. using firm-level data to understand what happens when the government purchases goods and services from firms. This is very much due to the lack of data capturing government expenditure at firm level. Hence, the data used in chapter four is novel and captures central government procurement of goods and services excluding the government's wage bill, representing on average about 27% of yearly total government procurement expenditure between 2010 and 2015. Although attempts have been made to use micro-level data to understand the impact of government spending on private investment (e.g. Hebous and Zimmermann, 2016) and employment (e.g. focus on the construction sector by Saini and Silva, 2015), to my knowledge, no paper has mapped firm-level government spending data to employment and wage data across multiple industry sectors as done in this chapter. With results consistent with those in chapter three, results from the chapter suggest that the impact of government spending on employment and wages varies not only by industry sector, but also by firm size. In addition, the size of government demand seems to be important at firm level because the employment impact of government spending is about five times larger when government demand makes up at least 10% of total demand received by a firm. Also, the different response of firms in the manufacturing and service sector compared to defence spending indicates that we might be underestimating the impact of government spending when defence spending is used as a spending instrument for aggregate analysis (e.g. Ramey, 2011), especially for a country such as the UK where the service sector makes up a significant proportion of the economy. Results presented suggest that not only is the size of government spending important, but what the government buys matters.

Chapter 1

The Effects of Government Spending on the Economy: A Brief Review of the Literature

1.1 Introduction

> '*If the government, either by borrowing or taxation, acquires funds which would otherwise have been spent privately, the public spending of those funds is a mere shifting, not an increase in the aggregate. But if government acquires funds which would not otherwise have been spent (and borrowing is the more likely method of doing this), then when it spends these funds it does increase the aggregate.*'
>
> J.M. Clark (1935, p.1)

The view expressed by Clark (1935) would make it seem that all should be in agreement with the impact fiscal policy has on aggregate demand; however, this is not the case. The theoretical and empirical debate on the effectiveness of fiscal policy is quite complex, so it shouldn't be a surprise that there is no general consensus on the effect of fiscal policy on aggregate demand, and the impact changes in aggregate demand has on real economic activity. There is generally an agreement on the role and importance of automatic stabilisers[1]; however, the same cannot be said for the use of discretionary fiscal policy[2]. In this chapter I provide a brief review on the theoretical and empirical debate on the short-run effects of discretionary fiscal policy, a debate that is traditionally framed around a *multiplier* effect[3]. By focusing on short-run effects, the

[1] See e.g. Auerbach, 2003; Blinder, 2004; Fatas and Mihov, 2012; Musgrave and Miller, 1948.

[2] In this chapter, fiscal policy refers to discretionary government spending.

[3] This distinction to focus on the short-run effects is important as not only can we explore the long-run effects, but we can also explore the medium-term effects of fiscal policy; this adds other complexity that must be explained, and in doing so shifts attention away from the main motive of the chapter. For example, the main channel of long-run effects of fiscal policy include labour supply (Devereux and Love, 1994; Turnovsky, 2000), physical capital (Devereux and Love, 1994; Mendoza et al., 1997; Rebelo, 1991; Stokey and Rebelo, 1995), human capital (King and Rebelo, 1990; Lucas, 1988; Barro, 1990, 2001), and total factor productivity (Baier and Glomm, 2001; Romer, 1987, 1990). Discussion on these channels warrants a whole chapter, thus they are best left undiscussed in this chapter.

assumption is that, by and large, the effects are not due to changes in productive capacity but in the degree of utilisation of capacity, due in turn to changes in aggregate demand.

The categorisation of Clark (1935) on the essential elements in the multiplier process is as relevant today as it was decades ago when it was first presented, a year before Keynes' *General Theory of Employment, Interest and Money* was officially published in 1936[4]. Over the decades, different elements have taken centre stage in the debate on the effectiveness of expansionary government spending. Clark (1935) recognised eight essential elements which can be compressed into the following: i) expansionary expenditure; ii) a resultant increase in income that is subsequently spent by the recipient; iii) leakages arising from the increase in income not being spent[5]; iv) the resulting multiplier, with leakages assumed to remain constant through the process[6]; v) the time it takes for the multiplier process to complete; and vi) counteracting factors.

Whereas elements *i* through to *v* are factors working within the tradition fiscal multiplier formula, there are factors outside the formula that impact the effects of an expansionary fiscal policy; this is captured by element *vi*. Most recent contributions to the debate on the short-run effects of fiscal policy have been heavily focused on element *vi*, so in this chapter I explore the different theoretical perspectives on counteracting factors that can render fiscal policy ineffective[7]. With recent empirical contributions showing the fiscal multiplier to be endogenous to the state of the economy[8], confirming a view always held by Keynesians and post-Keynesians, I also discuss the role given to leakages in explaining this endogeneity (elements *iii* and *iv*).

While changes in fiscal policy can take the form of changes in taxation and/or changes in spending, the motivation to focus on changes in government spending is driven by recent events. The global financial and economic crisis that started in 2008 resulted in unprecedentedly large fiscal expansion in many countries, as reported by Prasad and Sorkin (2009, p.2): 'total amount of stimulus in the G-20 amounts to about $692 billion for 2009, which is about 1.4 percent of their combined GDP and a little over 1.1 percent of global GDP'. Based on their calculation, they showed that about one-third of the total stimulus response is accounted for by tax cuts

[4]While there are other elements such as an expansionary monetary policy, the 'counteracting factors' can capture the need for environments that are accommodating to the private sector which can be captured by element vi in Clark's eight essential elements.

[5]The assumption here is that we are dealing with a closed economy. In an open economy, scenario leakages would also include income spent on imported goods.

[6]Although as I show in section endogenising-leakages-from-imports[subsec:Accounting-appropriately-for leakages], recent contributions such as Charles et al. (2015) have endogenised 'leakages' to provide a theoretical explanation for the multiplier being endogenous.

[7]A challenge one faces when discussing fiscal policy is drawing a boundary and staying within that boundary of discussion. To illustrate, suppose in this chapter we are interested in answering the following question: If the government spends an extra X amount, what happens to the economy? By answering this question, we are not only faced with an additional question of the sustainability and optimality of the funding channel for such additional spending, but also the debate the role fiscal policy is given in the dominant new macroeconomic consensus if government spending is indeed able to stimulate the economy. The aim of the chapter is to stay within the boundaries of the short-run effectiveness of government spending, but if I stray into other important debates on fiscal policy, they will at best be brief.

[8]See chapter two of this thesis.

and the remainder by spending measures[9], although there were exceptions such as the UK with 73% of tax cuts. Given the sizeable portion being in the form of spending, it is a useful exercise to revisit what the literature tells us about the effects of government spending[10].

The conclusion reached in this chapter is unsurprisingly consistent with other similar review papers in that the short-run effect of fiscal policy is very much dependent on the adopted macroeconomic perspective. Moving beyond the contributions aimed at explaining the process behind the multiplier principle and ultimately the multiplier value (e.g. Machlup, 1939), the major focus in the literature is on the displaced private sector spending caused by government spending, i.e. the 'crowding out' effect. The early debates can be said to be heavily based on the competition between the government and the private sector for the same pool of money, with expansionary fiscal policy seen as asserting upward pressure on interest rates, and, in doing so, 'crowding out' private consumption and investment (Carlson and Spencer, 1975)[11]. While this line of crowding out is still present in the literature, recent contributions have been dominated by the crowding out that arises as a result of 'wealth effects' a la *Ricardian equivalence.* At least in the early debate there was a sense of general agreement on the major route with which crowding out could occur (interest rates); however, such agreement is not present in recent contributions as the *Ricardian equivalence* is not accepted by all. Thus, the lack of a general consensus on the short-run effects of fiscal policy should not come as a surprise, but as presented in this chapter, a few points are worth highlighting. When there is general acceptance of prerequisites, such as an accommodative monetary authority and slack in the economy, then government spending can be effective in stimulating the economy[12].

The lack of consensus described above also extends to the empirical literature; however, what recent contributions have shown is that the size and sign of the government spending multiplier is 'context-dependent'[13]. The time-varying characteristic of the multiplier, as shown

[9]The International Institute for Labour Studies (2011) provided an alternative approach and grouped the fiscal stimulus into five categories: i) labour market measures; ii) transfers to low-income individuals and households; iii) infrastructure spending; iv) tax cuts; and, v) additional measures to boost the aggregate demand. They also showed tax cuts to make up a lesser share of the total stimulus, although advanced economies in the G20 focused mostly on tax cuts at 40%, e.g. UK.

[10]The International Institute for Labour Studies (2011) presented that 'most countries with stimulus spending channelled a sizeable chunk of their resources into infrastructure development and renovation aimed at lifting aggregate demand and creating employment opportunities'. It is worth pointing out that the theoretical and empirical literature on the short-run effects of changes in government spending tend to exclude the type of infrastructure spending that was common in the recent fiscal stimulus given that including such spending makes it difficult to differentiate if reported effects are due to productivity shock or the government spending shock. Nonetheless, the response of governments to pull the spending over tax trigger during the crisis means insight from the literature can act as a guide for the future.

[11]Two other early arguments were that government spending was unproductive so the government should avoid using resources that could be better used by the private sector, and increasing government spending was merely reallocating a fixed output through changes in relative prices (see Spencer and Yohe, 1970).

[12]As shown in chapter two of this thesis, the state of the economy becomes even more important when distinction is made between negative or positive government spending shocks.

[13]I use the terminology of DeLong and Summers (2012) that the fiscal multiplier is 'context-dependent', but rather than simply associating this context just with the state of the economy and reaction function of monetary policy, I extend it to include the characteristics identified by Ilzetzki et al. (2011). Batini et al. (2014) categorised 'context' into structural characteristics (e.g. trade openness, labour market rigidity, exchange rate regimes, debt level, public expenditure management and revenue administration) and temporary factors (e.g. state of the

for example by Cimadomo and Benassy-Quere (2012) and evidence from Glocker et al. (2017) that suggests cyclical factors[14] and structural factors[15] behind these variations[16], means the conclusion reached by Hemming et al. (2002)[17] is as relevant today as it was when it was presented. The difference now is that there are many more empirical contributions to support this conclusion, shedding more light on the factors behind the lack of consensus and providing better clarity on the sign of the government spending multiplier. While the theoretical debate is shaped by macroeconomic perspectives, the empirical literature is shaped by the identification scheme used to isolate fiscal shocks. Given that fiscal instrument data to suffer from reverse causation or endogeneity problems with other macroeconomic variables like GDP, a major debate in the literature is the identification of a truly exogenous unanticipated fiscal shock and capturing the economic reaction to it in an unbiased manner. The validity of any estimated fiscal effect (multiplier) is judged against the backdrop of these issues being addressed; thus, the literature is shaped by shock identification schemes and the search to find instruments for government spending shocks that are uncorrelated with economic activity. I discuss the main identification schemes utilised in the literature, presenting not only estimates of output multipliers, but also reported effects on the other macroeconomic variables commonly discussed in the theoretical debate. The construction and use of new credible government spending instruments has resulted in more studies at the local (regional/state) and sector level, so this chapter will not only focus on the aggregate effects, but will also discuss the effects at the local level and briefly discuss a few papers that have attempted to provide sector-/industry-level evidence.

The remainder of the chapter is structured as follows. Section two provides a brief discussion on the role given to fiscal policy and the complexity of the debate on its effectiveness in stimulating economic activity. Section three presents the Keynesian fiscal multiplier, discussing recent contributions to the endogenous multiplier and the role played by leakages. Section four presents a summary of the theoretical predictions of different macroeconomic perspectives. Sections five, six and seven present the main empirical approaches and evidence. Section eight concludes.

economy and an accommodating monetary authority). DeLong and Summers (2012) presented the fiscal multiplier as context-dependent, depending in particular on the reaction function of monetary policy. They argued that in a depressed economy 'when interest rates are constrained by the zero bound, the output gap is large, and cyclical unemployment is high, fiscal policy is likely to be more potent than standard estimates suggest', estimates which are often on the low side given the crowding out caused by monetary authorities' actions.

[14] Output gap and the real monetary policy rate.

[15] Government interest payments to GDP and import ratio.

[16] Factors which are consistent with other empirical contributions (e.g. Ilzetzki et al., 2013).

[17] They argued that 'the proper fiscal policy response to a downturn in the economy will depend on a range of factors, and only country-by-country approach, and indeed episode-by-episode approach, can reveal whether a fiscal expansion or fiscal contraction is appropriate'.

1.2 A role for fiscal policy

> '*Perhaps the most fundamental achievement of the Keynesian revolution was the re-orientation of the way economists view the influence of government activity on the private economy. ... Before Keynes, it was commonplace that government spending and taxation were powerless to affect the aggregate levels of spending and employment in the economy; they could only redirect resources from the private to the public sector. ... The Keynesian demonstration ... changed all this. Economists began to stress the macroeconomic effects of government spending and taxation. It became commonplace that not only would a dollar of additional government spending raise national income by the original dollar but that this expenditure would have multiplier effects of perhaps several dollars more. The old view that government spending simply crowded out private spending was banished to the scrapheap of discarded economic doctrines.*'
>
> *A.S. Blinder and R.M. Solow (1973, p. 319)*

Blinder and Solow (1973) asked the question over four decades ago about whether fiscal policy matters, and the answer was 'fiscal policy does matter after all'; unsurprising to some, this answer is still applicable in the current environment where monetary policy is given the dominant role in stabilising the economy. For Keynesians and post-Keynesians, the question of whether monetary or fiscal policy matters in stimulating economic activity has long been settled, as highlighted in the third proposition of Keynesian economics summarised by Fontana (2009)[18]. Thus, they are probably wondering what all the fuss is about in recent contributions to the literature on the effects of fiscal policy, and more specifically government spending, given that they advocate that when the economy is underutilising resources or monetary authorities are accommodating, then government spending can be very effective at stimulating economic activity.

While it is outside the scope of this chapter to give proper treatment to the debate on the role given to fiscal policy as a stabilising tool, it is still a worthwhile exercise to provide a brief summary[19]. With Friedman's Permanent Income Hypothesis (1957), the success of the expectation critique[20] (Friedman, 1968; Phelps, 1967), the apparent inability of Keynesian theory to explain the high level of unemployment and inflation in the 1970s, Barro's (1974) revival of the Ricardian Equivalence Theorem (RET), and the rational expectation revolution (the Lucas critique, 1980), it is easy to conclude that a new dominant framework needed to replace the Keynesian framework. However, as explained by Fontana (2009)[21], there is a lack

[18] 'Keynesian Economics Proposition III (the principle of policy effectiveness): fiscal and monetary policies are effective for determining, under certain circumstances, the level of output and employment in the economy' (Fontana, 2010, p. 519). See the paper for the other two propositions.

[19] For fuller treatments, please see Arestis (2011), Arestis and Sawyer (2004), Blinder (2004), Forder (2007a, 2007b), Fatas and Mihov (2001, 2012), Setterfield (2007), and Tcherneva (2010).

[20] Forder (2007a, 2007b) argues that this played a role in the downgrading of fiscal policy. Expectation critique is based on the idea that 'expected inflation affects the wage bargaining process such that any reduction in unemployment would be short-lived' (Fontana, 2009).

[21] Fontana (2009): 'The traditional story goes that IS-LM Keynesianism and its policy implications failed to provide any understanding of the event of the 1970s, let alone to solve them, and hence it was replaced by a new theoretical framework, namely New Classical Macroeconomics (Lucas and Sargent, 1978). Whatever the merit of

of unanimous support for this usual conclusion. Nonetheless, the Keynesian framework was replaced by a new framework, ending up with the New Consensus Macroeconomics (NCM)[22] that downgrades the role of fiscal policy and upgrades that of monetary policy. This downgraded role of fiscal policy is still very evident in the current debate on the effectiveness of fiscal policy given that, as expressed by Lavoie (2006), the new consensus is 'simply a variant of monetarism, but without any causal role for money' (p. 9). As highlighted by Arestis (2009), in the confines of the NCM, early empirical studies concluded that fiscal policy is ineffective, a conclusion based on three assumptions: 'households were able to optimise inter-temporally, they were not subject to any liquidity constraints, and were able to anticipate intertemporal financial constraints' (Hemming et al., 2002). However, recent developments in the literature points to fiscal policy being effective once additional assumptions are introduced into the NCM, for example the relaxation of the Ricardian equivalence assumption that has dominated the debate in the past few years. According to the RET, the government cannot run deficits forever, so there is an assumption that the governments face an intertemporal budget constraint, so any deficit spending today must be financed by future increase in taxes. Thus, the 'central Ricardian observation is that deficits merely postpone taxes' (Bernheim, 1987, p. 264). Agents recognise this fact that the government faces intertemporal budget constraints and adjust their consumption accordingly. The key assumptions about households highlighted by Arestis (2009) must hold for this Ricardian behaviour; however, it is argued that these assumptions do not hold in the real world[23].

Even with the relaxation of the Ricardian equivalence assumption, there are still other hurdles because 'within the mainstream New Consensus, the responsibility of achieving the appropriate amount of employment, compatible with the natural rate of unemployment, is attributed to monetary policy, fiscal policy has been relegated to a very secondary role. Mainstream economist have been arguing that fiscal policy should broadly aim at balanced budgets ... over the business cycle ... pursuing procyclical budget policies and what could be called sound finance' (Lavoie, 2014, p. 356). Although the global financial and economic crisis that started in 2008 put a halt to this thinking briefly, it has not been discarded, highlighting that there is still a secondary role assigned to fiscal policy. Nonetheless, there is an alternative to this thinking in the form of 'functional finance', as advocated by Lerner (1943)[24]. Functional finance rejects completely the

the contributions by New Classical macroeconomists, the work of Blinder and Forder discussed above seems to suggest an alternative story, where ideology, policy mistakes and particular historical circumstances played a role at least as important as economic theory in the rejection of IS-LM Keynesianism, and the consequent downgrading of fiscal policy.'

[22]Initially referred to as 'New Classical macroeconomics'. New Classical macroeconomics was followed by new Keynesian economics, and then from the early 1990s the NCM/DSGE model.

[23]The empirical literature shows that there are non-Ricardian households in the economy who base their consumption decisions on current income and not their lifetime income (Campbell and Mankiw, 1991; Jappelli and Pagano, 1989), with liquidity constraint also a factor in households' consumption (Bacchetta and Gerlach, 1997; Hayashi, 1985; Zeldes, 1989).

[24]Lerner (1943, p. 39) stated that 'the central idea is that government fiscal policy, its spending and taxing, its borrowing and repayment of loans, its issue of new money and its withdrawal of money, shall be undertaken with an eye only to the results of these actions on the economy and not to another any established traditional

traditional doctrine of 'sound finance' and the principle of trying to balance the budget over a solar year or any other arbitrary period' (Lerner, 1943, p. 41), with government budget surplus or deficit neither good nor bad (Lavoie, 2014, p. 342). The government is able to raise funds, there is no financial constraint on a government backed by a central bank (Lavoie, 2014, p. 342), and the public debt-to-GDP ratio is unconditionally sustainable (Lavoie, 2014, p. 343). Thus, the government budget position should be used to secure a high level of economic activity where otherwise there would be a lower level of economic activity (Arestis and Sawyer, 2004, p. 133)[25], and fiscal policy should be judged not by ex-post budgetary results, but by its real effects on the economy (Tcherneva, 2008, p. 27). As also highlighted by Lavoie (2014, p. 341), post-Keynesians such as Arestis and Sawyer (2004) have been quite clear about the relevance of countercyclical fiscal policy, with post-Keynesian fiscal policy based on one form or another of 'functional finance'. The real effect to aim for gives birth to the two main variants of functional finance: aggregate demand and direct job creation (Tcherneva, 2008)[26].

Tcherneva (2008) presented the idea that by far the most common approach among the two variants is the 'aggregate demand' approach, which is not surprising given that this approach lends itself easily to being integrated within NCM. For example, Fontana (2009, p. 31, eq. 3.4) proposed that the NCM model could be amended by replacing the IS-like equation with one that is a function of real government expenditure[27]. I only discuss the aggregate demand[28] variant due to how it can be tied back to the NCM[29]. Functional finance via aggregate demand argues from the perspective that the role of fiscal policy is raising the level of aggregate demand, where it would otherwise be too low, while leaving open a level of economic activity that is regarded as optimum or desirable (Arestis and Sawyer, 2004, p. 132). The importance of this is that when a functional finance view is adopted, then the common arguments used against the effectiveness of fiscal policy in stimulating economic activity do not apply. Arestis and Sawyer (2004) examined the common arguments and concluded that when the circumstances in which fiscal policy is implemented are considered, then these arguments categorised under the crowding out umbrella do not apply; consequently, fiscal policy is effective in closing the demand gap (output gap). In a model in which aggregate demand determines output, examining the period from 1960 to 2010, Fatas and Mihov (2012) showed that fiscal policy has been a stabilising tool for many of their panel of 23 OECD countries, 'operating mostly through the mechanical way in which

doctrine about what is sound or unsound ... The principle of judging fiscal measures by the way they work or function in the economy we may call Functional Finance.'

[25] Arestis and Sawyer (2004): 'a view that arises from the simple Keynesian proposition that there is no automatic mechanism which ensures that aggregate demand is sufficient to underpin a high level of economic activity (Kalecki, 1939; Keynes, 1936).'

[26] This functional approach argues that government spending should guarantee full employment because stimulating aggregate demand to achieve full employment is difficult to do, so the government should directly provide jobs to whoever wants to work.

[27] $y - \overline{y} = f(G, T, X)$

[28] As summarised by Tcherneva (2008, p.32) 'the core proposition is to boost aggregate demand, investment and growth (through increasing productive capacity) to underpin full employment'.

[29] Please see Tcherneva (2008), who provides a discussion of both variants.

large governments seek to stabilise aggregate demand', with a different mix of discretionary and automatic fiscal policy employed by different countries. A takeaway from their findings is that fiscal policy can play a more prominent role within the NCM and should not be 'seen as a poor stabilisation tool and always second to monetary policy' (Fatas and Mihov, 2012, p. 52). Also, given the experience of the past few years following the global financial and economic crisis that started in 2008, what the brief discussion in this section shows is that the debate on the effectiveness of fiscal policy should not be shaped just by one theoretical framework; rather, there is a need for pluralism (Palley, 2013, p. 181), which it is argued is able to generate better economics (Lavoie, 2014, p. 70). Pluralism is taken to mean an openness to alternative approaches to the history and methodology of economic analysis[30]. To highlight the need for pluralism, a brief description of the complexity that surrounds the debate is presented next.

1.2.1 A brief overview on the complexity of the debate

The complexity of the theoretical debate on the short-run effect of fiscal policy is highlighted using figure 1.1. The figure is a simple diagrammatic view of the debate and captures a set of questions that impact the predicted effects. Since this chapter examines the effects of government spending, the view here is that an initial question has been answered regarding the choice of spending over taxation. After which there is the question of money versus bond finance fiscal policy, which in our case is government spending. Money finance refers to the central bank issuing high-powered money to cover the government deficit, i.e. 'printing money' by crediting the government's account with new money. Bond finance on the other hand sees the central bank finance the deficit by buying government bonds from private bond sellers who had previously purchased the bonds from the government. After this stage, there is the question of whether the RET holds in the case of bond financing of such spending, with the answer to the question closely tied to the macroeconomic perspectives. These macroeconomic perspectives ultimately govern the answers to the next set of questions, questions such as 'What is the short-run effect of fiscal policy on aggregate demand and ultimately on the real economy?' Thus, the predicted short-run effects of fiscal policy on the real economy are impacted by the path taken by the fiscal impulse, a path governed by macroeconomic perspectives that are either micro- or non-micro-founded. Nonetheless, as highlighted by Palley (2013), there are three propositions that are applicable to all macroeconomic perspectives:

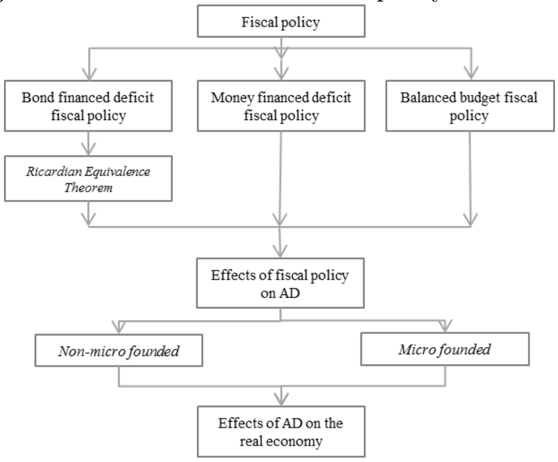
Proposition i *Compared with bond-financed fiscal policy, money-financed fiscal policy is always at least as powerful, if not more powerful, in stimulating AD.*

[30] See Dobusch and Kapeller (2012) for a discussion.

Proposition ii *Compared with tax-based fiscal policy, government spending is always at least as powerful, if not more powerful, in stimulating AD. That is because each unit of government spending adds a full unit to aggregate demand whereas tax cuts work through the filter of consumption spending and some or all of the cut may be saved.*

Proposition iii *In all perspectives, bond-financed fiscal policy is more powerful in stimulating AD the more the necessary assumptions of the RET are violated.*

Figure 1.1: The debate over fiscal policy effectiveness



Source: *Palley (2012) with minor modifications.*

Once we are at a stage where there is an agreement that fiscal policy does affect *aggregate demand*, the question that naturally follows is 'by how much' and this question tends to be answered by a multiplier figure. Theoretical assumptions underpin multiplier estimates, and since these assumptions vary across macroeconomic perspectives, the differences in estimated multiplier sizes should not come as a surprise. However, the importance multipliers play in policy decisions means they can't be ignored and must be taken seriously although there are many who have a distaste for them. The distaste for a singular fiscal multiplier figure by many economists has a long history, for example Clark (1941) in a letter sent to Keynes about the multiplier expressed:

> *I am myself enough of an 'institutionalist' (whatever that may mean) to have more than a lurking distrust of formulas and equations! But not enough of an institutionalist to ignore their importance: merely to want to think all round them and reckon with the imponderables that modify their action: and the other factors which no single formula can comprehend – for instance, the long-run incidence of continued large deficit spending.*

Just as Clark (1941) acknowledged, distaste does not reduce the importance of a robust multiplier figure given that single-figure multipliers have been used actively to advise policy makers, and as shown by Blanchard and Leigh (2013), the multiplier has been underestimated in recent times and this has important implications. Perhaps even more important than recent contributions to the debate on the *size* of the multiplier is the *sign*. With policy makers relying on recent contributions of a negative multiplier from the expansionary fiscal contraction literature (e.g. Giavazzi and Pagano, 1990; Alesina and Ardagna, 2010) to justify deficit reductions, it seems getting the multiplier sign wrong can have bigger consequences than getting the size wrong, given recent contributions to the path dependency economy literature[31], where 'evidence suggest that additional government spending that mitigates protracted output losses raises potential future output' (DeLong and Summers, 2012, p. 234)[32,33]. Finally, an agreement on the short-run effect on *aggregate demand* does not translate to an agreement on how the real economy is impacted by changes in *aggregate demand*. As I show in this chapter, there are disagreements among different macroeconomic perspectives on the effects of short-run fiscal policy on real economic variables such as real wages and household consumption. Before exploring these differences, I present first the Keynesian fiscal multiplier, discussing recent contributions to its relevance in today's world of endogenous credit money and the role leakages play in an endogenous multiplier.

1.3 The Keynesian fiscal multiplier and leakages

As explained by Romer (2004, p. 2), 'the fundamental cause of the Great Depression[34] in the United States was a decline in spending (sometimes referred to as aggregate demand), which led to a decline in production as manufacturers and merchandisers noticed an unintended rise in inventories. The sources of the contraction in spending in the United States varied over the course of the Depression, but they cumulated into a monumental decline in aggregate demand. The American decline was transmitted to the rest of the world largely through the gold standard. However, a variety of other factors also influenced the downturn in various countries.' Thus, the attractiveness of Keynes' proposal was that his theory in his *General Theory of Employment, Interest, and Money* (1936) was able to provide an explanation for the dire economic situation of the 1930s. So when he proposed that fiscal policy could and should be used to achieve high levels of employment and output, it led to much more active fiscal policy from the 1930s (Romer, 2004, p. 8)[35] to at least the 1970s, when it is argued that the Keynesian framework was then unable to explain the occurrence of high unemployment and inflation. Keynes was able to explain why economies were likely to experience severe and lengthy recessions, using the Great Depression

[31] Using the general definition provided by Setterfield and Suresh (2016), 'A dynamical system displays path dependence if earlier states of the system affect later ones, including (but not limited to) anything that can be construed as a "long-run" or "final" outcome of the system'. In simple terms, 'history matters', so actions taken by the government to increase or cut spending do not just affect current economic activity, but also have an impact on the output potential of the economy in the long run. See Setterfield (1995, 2009) for good overviews.

[32] This strand of the literature is concerned with long-run effects, which are not the focus of this thesis.

[33] See also Fatas and Summers (2016).

[34] Crafts and Fearon (2010) provide a great survey of the period, although focused on the US.

[35] This view is not universally accepted given that although Stein (1969) labelled the 1936–1966 period as The Fiscal Revolution in America, Blinder (2004) presented that 'the Kennedy-Johnson tax cuts of 1964–1965 marked the first deliberate use of fiscal policy in US'.

as a period of focus. He argued that firms would invest and produce output if they believed consumers will spend and buy their products, so if spending fell due to factors such as pessimism, as was the case in the 1930s, then firms will reduce production. By reducing production, firms have little need to invest and hire new employees and in many cases let go current employees, thus increasing unemployment. With unemployment increasing, consumers are less able to buy their products so the cycle continues with the economic situation spiralling down and remaining down. With the economy in a recessionary state, Keynes did not believe that reduction just in interest rates or prices would promote economic recovery, hence he proposed that some sort of stimulus should be used and it should come either in the form of an increase in government spending or/and reduction in taxes. This did not rely on the profit-driven spirit animal of private entrepreneurs.

The Keynesian view of the economy is one which states that the major source of economic instability is fluctuation in investment, a component in aggregate demand, with *aggregate demand* determined by three types of agents: consumers, firms and the government. Since Keynesians believed that economies tend to fluctuate between booms (excessive demand) and recessions (insufficient demand), and didn't share the same beliefs as the classical economists for the economy being able to stabilise itself, the proposal was that to get the economy back to stability, we could and should influence one of the macroeconomic groups that make up *aggregate demand*, namely the government. Thus, the theory proposed by Keynesians is one that promotes the potential of fiscal policy as an economic stabilising tool that is capable of reducing fluctuations in *aggregate demand*. From this, the policy implication from a Keynesian perspective is rather straightforward because it suggests that when the economic output is below its potential output, then fiscal policy should be more expansionary by increasing government spending or/and reducing taxes. However, the policy implication gives rise to many counterarguments, which I present in the following sections. Before discussing these arguments, I present the simple formula that allows us to explore the impact of changes in fiscal instruments, i.e. the *fiscal multiplier*. Although recent empirical evidence has confirmed the always held views of Keynesians and post-Keynesians that the multiplier effect of fiscal instruments such as government spending is dependent on the state of the economy and an accommodating monetary authority, the standard multiplier formula fails to reflect this. However, recent contributions have attempted to address this limitation by *endogenising* 'leakages'.

1.3.1 The fiscal multiplier

The simple Keynesian model assumes that demands from consumers, government and individual firms are exogenously determined, with consumer consumption determined by disposable income, so there is a key relationship between what consumers consume and what firms produce since consumption is a function of disposable income. As a result of this relationship, the fiscal multiplier concept is fundamentally based on households' marginal propensity to consume their additional income. Built on the basis that an individual's spending becomes the income of another, the Keynesian proposal is that the increase in economic output can be a multiple of the original unit change in spending or taxes.

A simple Keynesian model in a closed economy:

$$AD = C + I + G \tag{1.1}$$

Presenting the behavioural equations:

$$C = c_0 + c_1\{[1-t]Y \qquad c_0 > 0,\ 0 < c_0 < 1,\ 0 < t < 1 \tag{1.2}$$

$$I = I_0 \tag{1.3}$$

$$G = G_0 \tag{1.4}$$

Where AD is aggregate demand, C is consumption (an increasing function of disposable income), c_0 is autonomous spending, c_1 is marginal propensity to consume (MPC), G is government spending, G_0 is autonomous level of government spending, I is investment, I_0 is autonomous level of investment, and t is the rate of income tax, i.e. the increase in taxes when income rises by 1 unit. Equilibrium occurs at $Y = AD$; at this point, spending equals current output and producers have no incentive to either expand or contract their production. In the short term, change in Y is due to changes in autonomous components of *aggregate demand*. We can solve for the fiscal multiplier[36].

The multiplier effect on output[37]:

$$\triangle Y = \frac{1}{1-[1-t]c_1}(\triangle G + \triangle I + \triangle c_0) \tag{1.5}$$

The fiscal multiplier is thus determined by a consumption function and the autonomous components of *aggregate demand*, where a constant share of current disposable income is consumed by households, and since not all current disposable income is consumed, there are 'leakages'. The multiplier measures the cause–effect of changes in output set into motion by changes in autonomous components of *aggregate demand*, which in this case is government spending. A positive multiplier implies that an increase (decrease) in government spending causes an increase (decrease) in output, whereas a negative multiplier implies that an increase (decrease) in gov-

[36]It is worth noting that while it is the case that an increase in aggregate demand increases the utilisation rate, any increase in capacity utilisation that induces a firm to invest more is ignored in the standard multiplier process; however, the multiplier-accelerator model of Hansen and Samuelson or the Hicksian super-multiplier can be used to explore this relationship (See Samuelson, 1939; Hicks, 1959).

[37]The multiplier effect on consumption is $\triangle C = \frac{c_1}{1-c_1} \triangle G$. Since change in consumption is proportional to change in government deficit, even in its simplest form, the sustainability of such deficit becomes questionable, and forms the basis of a major criticism of using expansionary fiscal policy to stimulate the economy.

ernment spending causes a decrease (increase) in output. Leakages can be described as unspent disposable income that not only affects the overall impact of changes in government spending on output, but also brings the system to an end as it prevents government spending from causing an infinite expansion. While the formula is appealing from an analytical point of view, it is not free from criticism; Gechert (2012) provides a good summary of these criticisms which can be generally grouped into two strands: one strand tends to be focused on the Keynesian consumption function (Modigliani and Brumberg, 1954; Godley and Lavoie, 2007; D'Orlando and Sanfilippo, 2010), while the other focuses on the implied cause (autonomous spending) and effect (consumption) (Villard, 1941; Lutz, 1955; Machlup, 1965). Nonetheless, these criticisms do not distract from the widespread use of the formula to convey the impact that changes in government spending can have on *aggregate demand*, so they are not discussed here.

A government spending multiplier greater than one, usually termed a Keynesian effect, indicates that a unit increase in government spending is able to stimulate the economic activity by more than the initial unit increase in government spending. So if, for example, the cumulative multiplier is 1.5, then a unit increase in government spending is expected to raise economic output by 1.5 units, and as such it would be argued that increasing government spending is efficient in stimulating the economy as you are getting more for your buck. According to Blinder (2008, p. 2), 'contrary to what many people believe, Keynesian analysis does not require that the multiplier exceed 1.0. For Keynesian economics to work, however, the multiplier must be greater than zero.' Nonetheless, a multiplier less than unity means there is some counteracting effects eroding the impact of the increase in government spending, which is usually termed the 'crowding out' of productive private sector activities[38]. The crowding out of the private sector takes centre stage in the debate on the effectiveness of fiscal policy and it is explained in more detail in sections below, but before this discussion, some clarifications are warranted with regards to 'leakages' and an endogenous multiplier.

1.3.2 Endogenising leakages

In this section, two questions are tackled: is the multiplier principle still relevant in the world of endogenous money? Can leakages offer an explanation for the endogenous multiplier? The endogenous money view relies on the following causation: the supply of money is determined by the demand for credit (bank loans), and the latter originates within the system to finance the production process or the upsurge of speculative purchases (Fontana, 2004, p. 367). This

[38]When discussing tax multipliers, we have to take into account that taxes are expected to have a negative effect on the economy, so increasing taxes by one unit is expected to negatively affect economic activity, but how much economic activity is affected is a hotly debated topic; the effect being negative is also a hotly debated topic. A tax multiplier greater than one would indicate that a unit increase in taxes would cause a boost in economic activity by more than one unit, but how likely it is to achieve this scenario is subject to debate. A tax multiplier of less than zero but more than -1 would indicate that a unit increase in taxes only partially affects economic activity, thus economic activity decreases by less than one unit. However, a tax multiplier less than -1 indicates that for every extra unit of taxes collected by the government, economic activity will decrease by more than one unit.

endogenous money[39] view is opposite to the inaccurate widespread view of money supply being exogenous and controlled by the central bank, so the question is how the multiplier story is affected by adopting this view. Put differently, this section examines how the multiplier should be re-thought in the world of endogenous money.

The simplicity of equation 1.5 makes it very attractive in explaining how government spending can influence economic activity. It shows the resting point of a process of expenditure and receipt that is initiated by an initial demand (i.e. government spending); however, it does little to explain the process behind it. One can rely on the process analysis of Dalziel (1996) to dismantle the process, although by doing so some additional questions arise, as highlighted by Gechert (2012): how long does one round of the process and the whole process actually take? What are the leakages in the circuit and where does the money go? Before addressing these questions, it is vital to visit another important question that is commonly overlooked when discussing the fiscal multiplier: how is the process initiated? i.e. how is the first round financed? By addressing this question, it becomes quite clear that the principle of the multiplier is grounded on both fiscal and monetary expansion being necessary to achieve the desired effect on economic activity.

Even though Keynes (1936) did not emphasise the importance of the banking system when discussing the multiplier process in *The General Theory*[40], the narrative provided by Trevithick (1994)[41] on the contributions of Kahn (1931)[42] and Keynes[43] made it very clear that monetary policy and the banking system have an important part to play if the multiplier process is to become airborne. In his paper aptly titled 'Monetary prerequisites for the multiplier...', Trevithick (1994) showed that the debate between Keynes and Robertson (1936) resulted in Keynes readily admitting that an expansion in the supply of money was needed to finance the initial round of investment stimulus (government spending) to move the economy from a lower to a higher scale of activity. Thus, there needs to be a creation of money because an increase in saving is only forthcoming as a result of an increase in income which is only forthcoming as

[39] See for example Moore (1988), Palley (1991), Wray (1992) and Fontana (2003) for fuller discussion.

[40] He corrects this in subsequent writings: 'surely nothing is more certain than that the credit or finance required by ex-ante investment is not mainly supplied by ex-ante saving' (JMK, XIV, p. 217).

[41] 'It had always been obvious from the very first stirrings of the Keynesian Revolution that expansionary policies would require the complementary implementation of fiscal expansion with monetary accommodation. This complementarity was clearly present in all of Keynes's pre-General Theory writings on public works; it was clearly present in Kahn's multiplier essay; and it was clearly present in its most fully articulated form in Keynes's post-Genera/Theory writings. Unfortunately it was not clearly present in the analysis of The General Theory itself, though, from a policy point of view, this should not come as much of a surprise since Keynes's main concern there was with the working of a market economy without systematic macroeconomic intervention by government' (ibid. p. 88).

[42] Kahn (1931, pp. 174–175): 'It is, however, important to realise that the intelligent co-operation of the banking system is being taken for granted. It is supposed that the object of the Central Bank is to achieve the maximum of employment that is consistent with remaining on the gold standard. If the increased circulation of notes and the increased demand for working capital that may result from increased employment are made the occasion for a restriction of credit, then any attempt to increase employment—whether it is by way of road-building or by any other means, or indeed, by awaiting the return of world prosperity—may be rendered nugatory.'

[43] Keynes (1930, VI, p. 197) recognised early on the need for banks to play their part, so it is strange he did not incorporate this thinking in the *General Theory*: 'Credit is the pavement along which production travels, and the bankers if they knew their duty, would provide the transport facilities to just the extent that is required in order that the productive powers of the community can be employed at their full capacity.'

a result of an increase in investment. Without the initial investment, an increase in saving is simply not forthcoming[44]. After this initial stage, the higher level of investment is subsequently funded by saving. Trevithick also pointed out that in principle this money supply can come from dishoarding, but since Keynes believed these sources of finance to be limited, we can take it that the provision of credit by banks is the main source of finance. Given this conclusion, and taking the increasing view that money is created endogenously when banks grant such credit, a question that then needs to be addressed is the impact of endogenous money on the soundness of the multiplier analysis, i.e. is the standard income multiplier principle still applicable? The debate between Cottrell (1994), Moore (1994) and Dalziel (1996), plus recent contributions by Gechert (2012), provides an answer.

Looking behind the standard income multiplier process in the confines of endogenous credit money theory led to its very relevance being challenged by Moore (1994). He stressed that by accepting an endogenous money view where credit finances investment, then you must reject the role given to saving in the standard income multiplier analysis (i.e. saving finances investment), and in doing so reject the standard Keynesian income multiplier. To explore this, we can express equation 1.5 above as a 'converging series of ever diminishing waves of expenditure' (Meade, 1975, p.84):

$$\triangle Y = (1 + c + c^2 + c^3 + ...)\triangle I = \frac{1}{s}\triangle I \qquad with\ 0 < c,\ s < 1 \tag{1.6}$$

From this representation (the series multiplier), it is clear to see that the multiplier process stops once saving equals investment (the process shows how saving gradually grows, though this is not shown in the logical multiplier in equation 1.5, which is based on long-run MPC). However, what determines saving is not explicit, so there is no guarantee that the process stops; Cottrell's (1994) use of the logical multiplier did little to persuade Moore that saving can equal investment because he questions the existence of a long-run MPC, while Dalziel's (1996) use of the process analysis[45] simply showed how saving could end up equalling investment, but the process itself does not actually tell us which mechanism determines saving, so some levels of saving could mean the process never stops (i.e. when saving is negative).

The debate between Cottrell, Moore and Dalziel was very much focused on the role given to saving and the creation of saving; however, the introduction of the so called *reflux principle* into the analysis negates the need for saving to equal initial investment. The reflux principle provides a logical sequence of events that traces the creation and ultimate destruction of money;

[44] 'Increased investment will always be accompanied by increased saving, but it can never be preceded by it' (Keynes, 1936, XIV).

[45] With the analysis taking place in logical time rather than historical time, the process analysis shows a sequence of events where an initial increase in investment in the first round generates additional income of the same amount; the additional income is then used for consumption and saving in the next round; the additional consumption then generates additional income of the same amount, which is then used in the next round; the process continues until all additional income in a round is saved, and at this point savings equal investments, i.e. at the end of any round for $r > 0$: $I = \sum_{i=1}^{r} S_i + Y_i$, the process continues until $Y_i = 0$, so $I = \sum_{i=1}^{r} S_i$.

put differently, it traces the reimbursement of initial debt incurred by firms (see Kaldor and Trevithick, 1981; Lavoie, 1999; Rochon, 2008). In this view, leakage is strictly money that ceases to exist in the circuit. Savings and hoarding can remain in the circuit without leaking out, but their usage in, for example, buying financial assets that already exist rather than for production activities simply reduces the size of the multiplier effect, but doesn't necessarily end it. As long as firms pay off their original debt, and after doing so obtain new credit from willing banks, then savings do not need to equal investment, and thus the multiplier principle is still relevant in the context of endogenous credit money[46]. Consequently, one way to bring the multiplier process to a stop is by paying down loans, and in doing so extract money from the process rather than requiring savings to equal investment to end the process. Still, while the introduction of the reflux principle in the process helps explain how the process can come to an end and the use of leakages in the process, it does not provide an answer to how long a round of the process is and how long the whole process actually takes. Moore (1988, 1994, 2006, 2008), in the process of challenging the notion that 'savings are needed to finance investment', developed an alternative multiplier where the MPC is replaced by the income velocity of money V_t, so $\triangle Y_{t+1} = V_t \triangle I_{t+1}$. And while this alternative addressed the issue of the multiplier process length, it did not allow for leakages, which seems to be unrealistic[47]. To address this, Gechert (2011, 2012) proposed an alternative '*integrated*' multiplier that incorporated elements of both the standard income multiplier and the income velocity multiplier of Moore, presenting a time-dependent multiplier that allows for leakage in the circuit based on three key parameters: the number of rounds in the period, propensity to settle debt, and propensity to hoard. The integrated multiplier is time-dependent via the number of rounds in the period and allows for net inflows and outflows (leakage) via the propensity to settle debt and propensity to hoard. In this setting, 'the more multiplier rounds per period, the higher is the multiplier. The more intense the leakage through net debt settlement and net hoarding, the lower is the multiplier' Gechert (2012, p.12):

$$\sum_{i=0}^{n} \triangle Y_{t+i} = \varphi \triangle L_t \sum_{i=0}^{n} (1-\lambda-\mu)^i \tag{1.7}$$

Where L_t is credit money, φ is number of rounds in a period, λ is propensity to settle debt, and μ is propensity to hoard. Interestingly, by assuming every subscript t to be r (so one multiplier round and necessarily $\varphi = 1$, since there is always one round per round), adding up the leakage as shown in the process analysis (so we simply get the marginal propensity to save,

[46]By expressing savings (leakage) as being made up of 'hoarding' and equity holdings that give the holders an explicit or implicit share in the economy's capital stock, Dalziel (1996, p. 316) actually included some elements of the reflux mechanism into the process, calling it the 'Kaldor effect', presenting the idea that 'the sale of equities in the new capital stock provides funds to the investing firms that can be used to retire their original loans, and this reduces the stock of credit money by this amount'. However, this was not fully developed by Dalziel given that, as highlighted by Gechert (2011), the definition of leakage as '*savings*' (hoarding and equity holdings) is very much different from its definition as '*money that ceases to exist*'.

[47]See Gechert (2011) for other weaknesses of Moore's alternative multiplier.

$s = \lambda + \mu$) and setting the additional credit money to the initial round of investment $\triangle L_t = \triangle I_0$, for$r \to \infty$ we get the familiar formula:

$$\sum_{i=0}^{r} \triangle Y_r = \triangle I_0 \sum_{i=0}^{r} (1-s)^i = \frac{1}{s} \triangle I_0 = \frac{1}{1-[1-t]c_1} \triangle I_0 \tag{1.8}$$

Thus, the standard multiplier is still applicable; however, as Gechert (2012, p. 13) stressed, 'the usual multiplier formula is only applicable to concrete time periods when the duration of a multiplier round is set to one per period, a point which was already made by Tsiang (1956: 555–6)'. The standard multiplier makes ad hoc assumptions concerning parameter values that should be determined empirically in order to calculate the multiplier effect for a given time span properly. The integrated multiplier makes that possible because it is not just a theoretical construct, but it can be directly applied to empirical questions. By making the distinction between the impact net debt settlement and net hoarding has on the stock of credit money[48], Gechert (2012, p.17) concluded that in a credit money economy, the multiplier 'does not show the income generating process until an initial investment is financed or paid by savings. What it does show is the income generating process until an additional amount of credit money is repaid.' Key importance is placed on the behavioural parameters φ, and μ, all of which can be exogenously or endogenously determined. The *integrated* multiplier is a promising development because it easily allows for the incorporation of a credit money and banking system where debt is repaid. It provides a bridge between a theoretical and empirical multiplier since empirical studies tend to be interested in time-dependent multipliers. Since the behavioural parameters can be endogenously determined, the *integrated* multiplier naturally fits and moves us into the endogenous multiplier literature as these parameter values can also be dependent on the state of the economy; however, further research is needed on identifying the determinants of these parameters and extending to an open economy.

To provide a more formal explanation why the multiplier is endogenous, we have to rely on the contributions of Charles et al. (2015)[49], who endogenise savings in a Kaleckian post-Keynesian model. The assumption in the standard multiplier process is that propensity to save is fixed (i.e. MPC is fixed), but Charles et al. (2015) depart from this assumption by modelling rentiers' propensity to save to evolve with the state of the economy (i.e. capacity utilisation), and in doing so present a multiplier that is endogenous. Separating the propensity to save into those of workers and rentiers (capitalists), Charles et al. use the argument that rentiers tend to reduce their propensity to save to maintain their consumption level; since rentiers have been

[48] Gechert (2012, p. 13): 'Net debt settlement is a definite leakage because the economy's gross debt level and the amount of credit money shrinks; net hoarding, on the contrary, is not a leakage in the strict sense. It maintains the stock of credit money (and the liabilities to the banking system), but the hoarded receivables are not used for aggregate demand anymore, i.e. they are not in active circulation. This does not mean that the money is held idle though. It may well circulate with a high frequency for financial and non-financial assets, but it is not active for current production.'

[49] Setterfield (2015) also proposes an endogenous multiplier, but the focus was on investment spending by firms rather than the saving behaviour of households.

able to accumulate large amounts of wealth, they are not as financially constrained as workers so are able to maintain their spending habit during a recession when income falls (including profits). As such, 'when the rate of capacity utilisation declines, indicating a recession, they decrease their propensity to save in order to maintain their level of consumption' (Charles et al, 2015, p. 459), and this decrease in propensity to save translates to a higher multiplier[50]. While the decision to use rentiers' propensity to save is easily accepted based on evidence presented by Maki and Palumbo (2001) and Wunder (2012, p. 183) in that macroeconomic propensity to save is determined by the behaviour of rentiers, there is a contrasting view on the actual behaviour of rentiers. Cynamon and Fazzari (2013) presented evidence which suggests rentiers decrease their propensity to save during a recession, while the evidence presented by Wunder (2012) suggests rentiers tend to increase their propensity to save during recessions to offset the fall in their wealth; this behaviour means the prediction size of the multiplier based on the approach by Charles et al. (2015) is opposite to what has been observed in the empirical literature. Nonetheless, as an approximation, relying on the evidence of Cynamon and Fazzari (2013) is deemed acceptable.

There are two takeaways from this section: first, the multiplier principle is still very much applicable in a world of endogenous money[51]; second, more research is needed to provide a theoretical explanation for the multiplier being endogenous. As I show in the next section, explaining an endogenous multiplier through an endogenous propensity to import is at present more convincing because the modelled behaviour of import is more in line with empirical evidence. I now turn to the other form of leakage that can impact the size of the multiplier: imports.

Endogenising imports leakages

An additional form of leakage that is yet to be discussed is that which arises from imports, and by extending the income-expenditure model to an open economy setting, we are able to explore this. The need to appropriately account for imports in the income-expenditure model has a rich history, from Suits (1970) and Benavie (1973) to more recent contributions by Cherry (2001) and Palley (2009); however, these contributions are usually overlooked in the fiscal multiplier debate. I show in chapter two that by moving away from the conventional approach of having a singular marginal propensity to import and instead having marginal propensity to import for each component for aggregate demand, the marginal propensity to import becomes an even more important parameter. Nonetheless, with a singular marginal propensity to import, Charles (2016) showed that an endogenous propensity to import, varying with capacity utilisation, is able to provide an explanation for the varying size of the fiscal multiplier during a recession and boom. It is worth noting that an increase in importance of marginal propensity to import

[50]Please see Table 3 of their paper for multiplier simulations that capture this.

[51]The introduction of the reflux principle in the process 'allows for a crucial understanding of the multiplier process in a credit money economy. As long as the money is kept within the circuit it is used for additional effective demand. Once it is used by anyone to refinance or repay debt, it leaks out. When the amount of debt returns to its former level the multiplier process has come to its end' (Gechert, 2012, p. 16).

does not mean a policy action would be to reduce imports as a means of achieving a higher multiplier. Thus, economies trying to net export their way out of a global recession such as the great recession of 2008 can inadvertently be making the situation worse given the structure of international trade, and as Keynes (1936, p. 349) expressed, 'the opposite holds true. It is a policy ... unimpeded by international preoccupations, and of a national investment programme directed to an optimum level of domestic employment which is twice blessed in the sense that it helps ourselves and our neighbours at the same time. And it is the simultaneous pursuit of these policies by all countries together which is capable of restoring economic health and strength internationally.'

Figure 1.2 presents a Kaleckian model of distribution and growth proposed by Charles (2016). The x-axis of the figure is capacity utilisation, while the y-axis is growth. The figure shows that an increase in government spending is unambiguously positive to the rate of capacity when the propensity to import is assumed exogenous, and the relative effect of fiscal policy is the same regardless of the point of capacity utilisation; changes in government spending at point u_1 or u_2 yield the same effect, so $\triangle u = u_2 - u_1 = u_3 - u_2 > 0$.

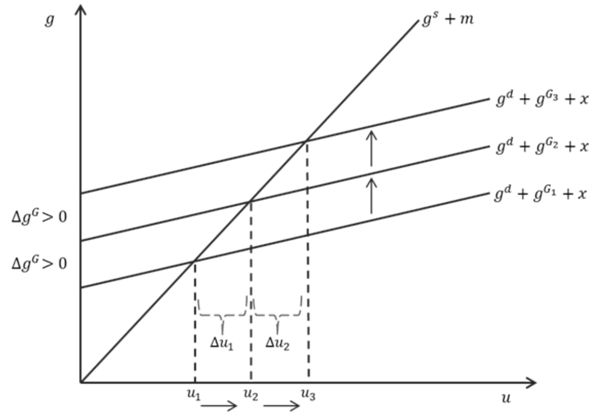
However, if we assume, as evidence suggests[52], that the propensity to import is endogenous and varies with the state of the economy[53], the impact of fiscal policy is very much dependent on the state of the economy as shown in figure 1.3. The starting point of capacity utilisation is important, since imports tend to be lower during periods of low capacity utilisation, at point u_1; increasing (decreasing) government spending increases (decreases) capacity output by more than the increase in government spending since $\Delta u > \Delta g^G$. However, when the economy is at point u_3 where the propensity to import is higher, then an increase (decrease) in government spending increases (decreases) capacity output by less than the increase in government spending. This conclusion is not only applicable to expansionary fiscal policy, but also contributes to the contractionary fiscal policy debate as it shows that austerity measures have greater impact when capacity utilisation is low in the economy, offering policy guidance for when such policy should be pursued even if such austerity policy has a negative impact on capacity output.

While this can be seen as simply confirming the views on the importance of considering the state of the economy when implementing fiscal policy, Charles (2016) is explicitly proposing a theoretical explanation for evolving the multiplier over the business cycle that looks beyond the traditional accommodating monetary policy and collapse of saving rate arguments. By including an endogenous propensity to import mechanism into the debate on why the multiplier is state-dependent, Charles (2016) is further highlighting the importance of imports in the fiscal policy debate.

[52] See Bussiere et al. (2009).

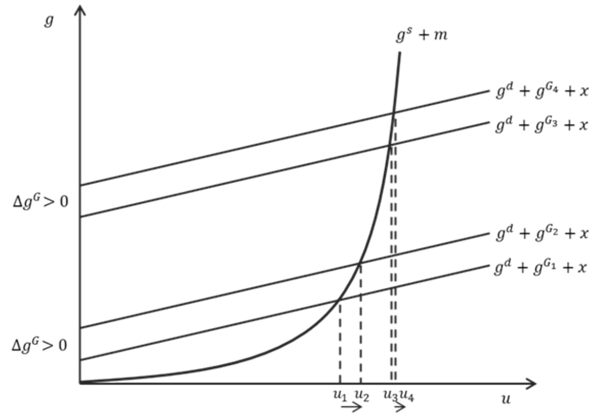
[53] $m_u = \alpha_u u$, where $\alpha_u > 0$ indicates the propensity's reaction to the level of economic activity (Charles, 2016, p. 16).

Figure 1.2: Fiscal policy in the standard post-Keynesian model



Where $g^s = S/K$ where $S = Y - C$; $g^d = I/K$ is growth plans made by firms; $g^G = G/K$ is government spending normalised by the stock of capital; $x = X/K$, where X is export and K is capital stock.
Source: *Charles (2016)*

Figure 1.3: Fiscal policy in a post-Keynesian model with an endogenous propensity to import



Source: *Charles (2016).* See notes in figure 1.2.

The conclusion from this section is that fiscal policy can stimulate *aggregate demand*, the multiplier effect is dependent on the size of leakages in the form of *income not consumed* and the *import content of government and household consumption*, whereby the smaller these leakages, the larger the multiplier. The size of the leakages is argued to be dependent on the state of the economy, but this argument needs further research for it to be fully accepted, especially in the case of a closed economy. This conclusion doesn't shed any light on how the effect on *aggregate demand* impacts the real economy, plus there is opposition to this view that government spending can stimulate *aggregate demand*, which I discuss next.

1.4 The short-run (in)effectiveness of fiscal policy: theoretical debate

While the multiplier formula shows that an expansionary fiscal policy has an expansionary effect on the aggregate demand, this is not without opposition. This section explores effects on the real economy and presents arguments commonly used against such effects. There are three main lines of argument that are typically presented against the use of fiscal policy. They are the crowding out effect from an increase in interest rates and exchange rate, supply-determined level of output and employment (NAIRU literature), and the RET[54] (Hemming et al., 2002). The argument follows that the Keynesian type of multiplier effects can be dampened through the expectational and wealth effects, so there is a 'crowding out' of private consumption and investment as a result of an increase in government spending. The RET suggests that how the government finances its spending doesn't matter, as the total level of demand in the economy remains the same regardless of whether the government spends by borrowing or increasing taxation, because by borrowing to finance a deficit, you are merely postponing taxes (Bernheim, 1989). Thus, a government's attempt to influence aggregate demand using fiscal policy will prove fruitless (Fontana, 2009). However, after reviewing the literature, Hemming et al. (2002) concluded that 'there is little evidence of direct crowding out or crowding out through interest rates and the exchange rate. Nor does full Ricardian equivalence or a significant partial Ricardian offset get much support from the evidence' (p. 36)[55]. Their conclusion on RET is similar to that reached by Bernheim (1989), who stressed that 'the existing body of theory and evidence on intergenerational transfers casts very serious doubt on the validity of the Ricardian assumptions', dismissing it on both theoretical and empirical grounds given that it is predicated upon extreme and unrealistic assumptions. Nonetheless, these conclusions haven't dampened the dominance of the RET in micro-founded theories.

The supply-determined level of output and employment line of argument can also be categorised under the crowding out debate as it is based on the notion that there is some form of supply-side equilibrium (such as the natural rate of unemployment or the NAIRU), and that this supply-side equilibrium is an 'attractor' for the level of economic activity (Sawyer, 2009, p. 85.), so any effects of government spending are naturally crowded out. To challenge this view, one can use the argument that the natural rate of growth is sensitive to aggregate demand: 'the supply-side argument can itself be influenced by the path of the economy' (Sawyer, 2009, p. 85). As described by Sawyer (2009, p. 86.), the level of aggregate demand has an impact on investment expenditure, which in turn has an impact on capital stock. And since the size and

[54]Bernheim (1989): 'Under the Ricardian view, successive generations are linked through voluntary, altruistically motivated resource transfers. Under certain conditions, this implies that consumption is determined as a function of dynastic resources (that is, the total resources of a taxpayer and all of his descendants). Since deficits merely shift the payment of taxes to future generations (the present discounted values of taxes and expenditures must match), they leave dynastic resources unaffected. Thus, deficit policy is a matter of indifference.'

[55]The conclusion of Briotti (2005) is also supportive of the lack of conclusive evidence on the existence of the Ricardian effect.

distribution of capital stock is a determinant of the productive capacity of the economy, a larger capital stock due to a higher level of investment spurred by a higher level of aggregate demand would be associated with a supply-side equilibrium of higher output and employment levels. Thus, when the size of capital stock is viewed as a major element in any supply-side equilibrium (Sawyer, 2002), then fiscal policy can have long-lasting effects (Sawyer, 2009, p. 87), and by doing so limits this channel of crowding out.

This brief discussion of the main channel of opposition to the Keynesian and post-Keynesian view simply emphasises the points made in section 1.2 in that the macroeconomic perspective plays an important role in the impact fiscal impulse has on *aggregate demand*, and ultimately on real economic variables such as private consumption, interest rates, prices and real wages. I turn next to the main macroeconomic perspectives that have dominated recent debates.

1.4.1 Theoretical predictions on the short-run effects of fiscal policy

When examining the theoretical predictions on the short-run effects of fiscal policy, two different assumptions about a crucial aspect agent behaviour leads to two different strands of theoretical frameworks. This section summarises the theoretical predictions of both strands of theoretical frameworks, focusing on the IS-LM, post-Keynesian, Real Business Cycle (RBC), and New Keynesian (NK) frameworks[56]. The first strand is of non-forward-looking agents, while the second is of micro-founded forward-looking agents. As a non-forward-looking agent, expected future change has no effect on current period decisions, so any expected future fiscal actions are not taken into account when making decisions today because agents simply don't look forward. Theories with micro-founded forward-looking behaviour are generally constructed as Dynamic Stochastic General Equilibrium (DSGE) models, so when explaining these models it is useful to begin by explaining the standard modelling strategy of DSGE models. DSGE models are built on micro-foundations[57], where all agents optimise their behaviour: households maximise their lifetime expected utility subject to a budget constraint, firms maximise their profits subject to a technology constraint, while the government satisfies a budget constraint. Monetary policy is usually set following a Taylor type rule, while fiscal policy is usually restricted to a Ricardian setting, so it can be argued that the effectiveness of fiscal policy is handicapped from the onset within the basic settings of a DSGE model. Subjecting the model to 'shocks' and solving the model with each representative agent optimising their behaviour allows the study of variable dynamics in the model; in the case of fiscal policy, the shock would be in the form of a change in

[56] The choice to focus on the four macroeconomic perspectives is based on their recent contributions in shaping the narrative on the fiscal policy debate.

[57] The dynamic reflects the assumption that the future and not just the current climate play an important role in current behaviour of agents, so the agents form 'rational expectations'. The stochastic captures the random components that explain the cyclicality of the economy, i.e. 'shocks'. The general equilibrium requires that every market is clear, i.e. that demand equals supply in every market through the adjustment of price and interest rates.

government spending or taxation[58]. The introduction of further assumptions in the basic model results in the two dominant micro-founded theoretical frameworks, assumptions such as flexible price and perfect competition in the RBC models[59], and price/wage rigidities and monopolistic competition in the NK model[60]. Next, I provide a summary of the theoretical predictions of these models

Table 1.1 presents a brief summary of the effects of an increase in government spending on key macroeconomic variables commonly reported in the literature. Before discussing these, there are a few assumptions worth noting across macroeconomic perspectives. First, it is assumed that government spending does not enter the production function of firms[61]; second, government spending does not enter household utility function[62]; third, taxes are assumed lump sum[63]; and fourth, changes in fiscal policy are assumed to be temporary[64]. By focusing on the short term, the assumption is that technology, capital stock and labour force remain unchanged, and thus potential output is unchanged. With these assumptions, what Table 1.1 highlights is that predictions vary across models with disputes related to the predicted effects on private consumption, real wages and demand for labour; the private consumption contention is eliminated through the addition of further assumptions to the benchmark neoclassical and NK model. The conclusion reached in this section is unsurprisingly similar to other review papers in that the short-run effect of fiscal policy is very much dependent on the adopted macroeconomic perspective. However, the importance of the macroeconomic perspective doesn't negate a few points worth highlighting.

i) The effects of expansionary fiscal policy on output and labour supply are generally positive; ii) the demand for labour and the effect on interest rates are generally positive or neutral; iii) the response of private consumption is generally positive once additional assumptions are introduced into micro-founded models; iv) the response of real wages is mixed as it is ultimately tied to the assumption of an increase in labour demand; v) there is generally an appreciation effect on the real exchange rate in standard models, but introducing additional assumptions changes this in micro-founded models, bringing results in line with post-Keynesians; vi), the

[58]Other shocks that can be introduced into the model include supply-side shocks (labour supply), demand-side shocks (preference), monetary shocks (interest rates), and mark-up shocks (price or wage mark-ups).

[59]See, for example, Baxter and King (1993) for a standard closed economy RBC model. Examples of an open economy set-up can be found in Baxter (1995) and Corsetti and Muller (2008). Linnemann (2006) provides an example of a set-up that relaxes the assumption of separability of consumption and leisure in the standard RBC model.

[60]An example of a NK model with a mechanism to derive a rise in wage is provided by the 'deep habit' model of Ravn et al. (2006), while Gali et al. (2007) introduced non-Ricardian consumers. Corsetti et al. (2009) provide a NK model with government spending reversal.

[61]This assumption is more applicable when investigating the effects of government investments; nonetheless, it is worth stating as it means we don't capture a 'productivity' element in our analysis and instead focus on the pure effects of changes in government spending.

[62]By entering the utility function of households, we must consider if government spending is complementary to or a substitute for household consumption and in doing so capture microeconomic effects of fiscal policy when we are interested in the macroeconomic effects.

[63]Distortionary taxes bring an 'incentive' element into the analysis, which makes it difficult to isolate the macroeconomic effects of fiscal policy.

[64]The described effects are generally stronger if the spending increase is permanent.

effect on trade balance is generally negative; and vii) the effect on investment is generally negative given an increase in interest rates. On investments, the standard neoclassical prediction of an increase in investment even with an increase in interest rates might seem odd, but it doesn't when considered in the context of significant amounts of empirical literature that argues that there are more important factors at play[65]. As expressed by Gilchrist and Himmelberg (1999, p. 1), 'it is well recognised that financial variables such as cash flow and cash stocks are robust and quantitatively important explanatory variables for investment' (also see Gilchrist and Himmelberg, 1995; Kadapakkam et al., 1998), but even if we take the argument that expansionary fiscal policy causes an increase in interest rates, the conclusion reached by Chirinko (1993, p. 1,881), that 'output (or sales) is clearly the dominant determinate of investment spending', indicates that the interest rate channel matters less[66]. Thus, the main channel with which changes in government spending could impact investments is muted. With this in mind, one can argue about whether the investment effects of government spending should be represented in Table 1.1; however, this representation can be supported with the evidence of Alesina et al. (2002), who argue that government spending can put upward pressure on private sector wages and in doing so depress profits, and ultimately depress investment, offering another channel where investment is affected by fiscal policy.

Table 1.1: Predicted theoretical effects of an increase in government spending

	Y	C	L^s	L^d	L	W	r	I	T	E
Keynesian: Closed economy	+	+	+	+**	+	+*	+	-		
Keynesian: Flexible exchange regime	=	+	=	=	=	=	=	=	-	+
Keynesian: Fixed exchanged regime	+	+	+	+	+	-	=	=	=	=
post-Keynesian	+	+	+	+	+	=	=	=	-	-
RBC	+	-	+	=	+	-	+	+	-	+
Separable utility	+	+	+	=	+	-	+	-	-	-
New Keynesian	+	-	+	+	+	+	+	-	-	+
Deep Hhabits	+	+	+	+	+	+	=	-	-	-
Spending reversals	+	+	+	+		+	+	***	-	-

This table is based on Hebous (2011).

Notes: The symbols are as follows: Y = output , C = consumption, L^s = Labour supply, L^d = Labour demand, L = employment, W = real wage, r = nominal interest rates, I = private investment, E = real exchange rate, T = trade balance. The "+" indicates a positive effect and in the case of the real exchange rate an appreciation whereas "-" indicates a negative effect and in the case of the real exchange rate a 'depreciation'. The "=" indicates no effect. A blank cell indicates that the paper(s) did not report the effects on these variables.
** For Neo-Keynesians, the effect on real wages is negative due to an increase in prices.*
***The Keynesian model does not provide an exact transmission mechanism that occurs in the labour market following an increase in government spending.*
****The model of Corsetti et al. (2009) does not explicitly include private investment decisions.*

[65] The literature on tax policy and firm investments offers a different narrative; tax incentives affect investment, with the compositional effects more easily identified than the aggregate effects (Auerbach et al., 2010)(see also Hassett and Hubbard, 2002).

[66] See also Fazzari (1993a, 1993b).

While there is little or no chance of every economist subscribing to one macroeconomic perspective, the policy actions taken during the great recession showed that the assumption that major fiscal policy actions are taken without a collaborative monetary authority is not a realistic one. Thus, theoretical models should start on the premise that fiscal policy is not implemented in isolation from monetary policy (Arestis, 2012). Taking this view immediately addresses one wing of the crowding out that arises when households and firms react to changes in interest rates. Leakages play a crucial role in the debate and the leakage due to household behaviour remains hotly debated. Looking underneath the hood of the dominant Ricardian equivalent theorem reveals similarity across all perspectives given that a simple view of the hypothesis is that households choose to save more as they foresee future tax increases to fund present expansionary fiscal policy. This decision to save ultimately dampens the multiplier size as it means lower consumption levels, a result that is consistent across all macroeconomic perspectives, i.e. the more households choose to save, the smaller the multiplier effect. However, the assumptions behind the Ricardian equivalence mean the reason why households choose to save is not universally accepted, so this wing of the crowding out debate remains to be resolved.

While Table 1.1 is useful for providing a quick summary, it is worth noting that these predictions are based on different prerequisites such as an accommodative monetary authority and slack in the economy. For Keynesians and post-Keynesians, the prerequisite is that though the slack in the economy and the monetary authority is accommodating to fiscal actions, this is not the case with the RBC and NK models. As stated by Sawyer (2009), 'the effects of fiscal policy depend on why it is introduced and in what economic environment. To state the obvious, fiscal stimulus introduced when the economy is at (or would be at) full employment will lead to "crowding out" through a variety of routes, but a fiscal stimulus applied when the economy is operating with excess capacity and unemployment of labour will crowd in.' Consequently, next I discuss recent contributions that show that when there is general acceptance of prerequisites, then government spending can be effective in stimulating the economy.

1.4.2 The state of the economy, an accommodating monetary policy, and zero lower bound

As expressed earlier, a standard post-Keynesian view is that if there is insufficient demand that causes output to be below its potential output, then the government can increase its spending to motivate the use of idle resources and in doing so raise output[67]. Also, given that one of the main arguments against the effectiveness of fiscal policy is 'crowding out' through an increase in real interest rates, a valid hypothesis then becomes what happens if government spending

[67]It follows that when an economy has excess production capacity, then an increase in aggregate demand can be met by a response in the supply side. However, if the economy is operating at near or full capacity, then the supply side cannot respond quickly to increases in aggregate demand, so the multiplier effect of government spending is reduced/dampened.

can't crowd out private expenditure because monetary authorities are accommodating[68] or are not able to act, which is ultimately the prerequisites recognised by Kahn and Keynes. Recent contributions to the literature have argued that fiscal policy can be very effective when monetary policy is accommodating (Woodford, 2011), which is in essence going back to the prerequisite of Kahn and Keynes as presented in section 1.3.2. The key mechanism is as follows: if monetary policy is not accommodative during fiscal expansions, it responds by raising nominal interest rates to fight higher inflation and a positive output gap that results from the fiscal stimulus. This would raise the real interest rate and naturally dampen economic activity. If, on the other hand, monetary policy is accommodative either by keeping the nominal rate constant or at least by not increasing it sufficiently strongly, then fiscal expansion will be more effective because the real rate will not rise.

The financial crisis of 2008 revived interest in the debate and sparked renewed interest in the nonlinearity of fiscal multipliers, i.e. fiscal policy can be more effective in some periods than others. Until recently, most fiscal multiplier estimates in theoretical models assumed linearity in multipliers or used a linear time-series model for the entirety of sample periods, but this pattern has changed with increasing agreement that fiscal multipliers are dependent on the state of the economy and an accommodating monetary policy. Thus, recent contribution to the literature has facilitated some level of consensus on prerequisites. The need (and increase in interest) to understand the impact the interaction between monetary and fiscal policy has on the effects of fiscal expansion was eloquently emphasised by Davig and Leeper (2011); driven by the results of their paper, they argued that 'the impacts of a fiscal stimulus cannot be understood without studying monetary and fiscal policies jointly. Moreover, different assumptions about joint monetary-fiscal behavior can lead to sharply different conclusions about the likely consequences of fiscal stimulus.'

By construction, any increase in government spending in a neoclassical or NK model with an optimal Taylor rule would result in an offsetting move of interest rates to respond to output deviations caused by an increase in government spending, thus dampening any multiplier effect (see Rebelo, 2005; Woodford 2011). However, if monetary authorities accommodate fiscal shocks or are unable to respond to output deviations because an interest rate is stuck as the zero lower bound (ZLB), then the multiplier effect can be larger.

[68]There is broad consensus in NCM that expansionary fiscal policy for stabilisation purposes should only be used under economic conditions when monetary policy is ineffective. When a nominal interest rate is stuck at the zero lower bound (ZLB), i.e. at or close to zero per cent, it causes a large multiplier. In that case, the central bank is unable to stimulate the economy by cutting the nominal interest rate. So, to lower the real interest rate, it has to resort to unconventional monetary instruments to raise inflation expectations, such as quantitative easing. Since this may be difficult to accomplish, fiscal policy can be very effective in such an environment because of its impact on inflation and inflationary expectations. Every policy measure that increases inflationary expectations in a ZLB lowers the real interest rate, and thus brings it closer to the natural rate that corresponds to full employment. This in turn stimulates aggregate demand, production and employment. Fiscal policy through increased government spending constitutes one policy measure that does the trick in this model. It creates a positive feedback loop between consumption and inflation: the rise in inflation created by government spending lowers the real interest rate, stimulating private consumption, which increases inflation and so on.

Both the RBC and NK model by construction don't lend themselves to exploring the impact the state of the economy could have on multiplier size. By imposing clearing factor and product markets, there is no room for spare capacity, which is a widely accepted indicator that the economy is in a slack state, so the literature exploring the hypothesis of larger multipliers in recessionary or slack periods is shaped by empirical evidence from Vector Autoregressive Regression (VAR) and single equation systems[69]. Also by construction[70], only the NK theoretical models are able to explore the hypothesis of larger multipliers when ZLB on nominal interest rates is binding, so the literature is dominated by experiments in a NK setting although there are some empirical contributions. As pointed out by Woodford (2011), while the degree of slack in a NK model setting is important in determining how plausible it is to expect monetary authorities to maintain an unchanged path, the actual predicted multiplier is independent of the degree of slack as long as monetary authorities maintain an unchanged path, so ZLB trumps slack in NK model setting. Woodford (2011) showed in a benchmark NK setting that there are a few cases where monetary policy remains unchanged[71] regardless of the path of government purchases; one of them is 'when monetary policy is constrained by the zero lower bound on the short-term nominal interest rate'. A simple view of a binding ZLB is that monetary policy is no longer active since monetary authorities are unable to set a negative nominal interest rate If monetary policy targets an unchanged path of nominal interest rates, then fiscal policy can be very effective.

Davig and Leeper (2011) in a NK model setting showed that when monetary policy is not accommodating, the output and consumption multiplier were 0.8 and -0.2 respectively, but with an accommodating monetary policy they were 1.80 and 0.8. So not only did both multipliers increase significantly, but the consumption multiplier goes from being negative to positive[72]. Their conclusion did not address the question of how realistic it is to hold nominal interest rates constant for long periods. Cogan et al. (2010) argued that it is realistic to keep the nominal interest rate equal to zero and constant for four quarters and then follow a standard Taylor rule afterwards; their view was that 'keeping interest rates constant for two years still does not seem very realistic and would likely result in an increase in inflation, but it is certainly more realistic than pegging the interest rates at zero forever, or even for four years'. In a NK model setting, they showed, by assuming that government spending is more permanent and the US monetary authority held nominal interest rates constant for four quarters, that the government spending impact multiplier was at best 0.96 in the first quarter and died off to 0.40 after four years even though government spending continued. When the ZLB period

[69] See chapter two of this thesis.

[70] Woodford (2011): exploring the effect of temporary increases in government purchases under a constant real interest rate is only feasible under a variety of sticky prices, sticky wages or sticky information which are not present in a neoclassical model.

[71] The central bank maintains an unchanged path for the real interest rate.

[72] When they simulated their model on the American Recovery and Reinvestment Act (ARRA), they found that output multiplier increased from a negative value of 0.68 to 3 or 5 dependent on the model incorporating fiscal foresight.

was extended to eight quarters, the impact multiplier was at best 1.03 and died off to 0.40[73]. The ZLB period assumption by Cogan et al. (2010) was lengthened by a few papers and in doing this the reported government spending multiplier was larger. Christiano et al. (2011)[74] assessed the impact a binding ZLB had on multiplier size and showed that if the nominal interest rate is governed by a Taylor rule, then the multiplier is 'quite modest' and was generally less than one, but when ZLB is binding and government spending goes up for 12 quarters, then the multiplier is very large, with the impact multiplier roughly 1.6 and a peak value of about 2.3. This result is dependent on government spending occurring during the ZLB period; the 12 quarters of a constant nominal interest rate is much longer than the four quarters of Cogan et al. (2010). Given that the multiplier in Christiano et al. (2011)[75] rises in a hump-shaped manner, attaining a peak value of about 2.3 after five periods, the differences in the reported multipliers are shown to be due to the fact that 'the bulk of the spending needs to come on line when the zero bound binds' (Christiano et al., 2011, p.6), something which doesn't happen in Cogan et al. (2010). Woodford (2011) analytically confirmed the importance of government purchases not persisting beyond the period of a binding ZLB or an accommodating monetary policy. Consistent with the conclusion of Christiano et al. (2011), Eggertsson (2011) estimated that when the interest rate is positive, the government spending multiplier was 0.48, while at zero interest rate, it was 2.3. Coenen et al. (2012) also provided evidence consistent with Christiano et al. (2011), showing that government consumption and investment multipliers were larger when monetary policy was accommodating for the duration of the increase in spending[76]. They reported that the effects were generally larger in the US than Europe[77]. As they also highlighted, a persistent stimulus is more effective if monetary policy remains accommodative, but only if it is temporary. Nonetheless, as pointed out by Erceg and Lindé (2014), the size of the stimulus is important given their evidence from an estimated NK model that showed that 'marginal benefits of fiscal stimulus may drop substantially as spending rises', meaning that even under an accommodating monetary policy, the full effect of an increase in government spending won't be felt if such spending is too large[78]. The point made by Erceg and Lindé (2014) seems appropriate to end this section in the sense that the discussed studies[79] have corroborated

[73]When they extended their analysis to the government purchases component of the ARRA, they reported even smaller multipliers and it turns negative with consumption also crowded out.

[74]Christiano (2004) and Eggertsson (2004) were early contributors to the debate on the effectiveness of government spending when ZLB binds.

[75]If a Taylor rule type is followed by the monetary policy committee, then the multiplier is less than one.

[76]Output, private consumption and private investment multipliers were generally all positive and larger under an accommodating monetary policy of two years.

[77]Three factors were considered to explain this: Europe is more open than the US, and therefore more susceptible to leakage to imports; automatic stabilisers play a larger role in Europe, therefore they are more susceptible to leakage from the discretionary fiscal stimulus into higher taxes and lower transfers; the degree of nominal rigidities is larger in Europe. They concluded that the differences 'are mostly a result of the higher nominal rigidities in Europe, with the relative openness of European economies and the larger automatic stabilisers playing somewhat smaller roles'.

[78]They use a threshold value of 1.2% of GDP.

[79]Uhlig and Drautzburg (2011) reported moderate higher spending multiplier compared to the other studies; nonetheless, multipliers under accommodating monetary policy were higher than otherwise.

Keynes's view by showing that increases in government spending can indeed have outsized effects on output when monetary policy allows real interest rates to fall. Nonetheless, the traditional fiscal multiplier formula hasn't been developed enough by Keynesians and post-Keynesians to capture an endogenous multiplier that varies with the state of the economy and monetary policy stance, and this is an area that deserves more attention.

The main takeaway here is that when there is general acceptance of prerequisites such as an accommodative monetary authority and slack in the economy, then fiscal policy can be effective in stimulating aggregate demand in the short run, and as such the debate turns to how much above unity the multiplier is. The challenge, however, remains on the actual estimate of 'the multiplier', which tends to be discussed within the empirical literature. I discuss this next.

1.5 Empirical evidence on the short-run (in)effectiveness of fiscal policy

This section focuses on the empirical literature examining the macroeconomic effects of government spending. The construction and use of new credible government spending instruments has resulted in more studies at the local (regional/state) and sector level, so I discuss not just aggregate effects, but also effects at the local level and briefly discuss a few papers that have attempted to provide sector-/industry-level evidence. The empirical literature on the effects of discretionary government spending tend to focus on two central questions[80]: (1) are empirical results consistent with theoretical models? and (2) what are the government spending multipliers? (Ramey, 2016). This section falls primarily in the strand of discretionary government spending multipliers, and secondarily on the consistency between empirical results and theoretical model predictions. I discuss the two main identification schemes utilised in the literature and discuss results from emerging themes among the contributions to the literature since the financial crisis: 1) the role and importance of identification schemes; 2) the role of fiscal instruments and the difference between defence and non-defence spending; and 3) capturing the signs of government spending, i.e. is government spending increasing or decreasing?

Although the 2008 crisis motivated a significant increase in research on the effect of fiscal policy, this review highlights that this increase hasn't resolved the common points of contention in the literature on the effects of discretionary fiscal policy. There is still no consensus on the size of the effect (i.e. the size of the government spending multiplier), but there is growing acceptance that the size is 'context-dependent'; I explain this further below. Unsurprisingly, just

[80]Literature reviews on the effect of discretionary government spending can be grouped into those that investigate if there is any evidence to support the arguments that fiscal policy is ineffective (Hemmings et al., 2002), those that discuss strengths and limitations of empirical approaches (Perotti, 2007; Ramey, 2016), those that discuss the controversial assumptions behind the theoretical models (Fontana; 2009b), and those that provide a summary of the current evidence either qualitatively (Beetsma, 2008; Hebous, 2009; Hristov, 2012; Ramey, 2011b, 2016) or quantitatively via meta-regression analysis (Gechert and Will, 2012). This chapter falls into the last category. The classification is not to say that each of the mentioned papers omit discussions on the other mentioned categories; however, the focus of each paper was used to form an idea of which categories best suit.

like the theoretical frameworks discussed earlier, competing empirical methods provide varying sizes of multiplier estimates. Even with the weaknesses and shortcomings of fiscal shock identification schemes[81], there seems to be some acceptance that the narrative approach of identifying fiscal shocks is superior to alternatives (Beetsma, 2008), while the VAR is better than a single equation system (Favero and Giavazzi, 2012). Nonetheless, there is still an ongoing debate on the differences in results obtained when using defence or non-defence spending instruments. A recent review of the literature such as work by Ramey (2011b) and Hebous (2009) shows that the estimated multipliers for the same country differ across papers even after controlling for recent structural characteristics that have been argued to influence the size of the multiplier[82]. Leeper et al. (2017), in their aptly titled paper 'Clearing up the fiscal multiplier morass', traced 'differences in estimates of multipliers to different model specifications' in simulation-based studies (DSGE). Put simply, the range of multiplier values presented by a researcher is pre-determined at the stage of model choice made by the researcher. Similarly, results presented by Gechert (2013) showed that various econometric and identification strategies result in different multipliers, highlighting the complexity of presenting 'a multiplier' value. Just as with the case of the theoretical perspective having an impact on the size of the multiplier in the theoretical literature, empirically estimated multipliers are influenced by the study design. Before turning to a detailed discussion of the empirical evidence, it is useful to explain some concepts that are relevant for the literature, such as what we mean by 'discretionary government spending' and how fiscal multipliers are calculated.

1.5.1 What do we mean by discretionary government spending?

Fiscal instruments can be categorised broadly into consumption expenditure, investment expenditure, general lump sum transfers, labour income tax rates, consumption tax rates and corporate tax rates. Changes in these instruments can be divided into two components: a cyclical component and a structural component. The cyclical component captures the automatic fiscal changes that occur due to business cycle movements; for example, tax revenues tend to be up and transfers such as unemployment benefits tend to be down during boom periods, while the opposite is true during a recession. The structural component is what is left after the cyclical component has been taken away from the government's budget, and it is the discretionary response of the government to events occurring in a country. This structural component has two sub-components: endogenous and exogenous components. Endogenous changes occur as a response to the current or future state of the economy; the stimulus plans of many countries during the recession of 2009 is an example of an endogenous change. Exogenous changes on the other hand occur as a response to events not tied to current or future economic activities;

[81] Ramey (2016) categorises them into two main issues: the foresight problems in SVARs, and the military news instruments likely to also capture confounding effects (e.g. rationing, price controls, conscription, patriotic increases in labour supply).

[82] Openness to trade, exchange rate regime, accommodating monetary authority, and debt level.

a popular example is the expenditure of wars (although it can be argued that in some cases this is not purely exogenous). Due to econometric considerations[83], exogenous changes are the changes commonly used in the empirical literature to capture the effects of fiscal policy, so it is clear from the above description that there is a missing component of 'discretionary' government spending, which is not the case in the theoretical literature. However, as highlighted by Fatas and Mihov (2012, p. 5), the reported effects from these empirical studies 'are not relevant to the potential stabilising role of government spending. There remains, however, a belief that the findings can still be informative about the potential stabilising role of countercyclical fiscal policy under the assumption that exogenous discretionary fiscal policy should have similar effects to endogenous discretionary policy.' Therefore, what we understand about the effects of exogenous discretionary government spending is relevant to policy making, i.e. exogenous discretionary government spending is a fair substitute of overall discretionary government spending.

A major issue with empirical evidence is the availability of data, more specifically the division of government spending data into the appropriate elements of structural components to allow for easy selection of data that captures the random structural component that is not connected to the state of the economy. Given that fiscal instrument data suffers from reverse causation or endogeneity problems with other macroeconomic variables like GDP, various identification schemes have been developed in the quest to examine only the effects of 'exogenous fiscal shocks'. Two main empirical methodological approaches have become the standards (Perotti, 2007 and Ramey, 2011b): the narrative approach[84] and the Vector Autoregressive approach (VAR). The narrative approach studies (especially military event variables) tend to present evidence that suggest that an increase in government spending increases output, but private consumption and real wages decline, consistent with the neoclassical model. The VAR approach studies tend to show that an increase in government spending increases output, private consumption and real wages, results consistent with Keynesian and NK models. Before discussing both approaches, it is useful to present how fiscal multipliers are calculated as the size of the multiplier can vary not only due to the adopted approach but also due to the type of multiplier that is calculated, of which there are four types.

1.5.2 How are fiscal multipliers calculated?

Many economists would protest against presenting a single 'multiplier' given that it can be argued to be a constantly changing figure, an issue that was very well described by Carroll (2009) when he commented that 'asking what "the" government spending multiplier is, [...] is

[83]See section subsec:Problem-of-identifying[subsec:Problem-of-identifying].

[84]An earlier approach in the narrative literature is the use of dummy variables to capture events that were deemed exogenous and unforeseen (e.g. war events, Ramey and Shapiro, 1998), and then regressing among other variables this dummy variable on GDP in a standard ordinary least square model or include it in a VAR system. This approach has steadily been replaced by the fully fledged narrative approach of collecting actual values of government spending on wars from magazine/newspapers, and using this value to construct a time-series instrument for government spending, usually termed the defence spending instrument.

like asking what "the" temperature is. Both vary over time and space. The really interesting intellectual questions involve the extent to which the whole set of other important factors causes the multiplier to vary.' What is undeniable about the comment by Carroll (2009) is the agreement among economists that the multiplier tends to vary, which should be a calling card for more research to further our understanding of the factor that causes this variation[85]. Nonetheless, there are four types of multiplier reported in the literature. The fiscal multiplier is defined by Coenen et al. (2010) as 'the "effects" of changes in fiscal instruments on real GDP'; this effect is captured as the ratio of change in output to an exogenous change in government spending or taxation. Given that the multiplier is time-varying, four different types of multipliers can be calculated and used: the impact, peak, cumulative, and horizon N multiplier.

Impact multiplier:

$$Impact\,multiplier = \frac{\Delta Y_t}{\Delta G_t}$$

The measure reports the increase in the level of output Y at time t following the change in G at time t. Thus, G denotes the increase in government purchases or the fall in tax revenues.

Multiplier at N horizon:

$$Multiplier\,at\,N\,horizon = \frac{\Delta Y_{t+N}}{\Delta G_t}$$

Peak multiplier:

$$Peak\,multiplier = \max_N \left\{ \frac{\Delta Y_{t+N}}{\Delta G_t} \right\}$$

Cumulative multiplier:

$$Culmulative\,multiplier = \left\{ \frac{\sum_{j=0}^{N} \Delta Y_{t+j}}{\sum_{j=0}^{N} \Delta G_{t+j}} \right\}$$

The commonly reported multipliers are the peak and impact multipliers; however, using the impulse responses at peaks or troughs is not a good way to calculate a multiplier, as argued by Ramey (2016). Presenting arguments by Mountford and Uhlig (2009), Uhlig (2010) and Fisher and Peters (2010), Ramey (2016) made a case for multipliers to be calculated as 'integral (or

[85] This thesis will contribute to our understanding by examining industry-level evidence and its importance in explaining why the multiplier is endogenous. The intuition for this path of research lies in the general agreement among economists that policy effects, whether monetary or fiscal, filter through to the economy via different responses of individuals, firms and industries (sectors). With the focus on industries, there is an agreement that policy actions don't affect all industries at the same time and effects are not uniform across industries, which has been documented in the literature on the industry effects of monetary policy (see, for example, Carlino and DeFina (1998, 1999), Dedola and Lippi (2005), Ganley and Salmon (1997), and Peersman and Smets (2005)). Hence, it could be argued that the ability for a policy action to have the desired effect on as many industries as possible is an important factor in the overall aggregate effect, and in our case the ability of fiscal policy to have a significant fiscal multiplier per industry would determine the overall fiscal multiplier of the aggregate output. Also, the timing of these effects on different industries should be expected to have explanatory power on the different horizon multipliers.

present value) of the output response divided by the integral government spending response', so the cumulative multiplier, as it addresses 'the relevant policy question because they measure the cumulative GDP gain relative to the cumulative government spending during a given period'. The issue here is the tendency to report a higher multiplier using the peak or impact multipliers, a claim confirmed by Gechert (2013), who stated that 'peak multipliers [are] on average 0.3 units greater than cumulative multipliers'. Since there is a tendency for authors to publish whichever multiplier they see fit, it becomes difficult to compare results across studies; nonetheless, for the purpose of this review, the cumulative multiplier is preferred and reported when available, and if not, then the impact multiplier is reported. I now turn to the empirical approaches used to obtain fiscal multipliers.

1.6 Empirical approaches for understanding the effects of fiscal policy– identifying fiscal shocks

A major issue in the estimation of fiscal multipliers is the identification of a truly exogenous unanticipated fiscal shock and capturing the economic reaction to it in an unbiased manner. The validity of any estimated fiscal multiplier is judged against the backdrop of these issues being addressed, so the literature is shaped by the search to find instruments for government spending shocks that are uncorrelated with economic activity. As highlighted earlier, two main empirical methodological approaches have become the standards (Perotti, 2007; Ramey, 2011b): the narrative approach and VAR. The narrative approach shall be explained first, before moving on to the VAR approach.

1.6.1 The narrative approach in macroeconomic policy analysis

The narrative approach in fiscal policy analysis is attributed to Romer and Romer (2010), who constructed a new tax series for the US, extending their earlier work on the monetary policy effect literature (Romer and Romer, 1989) to fiscal policy. The Romer and Romer narrative approach to fiscal policy analysis makes use of presidential speeches and Congressional reports to construct a time series for all major post-war tax policy actions, identifying the size, timing and principal motivation. By classifying tax policy changes as either endogenous or exogenous, a time series of exogenous shocks is then regressed on macroeconomic variables such as GDP. This approach was extended to the literature on the effect of government spending by capturing major movements in defence spending. Since war events are seen as truly exogenous to economic activity, Ramey (2011a) constructed estimates of changes to expected present value of government defence spending using news sources such as the *Businessweek* publication in the US[86].

[86] Due to the lower predictive power of the instrument if both the WWII and Korean War data are excluded, Ramey (2011a) also constructed another military spending variable by taking the difference between actual government spending growth and forecast of growth by the *Survey of Professional Forecasters* one quarter earlier, using this difference as the 'shock'.

Deviating from the ordinary least square (OLS) approach common in the narrative approach literature and initially used by Ramey and Shapiro (1998)[87] in their initial dummy variable approach, Ramey (2011a)[88] used her defence spending instrument in a VAR, reaching a conclusion that contradicts the conclusion commonly reached in the standard fiscal VAR literature where 'shock' is identified by the VAR system: 'to summarize, the results based on VARs using the richer news variable back to 1939 largely support the qualitative results from the simpler Ramey–Shapiro military date variable' (p.38), i.e. an increase in government spending increases output, but private consumption and real wages decline. Interestingly, as discussed in section 1.6.2, Favero and Giavazzi (2012) reached similar conclusions common in the standard fiscal VAR literature using the Romer and Romer (2010) tax shock dataset in a VAR, so advocates of the SVAR approach might take it as an opportunity to question the validity of the military spending instrument.

The main point argued by proponents of the narrative approach is the fact that you don't need a model to extract your 'exogenous shock' given that the government spending instruments constructed via this means are in a sense vetted by the process of construction, and instruments created via these methods are unlikely to be correlated with contemporaneous macroeconomic activities. The literature on instrumental variables is quite clear on two key properties that an instrument must have to be deemed fit for purpose. First, they must be correlated with the endogenous explanatory variable they are replacing. Second, they cannot be correlated with the error term in the explanatory equation. Although Ramey (2011a) was able to show that her military spending instrument was a valid replacement for overall government spending, the instrument is not free of criticisms, the main one being that major movements in defence spending are not representative of fiscal policy actions. They are not just big fiscal spending shocks; they are special unique events (Fontana, 2009, p. 598). Perotti (2007, p. 35) in effect was stipulating that we should accept the narrative approach conclusions of declining private consumption due to shocks to government spending if and only if we saw wars as normal events from the point of view of fiscal policy, but just bigger. However, since wars are abnormal events, it is inappropriate to use them in assessing 'the effectiveness of fiscal policy through an analysis of deviation of output and other macroeconomic variables from their normal path' (Fontana, 2009, p. 597).

Yang et al. (2012) provide an excellent critique of the defence spending/military build-up instrument and propose using non-defence spending such as a government's spending response to natural disasters, since these are unexpected, sudden and unrelated to economic conditions, thus qualifying them as exogenous[89]. This line of the narrative approach literature looks at the

[87]Usually referred to as the dummy variable approach, Ramey and Shapiro used dummy variables to capture unexpected changes in defence spending focusing on periods of war build-ups. This dummy variable is then regressed on economic output in a standard OLS approach to trace the impact of fiscal policy.

[88]In the same paper, she also used the dummy variable approach to capture major changes in defence spending. The dummy variable took a value of unity on major war events and represented the shock in the VAR system.

[89]Papers by Lis and Nickel (2010) and Melecky and Raddatz (2015) show that natural disasters tend to increase

multiplier for non-defence spending, which is driven in part by the problem highlighted by Barro and Redlick (2011) in that the defence instrument multiplier captures only the multiplier for defence expenditure, and thus it is not a multiplier for total government spending. According to Yang et al. (2012), 'when a natural disaster happens, government responds by spending resources for relief and repair which are more similar to the general government expenditure than the spending associated with military build-ups', so multipliers from this instrument are more representative of the total government spending multiplier. They reported a multiplier range of 1.41 to 2.48[90], exceeding the 0.6 to 1.2 range of Ramey (2011a). Due to a lack of data availability, they could not analyse the effects their instrument had on private consumption. However, if we take the findings of Lorusso and Pieroni (2017), who reported that civilian and military government spending affect private consumption differently due to their specific characteristics[91], and more importantly their conclusion that 'civilian expenditure induces a positive and significant response on private consumption whereas military spending has a negative impact', then we can expect the Yang et al. (2012) non-defence type fiscal instrument to have a positive effect on consumption. Other examples of newly constructed instruments for fluctuations in non-defence government spending in the local multiplier literature are discussed in section 1.7.4. Although these instruments address the issue of abnormality, they are not constructed narratively, as in the case of the military spending of Ramey (2011a) and natural disaster spending of Yang et al. (2012), meaning a gap remains for an alternative narrative instrument for government spending at aggregate level[92].

1.6.2 The vector autoregressive regression approach

The Vector Autoregressive (VAR) identification scheme literature can be divided broadly into three approaches: the recursive VAR of Fatas and Mihov (2001), structural VAR of Blanchard and Perotti (2002), and signs-restriction VAR of Mountford and Uhlig (2009). The structural VAR of Blanchard and Perotti (2002) can be argued to be the favourite among researchers given the amount of studies that use the identification scheme proposed by the structural VAR (SVAR) approach, but it does not mean it is the superior approach of the three.

Before explaining the different identification approaches used in the fiscal VAR literature, it is worth giving a quick overview of VARs. A VAR is an n-equation, n-variable linear model in which each variable is in turn explained by its own lagged values, plus current and past values of the remaining n–1 variable (Stock and Watson, 2001, p. 1). Each equation is estimated by OLS, with the error terms in these regressions capturing the 'shock' movement in the variables. The fiscal VAR literature tends to make use of the recursive and structural VAR, using the reported

fiscal deficits.

[90]For federal non-defence spending, with peak/cumulative multipliers estimated as 1.41/1.74 and for state government spending, with the corresponding multipliers 1.45/2.48.

[91]Difference in persistence of shocks and financing mechanism (military spending has larger persistence).

[92]Fisher and Peters (2009) used excess returns on defence stocks, so can be classed as being in the defence expenditure corner.

impulse response function to calculate fiscal multipliers. The impulse response function traces out the response of current and future values of each of the variables to a one-unit increase in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero (Stock and Watson, 2001, p. 7). The main difference between the recursive and structural VAR is how restrictions are placed on coefficients to allow for the identification of 'exogenous shocks'. Recursive VARs use an arbitrary mechanical method to model contemporaneous correlation in the variables, while structural VARs use economic theory to associate these correlations with causal relationships (Stock and Watson, 2001, p. 13). In a recursive VAR, the ordering of the variables plays a crucial role because it includes contemporaneous values as regressors in the equations, and these values determine the causal relationship. In the paper usually cited as the first to use this approach for fiscal policy analysis, Fatas and Mihov (2001) used a standard Cholesky decomposition to impose causal ordering of government spending, output and taxes[93]. The ordering implies that government spending does not contemporaneously react to output and tax; rather, output reacts to government spending and itself but not to changes in taxes, while taxes react to itself and the other variables. In this setting, government spending is assumed to be the 'most exogenous', while tax is the 'most endogenous'.

The SVAR[94] as an identification approach was first proposed by Blanchard and Perotti (2002) and has become the most used approach in the fiscal VAR literature. As expressed earlier, the SVAR is not too dissimilar to the recursive VAR, with the only difference being how restrictions are decided. Blanchard and Perotti assume the contemporaneous response of discretional fiscal policy to macroeconomic variables such as GDP to be zero, and also assume non-zero restrictions such as imposing estimated elasticities of automatic stabilisers, an assumption that is based on the elasticity of government spending to macroeconomic variables. Blanchard and Perotti, using institutional knowledge of the tight constraints imposed by tax codes and spending rules, argued that it tends to take more than a quarter for governments to respond to changes in macroeconomic conditions, so their assumption was a reasonable one. This assumption and others mean the VAR is open to some criticisms within the literature, which are discussed next, after which a summary of the main debates concerning identification schemes are presented.

Criticism of the VAR identification scheme

Some contributions to the literature have argued that the existence of legislative and implementation lags means households and firms receive signals, and can adjust their behavior to future

[93] Exerts a causal ordering on the contemporaneous variance/covariance matrix of the estimated VAR.

[94] There is a third identification approach in the fiscal VAR literature that tends to deliver results similar to those of the standard SVAR. It is the sign restrictions approach developed by Uhlig (2005) for monetary policy analysis, but was extended to fiscal policy by Mountford and Uhlig (2009) and Pappa (2009). This approach does not impose restrictions on contemporaneous effects on some variables, but places restrictions on the signs of the impulse response function. So if a negative sign is placed on an identified shock, then the impulse response of a variable to that shock is restricted to being negative on impact. Fry and Pagan (2011), Paustian (2007) and Caldara and Kamps (2017) provide discussions on the use of sign restrictions for identification.

changes in government spending and taxes before the change occur, this is termed as having 'fiscal foresights' (see e.g. Yang, 2005; Leeper et al., 2008). Econometric models typically make information assumption that fiscal policy changes are unanticipated by the households and firms, hence fiscal foresight is one of the main criticism usually thrown at VARs. The other main criticism is the omitted variable bias (controlling for all other factors that can determine output growth), and not addressing either of these two issues can lead to biased conclusions on the effects of fiscal policy shocks. Furthermore, the areas of contention and criticism for VARs can be easily extracted by taking the descriptions of Auerbach and Gorodnichenko (2012a) on the standard identifying assumptions of SVARs: 1) discretionary policy does not respond to output within a quarter; 2) non-discretionary policy responses to output are consistent with auxiliary estimates of fiscal output elasticities; 3) innovations in fiscal variables not predicted within the VAR constitute unexpected fiscal policy innovation; and 4) fiscal multipliers do not vary across the business. It is clear that we can contest all four assumptions, but the two that have seen most debate are three and four. As argued by Ramey (2011a), innovations in fiscal policy might not represent unanticipated changes since it is possible for the private sector to react to news about fiscal changes before they actually take place, thus leading to incorrect inference[95].

Until recently, the fiscal VAR literature had only presented multipliers that are linear, i.e. multipliers that stay the same over the business cycle, but this assumption is questionable and raises the possibility of state-dependent multipliers. Hence, although the SVAR is most commonly used in the fiscal VAR literature, the third and fourth assumptions have spurred new breeds of VARs being used by researchers to tackle some of the criticisms arising from those assumptions. They include the expectations-augmented VAR (EVAR)[96], regime-switching VAR (STVAR)[97], proxy SVAR[98], and the factor-augmented VAR (FAVAR)[99]. Favero and Giavazzi (2012, p. 3) compared the current debate on the identification of fiscal shocks to one that took place about the identification of monetary shocks[100]; given that the narrative record way of identifying fiscal shock is seen to have an advantage over the VAR, they proposed that the 'narrative VAR' could be utilised more in the fiscal VAR literature based on their result using

[95] Mertens and Ravn (2010) in their investigation using US data did not find evidence of anticipation effect overturning the existing findings of standard fiscal VARs, but on reviewing the literature, Ramey (2016) concludes that anticipation effects are found to be very important.

[96] Includes forecast of fiscal variables to take into account the expectation effect of the private sector, i.e. fiscal variables that can proxy for the change in agents' expectations.

[97] Allows for differentiation in multipliers between recessions and expansions, and also can be reverted to as a 'smooth transition VAR'. There are two types, the first is a system that allows the length of recession and expansions to change within the system, while the other assumes a fixed length.

[98] This method was developed by Stock and Watson (2008) and extended by Stock and Watson (2012) and Mertens and Ravn (2013); it takes advantage of information developed from outside the VAR, e.g. narrative fiscal instrument (Ramey, 2016, p. 12).

[99] Developed by Bernanke et al. (2005) to analyse effects of monetary policy. A standard VAR includes unobserved factors that are usually interpreted as the common forces driving the dynamics of the economy, so capturing the different dynamics of the economy that a standard VAR ignores. It was first extended to fiscal policy analysis by Forni and Gambetti (2010).

[100] The debate between Rudebusch (1998) and Sims (1998) was essentially about the lack of credibility in the monetary shock identified via VARs, with Christopher Sims defending the VAR.

the Romer and Romer (2010) tax shock[101]. However, as I discuss in the next section with the results presented by Barnichon and Matthes (2017), their result is not easily transferable to government spending.

An important aspect of VARs that is commonly overlooked is the assumption made when extracting the exogenous component of government spending. The exogenous shock in Blanchard and Perotti (2002) was the residual from a regression of government spending on four lags of itself: output, taxes, a quadratic time trend and a dummy variable (1975, p. 2), but this is just one possible specification among many alternatives of a fiscal rule, and as highlighted by Caldara and Kamps (2017), this plays a significant role in the different conclusions reached by papers seemingly using the same approach. They showed that assumptions made about the systematic response of fiscal policy to output can account for the differences in estimated multipliers, with the relationship between systematic response and spending multiplier negative. Put simply, if the systematic component of government spending is assumed to do more of the heavy lifting, then the estimated multiplier is small, whereas if it is assumed that the systematic response to output is small, then the multiplier is larger. They also showed that setting the systematic response to zero as in the case of Blanchard and Perotti (2002) results in a multiplier of about one, so an assumption made about the systematic response does not provide an answer for multipliers that are above and below one within the literature. To answer that question we have to examine new contributions to the empirical literature that stress the importance of the nonlinear impulse response function, with the multiplier also dependent on the sign of government spending (see section 1.7.2).

1.6.3 Debate on the sign of fiscal impulse and defence/non-defence impulse

As stated earlier, there has been a significant expansion in the fiscal VAR literature, and more recent contributions are looking beyond accounting for the state of the economy, but also controlling for the sign and size of the fiscal impulse. It was generally the case that previous empirical contributions tended to assume that government spending increases during a recession, but as shown for the US by Riera-Crichton et al. (2015) and Pragidis et al. (2018) and for the EU and OECD countries by Mencinger et al. (2017), government spending was actually going down during recessions in many cases. Four scenarios are captured in a typical sample period: 1) a period of expansion and a decrease in government spending; 2) a period of expansion and an increase

[101] Using this approach, they found that their tax multipliers were not different from those obtained using the traditional VAR identification approach, so the difference in multipliers between the narrative approach and the VAR wasn't the difference in shocks but rather the models themselves (Romer and Romer, 2010, reported multipliers of about 3, while those of Blanchard and Perotti (2002) and Perotti (2007) were about 1). Extracting the equation for output growth from a standard fiscal SVAR, they were able to show that the equation had several more sources of information that are omitted from the standard single equation model used by Romer and Romer (2010), and as a result both approaches cannot deliver the same estimate of the tax multiplier. They presented three conditions that needed to be satisfied for both approaches to deliver the same multipliers; however, they showed that one of those conditions could not be satisfied given Romer and Romer (2010) classification of exogenous tax changes and illustrated the empirical importance. See paper for more extensive analysis.

in government spending; 3) a period of recession and a decrease in government spending; and 4) a period of recession and an increase in government spending. While the seminal contributions on the state-dependent multiplier by Auerbach and Gorodnichenko (2012a) spurred other contributions using alternative threshold variables such as unemployment (e.g. Biolsi, 2017) and financial stre

ss (Berncardini and Peersman, 2015; Fazzari et al., 2015)[102], what these papers didn't account for was the sign or size of the fiscal impulse, i.e. is government spending going up or down? Recent contributions such as those by Afonso et al. (2018)[103], Riera-Crichton et al. (2015), Pragidis et al. (2018) and Mencinger et al. (2017) include nonlinear impulse response functions in their model, allowing the multiplier to vary not only by their threshold variable, but also by the size and sign of the fiscal impulse. The results presented by these papers not only have implications for the nonlinearity of government spending multipliers, but also for the role of the sign of the fiscal impulse, as discussed in section 1.7.2.

Another important contribution concerning the difference between defence and general government spending was provided by Barnichon and Matthes (2017), who presented evidence that suggests a negative spending shock has the biggest effect when there is slack in the economy; however, a positive spending shock didn't seem to depend on the state of the economy. With this result, they presented the hypothesis that differences in positive and negative shock composition between two competing identification schemes could explain the differences between VAR evidence, which found support for economic state-dependent multipliers, compared to the narrative approach, which found no evidence. The Ramey military news shock distribution was shown to be dominated by very large positive shocks, whereas the recursive identification scheme used by Auerbach and Gorodnichenko (2012a) had positive and negative shocks evenly distributed (this distribution is by construction). This hypothesis is given further support with the results of Ramey and Zubairy (2018), who used the Ramey news shocks in the recursive identification scheme and found support for state-dependent multipliers.

1.6.4 Summary of empirical approaches

The conclusion to draw from the discussion above is that while there might not be a consensus on the size of the government spending multiplier, there seems to be a consensus emerging in the fiscal shock identification literature. Developments in the identification debate suggest that accounting for the sign, size, distribution and timing of fiscal shock is quite important in the estimation of robust multipliers[104]. While the narrative approach is not free from criticism, the

[102] It is worth noting that there is a difference between the contributions of Auerbach and Gorodnichenko (2012), who use a smooth transition threshold, compared to Fazzari et al. (2015), who estimate a regime-changing threshold, so the threshold is not assumed a priori.

[103] It is worth noting that the fiscal impulse used by Afonso et al. was debt-to-GDP ratio, so no distinction was made between government spending or taxes. However, as a sensitivity analysis, they presented the impact multiplier for government consumption and investment expenditure.

[104] It is worth noting that a promising methodology that has received little attention is the input-output approach (Perotti, 2007; Nekarda and Ramey, 2011). As chapters 4 and 5 of this thesis aim to show, the input-output

fact that it has developed from a simple dummy variable approach into quantitative estimates of fiscal values means it is becoming preferred as the more convincing method of identifying fiscal shocks. The challenge now is to find easier ways to construct widely accepted government spending instruments like that of Romer and Romer (2010), an example of which is a government's response to natural disasters (Yang et al. 2012). Next I discuss some of the empirical results.

1.7 The multiplier effects of discretionary government spending

The aim of this section is to highlight the commonly cited results in the literature and areas of contention. I first present results that assumed the multiplier to be linear, an assumption that has been challenged with recent contributions that not only take into account the impact that the state of the economy has on the multiplier but also the sign of the fiscal impulse. In addition, I discuss results that argue that the multiplier is time-varying. The nonlinearity of the multiplier seems to be dependent on government spending instruments, so I also examine results that attempt to explain the differences between results obtained using defence and non-defence instruments. As expressed earlier, given that the financial crisis of 2008 spurred new contributions that exploit new government instruments at the local level, I discuss some of the key papers in this strand. I also present a brief summary of the small contribution from the sectoral and industry evidence.

1.7.1 Effects on the real economy: output, consumption, wages and other macroeconomic variables

The great recession of 2008 can certainly be credited with the explosion of research on the effect of fiscal policy on aggregate output. This explosion was not a surprise given the almost global coordination of many governments such as those of the OECD countries in implementing stimulus plans to address the decline in economic activities in their respective economies. While it was agreed that something needed to be done, it was also a very well documented fact that economists didn't agree on the multiplier effect of any such stimulus actions by governments. This section discusses briefly the evidence on the effect of an increase/decrease in government spending on economic activity and other macroeconomic variables. Tables 1.2, 1.3 and 1.4 show a small sample of commonly cited papers on the effect of shocks to government spending on output, consumption, interest rates, real wages, employment, exchange rates, net exports and trade balance; theoretical discussions highlight the importance of each variable in different capacities to impact the overall effect of an increase in government spending, meaning they are the commonly investigated variables in the literature. Each table shows the author of the study, the country(ies) of focus, the sample period, and the shock identification scheme used.

approach offers an alternative to understanding the effect of government spending at the disaggregated level.

The challenge with such summary tables is that, as expressed earlier, there are different types of multipliers reported and what is reported by each study differs, with the impact multiplier commonly reported and easily extracted from impulse response to fiscal shocks. For the purpose of this section, the cumulative multiplier is preferred and reported if available; if not, then the impact multiplier is reported. The tables are based on a structure used by Hebous (2011), and unsurprisingly the tables capture the same papers; nonetheless, new contributions that account for the state of the economy are presented in the following sections.

As reflected in tables 1.2, 1.3 and 1.4,much of the empirical literature tends to use a VAR to identify government spending shocks, with the most commonly used identification scheme that of Blanchard and Perotti (2002). In their seminal contribution, Blanchard and Perotti (2002) used a SVAR to estimate government spending multipliers for the US economy, concluding that a positive government spending shock increased both output and private consumption[105], with an output multiplier of 0.84. Even after accounting for identification schemes, what is evident from the literature and the sample studies in tables 1.2, 1.3 and 1.4 is that reported multipliers/effects on output and other macroeconomic variables tend to vary in sign and size by country, and while it can be a result of a multitude of factors, Corsetti et al. (2012)[106] and Ilzetzki et al. (2013)[107] provided empirical evidence that shows that the impact of government spending shocks very much depends on the country characteristics. Isolating one dimension at a time, Ilzetzki et al. (2013)[108] showed that fiscal multipliers for high debt countries was zero[109], and multipliers tend to be higher in industrial rather than developing countries, closed compared to open economies, and fixed rather than in flexible exchange rate regimes. Their results are similar to those of Corsetti et al. (2012), who found that exchange rate regime, public indebtedness, and health of the financial system (financial crisis) had an impact on the effects of government spending. Both studies were consistent with evidence presented by Favero et al. (2011), who showed that fiscal

[105]They also reported that investment decreased.

[106]They considered a panel of 17 OECD countries.

[107]They used a panel of OECD and emerging market countries. Chian Koh (2017) showed that the result of Ilzetzki et al. (2013) is sensitive to the country sample included in the analysis. He showed, using a sample of 120 countries, that ‘fiscal multipliers in countries that are relatively open to trade are not smaller than their closed counterparts ... the increase in private consumption more than offsets the decline in net exports’ due to import leakages (it is worth noting that the 16th and 84th percentile values indicated that this impact could be zero, meaning an alternative explanation is needed for the open economies not having significantly smaller multipliers in Koh’s sample). In addition, countries with fixed exchange rate regimes did not have larger multipliers than those under flexible exchange rate regimes, a result which can be attributed to the lack of evidence of an accommodating monetary policy stance, a key ingredient needed for a larger multiplier under a fixed exchange rate regime. The main takeaway from the above is that while it is useful to group countries to examine key characteristics that influence the size of the multiplier, it doesn’t negate the need to look at specific countries because by definition an average behaviour is not replicated across all countries, i.e. it is not readily the case that private consumption can fully offset import leakages in all open economies. In addition, the average behaviour changes with sample size and composition.

[108]Due to data limitations, they did not include tax revenues or any other tax variables in their SVAR, so there are likely biases in their results because an important part of fiscal policy is ignored.

[109]With long-run negative multipliers. They reported that a sovereign debt ratio 60% of GDP was a critical threshold.

Table 1.2: Empirical evidence on the effects of a 1% increase in government spending on output, consumption, real wages and employment

Study	Country	Sample	Identification	Y	C	L	w
Bénétrix (2012)	11 EU Countries (a)	1970–2006	RVAR	0.91			+
Bilbiie et al (2008)	US	1957–1979	RVAR	1.71	+		
		1983–2004	RVAR	0.94	+		
	US	1947–1995	NAR	+	=	+	-
Caldara and Kamps (2008)	US	1955–2006	RVAR	1	+	=	
		1955–2006	BP	1	+	=	
		1955–2006	SRVAR	ca 0.5	=	=	
		1955–2006	NAR	0	+	=	
De Castro and De Cos (2008)	Spain	1980q1–2004q4	BP	1.31	+	+	
Dungey and Fry (2009)	New Zealand	1983–2006	SRVAR	-	+		
Edelberg et al. (1999)	US	1948q1–1996q1	MILVAR	1.2	-	+	-
Fatas and Mihov (2001)	US	1960–1996	RVAR	0.3	+	+	
Lorusso and Pieroni (2017)	US	1960–2010	BP–Civilian		+		+
		1960–2010	BP–Military		-		-
Pappa (2009a)	USA (a)	1969–2001	SRVAR	+		+	+
Pappa (2009b)	Canada	1970–2007	SRVAR	0.18	+	+	+
	EU aggregate	1991–2007	SRVAR	0.16	+	+	+
	Japan	1970–2007	SRVAR	0.13	+	+	+
	UK	1970–2007	SRVAR	0.13	+	+	+
	US	1970–2007	SRVAR	0.74	+	+	+
Perotti (2007)	Canada	1947–2005	BP			-	
	UK	1947–2005	BP			-	
	US	1947–2005	BP			+	
Ramey (2011a)	US	1947–2003	NAR	ca 1	-	+	
Ramey and Shapiro (1998)	US	1947–1996	NAR	ca 1	-	=	

Source: Authors, based on reported multipliers from respective papers, but table structure is based on Hebous (2011).

Notes: The table includes both cumulative and impact responses of output and other variables to a government spending or consumption shock (please see corresponding study for definition of spending). '+' indicates a positive effect, '-' indicates a negative effect, and '=' indicates no effect. An empty field in the table indicates the study does not present effects on that variable. Y= output, C = consumption, L = employment, w = real wages, BP = Blanchard and Perotti shock identification scheme. RVAR = Recursive VAR shock identification scheme. SRVAR = Sign restrictions VAR shock identification scheme. NAR = Narrative approach. Samples are in quarterly intervals unless assigned with (a) which means annual data was used.

multipliers varied due to public debt dynamics[110], styles of fiscal corrections[111], and degree of economic openness.

As expressed by Hristov (2012), 'the fascination with the size of the multiplier is related to the predictive power of this simple metric regarding how fast the economy may grow following fiscal stimulus actions and whether some form of direct crowding-out may be taking place. Leaving aside normative analysis considerations, the general assumption is that the larger is the multiplier, the more beneficial is the discretionary stimulus. Multipliers as a metric are not very eloquent on the consequences for overall welfare. That is, whether output increases caused by activist fiscal policy are desirable or not needs to be evaluated by other means.' Turning to

[110] The path of debt-to-GDP ratios.

[111] Historical correlation between shifts in taxes and in spending.

Table 1.3: Empirical evidence on the effects of a 1% increase in government spending on output, consumption, real exchange rate, net export and trade balance

Study	Country	Sample	Identification	Y	C	E	NE	T
Blanchard and Perotti (2002)	USA	1960–1997	BP	0.84	+		-	
Beetsma et al. (2008)	14 EU countries (a)	1970–2004	RVAR	1.2		+	-	
Bilbiie et al. (2008)	USA	1957–1979	RVAR	1.71	+			
		1983–2004	RVAR	0.94	+			
Corsetti et al. (2012)	17 OECD countries	1975–2008	Mimic BP	0.7	=		-	
Gali et al. (2007)	US	1948–2003	BP	0.51	+			
		1954–2003	BP	0.78	+			
		1954–2003	BP	0.91	+			
Ender et al. (2011)	US	1975q1–2005q4	BP/SRVAR		=	+		
Hall (2009)	US	1930–2008	OLS–Mil	0.55	-			
Ravn et al. (2007)	4 OECD countries	1975–2005	BP	0.52	+	-	-	
Monacelli and Perotti (2006)	Australia	1975q1–2006q2	BP	0.4	+	-	-	-
	Canada	1975q1–2006q2	BP	-0.3	+	-	=	-
	UK	1975q1–2006q2	BP	0.6	+	-	-	-
	US	1975q1–2006q2	BP	0.1	+	-	-	-
Müller (2008)	US	1973–2003	RVAR		=		+	+
Tenhofen et al. (2010)	Germany	1974–2008	BP	0.83	+			

Source: Authors, based on reported multipliers from respective papers, but table structure is based on Hebous (2011).
Notes: The table includes both cumulative and impact responses of output and other variables to a government spending or consumption shock (please see corresponding study for definition of spending). '+' indicates a positive effect, '-' indicates a negative effect, and '=' indicates no effect. An empty field in the table indicates the study does not present effects on that variable. In the case of real exchange rate, a negative sign means a depreciation. Y= output, C = consumption, E = Real exchange rate, NE = Net export. T = Trade balance. BP = Blanchard and Perotti shock identification scheme. RVAR = Recursive VAR shock identification scheme. SRVAR = Sign restrictions VAR shock identification scheme. NAR = Narrative approach. OLSMil = Ordinary least square using military spending series. Samples are in quarterly intervals unless assigned with (a) which means annual data was used.

Table 1.4: Empirical evidence on the effects of a 1% increase in government spending on output, consumption, nominal interest rate, and private investments

Study	Country	Sample	Identification	Y	C	In	Inv
Afonso and Sousa (2012)	US	1970q3–2007q4	RVAR		+		+
	UK	1971q2–2007q4			+		-
	Germany	1979q2–2006q4			-		-
	Italy	1986q2–2004q4			-		-
Afonso and Sousa (2011)	Portugal	1978q1–2007q4	RVAR	-0.2	-		-
Barro and Redlick (2011)	US	1939–2006	OLS-Defence	0.6			
Biau and Girard (2005)	France	1978q1–2003q4	BP	1.4	+		+
Caldara and Kamps (2008)	USA	1955–2006	RVAR	1	+	=	
		1955–2006	BP	1	+	=	
		1955–2006	SRVAR	ca 0.5	=	=	
		1955–2006	NAR	0	+	=	
Corsetti et al (2012)	17 OECD countries	1975–2008	Mimic BP	0.7	=	+	
De Castro and De Cos (2008)	Spain		BP	1.31	+		
Dungey and Fry (2009)	New Zealand	1983–2006	SRVAR	-	+	+	
Edelberg et al. (1999)	US		MILVAR	1.2	-	-	
Enders et al. (2011)	US	1975q1–2005q4	BP/SRVAR			+	
Fatas and Mihov (2001)	US	1960–1996	RVAR	0.3	+	+	+
Favero and Giavazzi (2007)	US	1960–1976	BP	0.127		-	
		1980–2006	BP	0.056		-	
Giordano et al. (2007)	Italy	1982q1–2004q4	BP	0.6	+		+
Ilzetzki et al. (2013)	Developed countries	See paper	BP	0.66			
	Developing countries			0			
	Flexible exchange			-0.69	-	+	
	Fixed exchange			1.4	+	-	
	Closed economy			1.1			
	Open economy			0			
	High debt			-3			
	Low debt			0			
Mountford and Uhlig (2009)	US	1955–2000	SRVAR	0.44	=	=	-
Perotti (2005)	Australia	1980–2001	BP	0.21	+	+	
		1960–1979	BP	-0.1	+	-	
	Canada	1980–2001	BP	-0.28	-	+	
		1960–1979	BP	0.59	+	+	
	Germany	1975–1989	BP	0.4	-	-	
		1960–1974	BP	0.41	-	+	
	UK	1980–2001	BP	-0.2	-	+	
		1960–1979	BP	0.48	+	+	
	US	1980–2001	BP	0.31	+	+	
		1960–1979	BP	1.13	+	-	
Ramey (2011a)	US	1947–2003	NAR	CA 1	-	+	
Ramey and Shapiro (1998)	US	1947–1996	NAR	CA 1	-	-	-

Source: Authors, based on reported multipliers from respective papers, but table structure is based on Hebous (2011).
Notes: The table includes both cumulative and impact responses of output and other variables to a government spending or consumption shock (please see corresponding study for definition of spending). '+' indicates a positive effect, '-' indicates a negative effect, and '=' indicates no effect. An empty field in the table indicates the study does not present effects on that variable. Y= output, C = consumption, In = Nominal interest rate. Inv = Private investment. BP = Blanchard and Perotti shock identification scheme. RVAR = Recursive VAR shock identification scheme. SRVAR = Sign restrictions VAR shock identification scheme. NAR = Narrative approach. Samples are in quarterly intervals unless assigned with (a) which means annual data was used.

the 'other means', more specifically the effect of government spending shocks on consumption, tables 1.2, 1.3 and 1.4 capture a major source of contention in the literature. Given the size of the private consumption component of GDP, it is widely accepted that the response of private consumption of fiscal policy changes is vital in the transmission mechanism of any fiscal stimulus. Thus, any factor that can change the consumption behaviour of private individuals in the face of a change in fiscal policy is very important.

Tables 1.2, 1.3 and 1.4 all include the response sign of consumption for each of the studies that reported the impact of government spending on private consumption. A pattern that emerges is that studies that use defence instruments tend to report a negative impact, while non-defence instruments tend to report a positive impact. Possible explanations behind these differences are explored in section 1.7.3, but the general take is that both instruments have different profiles so shouldn't be expected to have similar impacts. It is common in the literature to have the shock identification scheme cited as the source of the opposite results, as shown by the results of Ramey (2011a), who argued that timing plays a major part in reaching the private consumption conclusion of Blanchard and Perotti (2002). If the timing of news about positive government spending is captured by the narrative approach used by Ramey, then positive government spending generates a decline in private consumption. Nonetheless, Lorusso and Pieroni (2017) who, using the Blanchard and Perotti identification scheme, presented results which suggest civilian spending had a positive effect on real wages and consumption[112], while government military spending had a negative effect on wages and consumption[113]. The results presented by Marattin and Salotti (2011), who provided evidence on the importance of differentiating government expenditure, suggests that an interesting avenue worth exploring is differentiating between the wage and non-wage component of military spending and whether that has an impact on the reported results. Using annual data for the EU area that covered the period from 1970 to 2006, they reported a persistent positive effect of government expenditure on consumption, with a multiplier of 0.32%. Separating government expenditure into wage and non-wage components, they found that shocks to both components had a positive impact on consumption, but showed that the impact of a 'government wage shock on private consumption is approximately six times bigger than the shock of non-wage expenditure (with similar persistence)', concluding that public salaries have a relatively stronger stimulating role (p. 9). So it is possible that the non-wage component of defence spending is a drag upon the reported impact on private consumption.

The empirical results for labour market variables captured in table 1.2 show that, on balance, employment increases after an increase in government spending; however, results presented by Perotti (2007) for Canada and UK suggest employment actually decreases, a result which doesn't match those presented for both countries by Pappa (2009b). An important difference to note is

[112]Civilian expenditure consumption multipliers of +0.06, +0.36, +0.82 and +1.01 (1st, 4th, 8th and 12th quarter).

[113]Military expenditure consumption multipliers of 0.09, 0.11, 0.10 and 0.08 (1st, 4th, 8th and 12th quarter).

the impact of government spending increase on real wages. Results presented in table 1.2 show that the narrative approach which relies on military expenditure tends to suggest real wages decreasing, but papers that use VAR tend to present results which suggest real wages increasing. These results, just as with the case of private consumption discussed above, further highlight the need to understand the profile differences of military and non-military spending series.

Table 1.3 captures results from a sample of papers that have examined the impact of government spending on real exchange rates, net exports and trade balance. The paper by Monacelli and Perotti (2006) examined all three variables and suggests that, except in the case of net exports for Canada, an increase in government spending has a negative impact on exchange rates. This means a depreciation in the real exchange rate, a result which is not consistent with both theoretical predictions of standard Keynesian and NK models. Their results, which suggest both a negative impact on net exports and trade balance, is not replicated for example by Muller (2008) for the US, thus suggesting that there is still a consensus to be reached on the impact an increase in government spending has on external sector variables. Empirical papers that examine the impact of government spending on trade balance sometimes consider this impact in the context of the ‘twin deficit hypothesis’. This hypothesis simply argues that both government deficit and the economy’s current account move in the same direction, thus an increase in government spending would have a negative effect on both variables. The results for the hypothesis are mixed; for example, Beetsma et al. (2008) provided supporting evidence for the hypothesis for a panel of European countries, Monacelli and Perotti (2010) found support for the US, but their result for the US is not replicated by Corsetti and Muller (2006) and Kim and Roubini (2008), who found no support for the hypothesis.

Given the debate surrounding the impact of an interest rate increase on private spending, it is worth looking briefly at the reported effects on interest rates. As table 1.4 shows, the majority of studies indicate that interest rates tend to rise with an increase in government spending, consistent with theoretical predictions[114], although the results for the US are quite mixed. This result is quite important because the impact government spending has on investment is often argued through crowding in/out due to changes in interest rates and cost of capital, although Arestis and Sawyer (2003) cite multiple evidence to argue that the cost of capital is weakly related to private investment. There are significant amounts of empirical literature arguing that more important factors are at play when it comes to investment decisions. Gilchrist and Himmelberg (1998, p. 1) expressed that ‘it is well recognised that financial variables such as cash flow and cash stocks are robust and quantitatively important variables for investments’ (see also Gilchrist and Himmelberg, 1995; Kadapakkam et al., 1998), but even if we take the argument that expansionary government spending causes an increase in interest rates, the conclusion reached by Chirinko (1993, p. 1,881) that ‘output (or sales) is clearly the dominant determinant

[114]It is worth noting that not all theoretical perspectives assume an increase in interest rates due to some market forces. As highlighted by Fontana (2009), any increase in interest rates is due to the action of a monetary authority not accommodating to an expansionary fiscal policy.

of investment spending' indicates that the interest rate channel matters less. Nonetheless, the evidence provided by Alesina et al. (2002), who argue that government spending can put upward pressure on private sector wages and in doing so depress profits, and ultimately depress investment, suggests there are other channels with which expansionary government spending can impact investment. With these arguments, table 1.4 also captures a few papers that have examined the impact of government spending on investment, and what it indicates unsurprisingly is that the result is mixed across countries, with the impact positive and negative. Interestingly, for the US, Shapiro and Ramey (1998) and Mountford and Uhlig (2009) presented evidence which suggests an increase in government spending had a negative impact on investment, but Fatas and Mihov (2001) and Afonso and Sousa (2012) reported positive effects, so the mixed result is not just a cross-country issue.

To conclude this section, we might summarise some of the key results from tables 1.2, 1.3, and 1.4 presented above. What they capture is the lack of consensus in the empirical literature on the impact government spending has on key macroeconomic variables; the tables show that the output multiplier can range from -3 for high debt countries[115] to 1.7 for the US, though the multiplier for the US appears to be around 1 in recent periods. Additionally, for countries other than the US, empirical evidence seems to suggest the multiplier is below 1 for most. What the results presented in the tables don't capture is the possibility that the size and sign of the government spending multiplier could be dependent on the state of the economy, and recent contributions to the literature show that this assumption is too restrictive, so the multiplier presented in these tables are average multipliers for all sample periods in each paper. Next, results from papers that account for the nonlinearity of the multiplier are discussed.

1.7.2 State of the economy and the sign of the fiscal impulse

'*The boom, not the slump, is the right time for austerity at the Treasury*'

J. M. Keynes (1937)

Until recently, most empirical models assumed linearity in multipliers and used linear models for the entirety of sample periods, but the financial crisis of 2008 revived interest in the nonlinearity of fiscal multipliers, i.e. government spending can be more effective in some periods than others. Recent contributions have become less restrictive in assuming a linear multiplier across different states of the economy, so fewer restrictions are placed on the impulse response function of macroeconomic variables, meaning responses are allowed to be dependent on the size and sign of the fiscal shock. In this section, I discuss first the results from papers that solely take into account the state of the economy, after which I discuss results which also account for the sign of the fiscal impulse. Table 1.5 presents some examples of the results.

[115] As expressed earlier, the results presented by Ilzetzki et al. (2013) are sensitive to sample countries. Chian Koh (2017) presented a multiplier of 0.4 for high debt countries, so the lower bound of a multiplier is close to -0.2 if based on the results of Chian Koh (2017).

Table 1.5: State of the economy and fiscal multiplier

Study	Country	Period	Identification	Threshold Variable	Multipliers Slack	Expansionary	Linear
Afonso et al. (2018)	US (impact)	1980q4–2014q1	RVAR	Financial stress	1.397	0.568	
	US	1980q4–2014q1			0.167	0.052	
	UK	1980q4–2014q1			0.555	0.083	
	Germany	1980q4–2014q1			0.526	0.215	
	Italy	1980q4–2014q1			1.356	0.233	
Auerbach and Gorodnichenko (2012a)	US (total spending)	1947q1–2008q4	RVAR	Output growth	2.24	-0.33	0.57
	US (defence)				1.67	-0.43	-0.21
	US (non-defence)				1.09	1.03	1.58
	US (consumption)				1.47	-0.25	1.2
	US (investment)				3.42	2.27	2.39
Auerbach and Gorodnichenko (2012b)	OECD countries		RVAR	Output growth	2.3	0.00	
Bachmann and Sims (2012)	US	1960–2011	RVAR	GDP	2.67	0.78	0.2
Berncardini and Peersman (2015)	US	1928q1–2013q4	Ramey news	Private debt	2.05	0.62	0.7
		1947q1–2013q4			1.59	0.17	
		1928q1–2013q4	RVAR		3.93	0.69	0.68
		1947–2013			1.84	0.3	
Biolsi (2017)	US	1947–2013	Ramey News	Unemployment	0.83–2.46	0.70–0.78	
Fazzari et al. (2015)*	US	1967q1–2011q1	RVAR	Capacity utilisation	1.6	0.8	
Mencinger et al. (2017)	EU	1995–2014	RVAR	Output growth	3.62	*0.26*	1.76
	EU–core				2.1	*0.88*	1.56
	EU–accession				4.32	-0.76	1.77
	OECD	1980–2014			2.28	0.08	1.03
Owyang et al. (2013)	US	1890q1–2010q4	LP–Mil	Unemployment	0.76	0.72	0.72
	Canada	1921q1–2011q4			1.6	0.44	0.67
Ramey and Zubairy (2018)	US	1889–2013	LP–Mil	Unemployment	0.78	0.69	0.76
Riera-Crichton et al. (2015)	29 OECD countries	1986–2008	LP	Output growth	-0.79*	0	*~0.4*
	Extreme recession				-1.23**	0	

Source: Author's, based on reported multipliers from respective papers.
Notes: The table captures cumulative, unless stated (please see corresponding study for definition of spending). Italic captures multipliers not statistically different from zero * peak multiplier. LP = Local Projection. LP-Mil = Local Projection with miltary spending. RVAR = Recursive VAR shock identification scheme.

In a very influential article, Auerbach and Gorodnichenko (2012a)[116] estimated a regime-switching SVAR model to investigate if fiscal multipliers differ across recessions and expansions. Using a moving average of output growth as the threshold variable to determine recessionary and expansionary periods for the US, they estimated a peak multiplier[117] for government spending[118] of 2.5[119] in recessions and 0.6 in expansions. More interestingly, their estimated cumulative multiplier showed that government spending had zero effect on output during an expansionary period and can actually become negative after two years. In a follow-up study,

[116]Batini et al. (2012) carry out a similar regime-switching analysis using quarterly data for the United States, Europe and Japan. Their findings broadly confirm these results. They conclude that fiscal consolidation or austerity measures should be smooth and gradual, emphasising that maintaining growth is key to lowering public debt levels.

[117]The impact output multiplier for both regimes is about 0.5, slightly below that estimated for the linear model.

[118]Consumption and investment.

[119]Auerbach and Gorodnichenko point out that this estimate should be regarded as an upper bound because of their assumption that regimes do not change themselves after a government spending shock. When they instead allow for a more general model specification that allows for regimes to change endogenously, they find the multiplier in recession to be between 1.0 and 1.5. Their results are not consistent with studies of military news shocks, as explained further in the section and shown by Ramey and Zubairy (2018) who questioned correctly the assumption made by Auerbach and Gorodnichenko (2012) that recessions last at least five years. Showing that the difference in results reported by both papers was not due to methods but the assumption made about the length of recessions, where Ramey and Zubairy assumed the average recession lasted three quarters and no recession lasted more than a couple of years. Alloza (2017) also showed that by reducing the moving average of GDP growth used by Auerbach and Gorodnichenko from seven quarters to five, then the result is reversed with multipliers during recessions being negative.

Auerbach and Gorodnichenko (2012b) examined a cross-panel sample of OECD countries and reported effects on output qualitatively consistent with those of their initial paper. They also found that in a recessionary period, an increase in government spending increased real private consumption, but reported consumption being crowded out in expansions. Real wages also increased in recessionary regimes, but remained largely unchanged in expansionary regimes. Increases in government spending also lead to higher total employment in the recessionary regime, driven largely by private sector employment; the response of employment in the expansionary period is close to zero and not statistically different from zero[120].

The panel data approach used by Auerbach and Gorodnichenko (2012b) is very useful in addressing the data availability issue, but since it is in effect providing average multipliers across countries, it can easily mislead readers into thinking that there is no heterogeneity in the effects. Baum et al. (2012)[121] explored the possible heterogeneity across countries that were not explored by Auerbach and Gorodnichenko (2012b). Using a regime-switching Threshold Vector Autoregressive model (TVAR)[122], Baum et al. (2012) showed that the state of the economy affected the impact government expenditure had on output in a sample of G7 countries[123], with multipliers larger in downturns than in expansion[124]. However, this larger effect was not reported for all; in Germany, Japan and US, spending shocks had a larger effect in downturns, while for the UK multipliers were small in both economic states. Their estimated cumulative multipliers for the average of the G7 economies (excluding Italy), constructed with a linear model for the whole sample, showed that the spending multiplier is very similar to the multipliers reported for expansionary periods using the regime-switching model and almost half the size of the multiplier for recessionary periods.

In addition to reporting qualitatively consistent results as those already mentioned, the results presented by Biolsi (2017) suggest allowing for a flexible threshold rather than a fixed threshold, with the difference between multipliers in good and bad times becoming more statistically significant as the threshold increases[125]. Interestingly, the multiplier breaches unity around an unemployment threshold of 6%, so fiscal stimulus becomes effective once it has breached a

[120] In one of the early papers to explore this avenue empirically, Tagkalakis (2008) used a simple theoretical model to argue that a 'fiscal expansion would generate a stronger response of private consumption in bad times compared to good times' with the difference dependent on the number of liquidity-constrained individuals (individuals are more liquidity-constrained in bad times). Using a panel of 19 OECD countries for the period 1990 to 2002, he empirically showed that government spending has a more pronounced positive effect on consumption in economic slumps than in booms.

[121] Their approach determines the threshold value endogenously compared to exogenously in the Auerbach and Gorodnichenko system.

[122] A nonlinear TVAR separates observations into different regimes using a threshold variable, e.g. output gap, output growth, unemployment rate, debt-to-GDP ratio, real interest rate or capacity utilisation.

[123] Canada, France, Germany, Japan, the UK and the US.

[124] This conclusion is consistent with the general conclusion of Batini, Callegari and Melina (2012), who presented evidence that showed the cumulative multipliers at one and two years were larger during recessions than expansion for the Euro area, France, Italy, Japan, and the US.

[125] Setting the unemployment rate threshold of 5.1%, the multiplier in the bad state was estimated to be 0.44, with a threshold of 6% it rises above 1, and at 6.5% the multiplier was above 2. In a good state, setting the threshold between 4.0% and 4.5%, the multiplier was about 0.5. (multipliers calculated for a two-year horizon).

threshold, though the question naturally becomes what that threshold is and if it changes over time. Also, while the nonlinear impulse response function is dependent on the sign and size of the fiscal policy, there is yet to be a contribution that tests different government demand size, so instead of testing out different threshold levels as done by Biolsi (2017), different government demand size should be tested.

This strand of the literature tends to also use different threshold variables; nevertheless, the conclusions reached by the aforementioned papers of larger multipliers in recessions are qualitatively consistent with other papers. Fazzari et al. (2015), after considering multiple threshold variables, used the mean-adjusted first lag of capacity utilisation and reached similar conclusions for the US as the aforementioned papers. They showed that while a government spending shock increases output in both high- and low-utilisation regimes, they concluded that 'the effects of government spending on output are larger and more persistent when capacity utilisation is low'[126](p. 15). They also showed that the response of consumption to a government spending shock is positive in both regimes with the effect much larger in a low-utilisation regime. What is also different with the contributions of Fazzari et al. (2015) and the aforementioned papers is that they account for the sign of fiscal impulse (negative/positive), and as shown by more recent contributions such as those by Barnichon and Matthes (2017) and Baum et al. (2012), accounting for the sign of fiscal impulse proves to be quite important for the reported fiscal multiplier. These results are presented in table 1.6, but before discussion of these, it is worth noting that these results are related to the expansionary contraction hypothesis[127], where it is argued that the government can stimulate the economy by reducing its spending, i.e. a negative multiplier. What the results from the table suggest is that the state of the economy is a key factor for the impact of a negative fiscal shock (fiscal consolidation) on the economy. The comparison of results provided by Jorda and Taylor (2016)[128] makes it quite clear that the worst time to implement fiscal consolidation is during a slack, regardless of the methodology. However, the impact of fiscal consolidation during expansion is not so clear given that the results of Jorda and Taylor (2016), Mencinger et al. (2017) and Riera-Crichton et al. (2015) suggest the effects are not significantly different from zero, but those presented by Batini et al. (2012), Baum et al. (2012) and Barnichon and Matthes (2017) suggest otherwise, with the impact negative in most cases. What the sets of results suggest is that while we can generally conclude that a recession

[126]The output response peaks after two years: low state (1.6) and high state (0.8).

[127]There are two main routes with which fiscal contraction can be expansionary: the consumption decisions of households and investment decisions of firms. Although most recent contributions to the expansionary fiscal contraction literature are empirical analysis, which is discussed in chapter two of this thesis, there have also been recent contributions to the theoretical debate to address factors commonly overlooked in the empirical literature. Opponents of this view point rightly to the fact that this hypothesis is derived from RET, and as such, most contributions by opponents to this hypothesis tend to be focused on criticising the assumptions behind the hypothesis (e.g. Demopoulos and Yannacopoulos, 2012; Boyer, 2012). Nonetheless, as shown by Foresti and Marani (2014) and Botta (2015), the debate can move beyond criticisms to alternative theories that not only show that fiscal contraction can indeed have expansionary effects, as stated by Alesina (2010), but also highlight scenarios when this is possible, even if these scenarios are extreme, very specific and uncertain.

[128]They compared results presented by Alesina and Ardagna (2010), who argue that fiscal contraction can be expansionary, against results presented by Guajardo et al. (2014), who show fiscal contraction to be contractionary.

is the worst time to pursue fiscal consolidation in the spirit of Keynes (1937), there is much to be done to understand the mixed results reported for an expansionary period. Nonetheless, during expansionary periods, there seems little evidence in support of non-Keynesian effects of fiscal contraction in the medium to long run.

Table 1.6: Sign of fiscal impulse and the output effects

				State-dependent multiplier			
				Positive shock		Negative shock	
Study	Country	Period	Approach	Slack	Expansionary	Slack	Expansionary
Barnichon and Matthes (2017)	US	1966–2014	RVAR	0.1	0.3	-2.1	-0.9
			NARVAR	0.5	0.6	-2.7	-1.5
Batini et al (2012)	Euro area	1985q1–2009q4	RVAR			-2.49	-0.07
	Italy	1981q1–2007q4				-1.78	-0.46
	France	1970q1–2010q4				-1.79	-1.88
	Japan	1981q1–2009q4				-2.01	-1.09
	US	1975q1–2010q2				-2.17	0.49
Baum et al. (2012)	Canada	1966q1–2011q2	RVAR	-0.9	-0.7	0.9	0.7
	France	1970q4–2010q4		0.1	-0.1	-0.1	0.1
	Germany	1975q3–2009q4		0.8	0.1	-1.2	-0.2
	Japan	1970q1–2011q2		2.4	1.9	-2	-1.7
	UK	1970q1–2011q2		0.1	0	-0.1	0
	US	1965q2–2011q2		1.2	1	-1.3	-1
Jorda and Taylor (2016)	17 OECD countries	1978–2009				-3.54	*-1.80*
	Guajardo et al. sample		Narrative			-3.35	*-1.36*
	Alesina & Ardagna sample		Fiscal rule			-0.98	*-0.02*
Mencinger et al. (2017)	EU	1995–2014	Recursive	2.4	*0.2*	*~-0.4*	*~-0.3*
	28 OECD countries	1980–2014		1.97	*~-0.9*	*~-1.1*	*~-0.9*
Pragidis et al. (2018)	US	1973q1–2014q3	RVAR	1.19	0	-1.79	0
Riera-Crichton et al. (2015)	29 OECD countries	1986–2008	LP	2.28	1.13	-0.79*	0
	Extreme recession			3.14	0	-1.23**	0

Source: Authors, based on reported multipliers from respective papers.
Notes: The table captures cumulative, unless stated (please see corresponding study for definition of spending). *The multiplier reaches the peak of 0.79 after 1 semester, but becomes insignificant after the 2 semester. ** The result is reported to be borderline not significant. Italic captures multipliers not statistically different from zero. RVAR = Recursive VAR shock identification scheme. NARVAR = Narrative VAR shock identification scheme. LP = Local Projection.

It is worth noting that results presented by papers using the identification method similar to Auerbach and Gorodnichenko (2012a) are not consistent with studies that use military news shocks, further highlighting the crucial role identification schemes play in the fiscal literature. Using the unemployment rate to separate observations into slacks and expansion for the US and Canadian economy, Owyang, et al. (2013) examined the effects of military spending news[129] shocks on output during expansions and slacks. They found multipliers to be substantially higher during periods of slack for Canada[130], but they did not observe the same for the US[131]. Similar results for the US were also reported by Ramey and Zubairy (2018)[132], who used military news and the Blanchard and Perotti shock method to provide evidence that the US spending

[129]'News' is the change in the expected present value of government spending caused by military events.

[130]Reported peak and two-year cumulative multiplier for slack [0.65, 1.60] and expansion [0.49, 0.44].

[131]Reported peak and two-year cumulative multiplier for slack [0.83, 0.76] and expansion [0.93, 0.72].

[132]It is worth noting that it is difficult to fully compare estimates from both studies given that Ramey and Zubairy (2018) highlighted that not all periods in a recession encompass high unemployment given that it captures unemployment rising from its low point to its high point. Thus, if we take the definition that only a high level of unemployment indicates a state of slack, then comparing both studies can be misleading.

multipliers are not state-dependent, as they highlighted: 'we find no evidence of sizeable multipliers in the periods of slack; the differences across states for the [Blanchard and Perotti] shock stem from multipliers being so low during non-slack states'[133]. Unlike the results presented by Biolsi, considering different threshold levels had no effect on their baseline result. It is striking that when military news shocks are used in a recursive identification scheme, then there is some sort of support for state-dependent multipliers. In addition, the results presented by Barnichon and Matthes (2017)[134] about the importance of accounting for the positive and negative shock composition of defence and non-defence spending suggests another explanation to that given by Ramey and Zubairy (2018).

Turning the focus more on variables such as consumption and investment, what recent contributions show is that the state of the economy matters for these other variables. As mentioned earlier, Auerbach and Gorodnichenko (2012b)[135] showed for the sample of OECD countries that private consumption tends to be crowded out in expansion, but this is not the case in a recession as private consumption is stimulated with quite a high multiplier of up to 2.8[136]. For investment, the impact was positive during a recession with a multiplier of 1.5, while a negative effect was reported during expansion with a multiplier of 1.4. They also reported a positive impact on inflation during expansion, and a negative impact during a recession[137]. However, their results did not distinguish between positive and negative fiscal impulses. Barnichon and Matthes (2017) showed that the response of consumption is negative to a negative spending shock, but the response is not significantly different from zero after a positive shock (for investment, an expansionary shock leads to a decline in investment, while a contractionary shock does not increase investment). Table 1.7 summarises the effects of accounting for the state of the economy and signs of fiscal impulse on other important variables based on results presented by Riera-Crichton et al. (2015). The table shows that government spending has no effect on consumption and investment during a boom, but inflation responds positively, a result which

[133] Also examining historical episodes of ZLB, they concluded that 'using military news, we see little difference in multipliers in the ZLB state', but using the Blanchard and Perotti shock they reported larger multipliers in ZLB compared to non-ZLB states (although they argued that the difference is due not to elevated multipliers in the ZLB but to multipliers estimated to be near zero in the non-ZLB state). By excluding the rationing period in WWII, they found differences across states with a multiplier estimate of 1.4 at ZLB, and 0.6 at the non-ZLB state when they used military news shock.

[134] They presented the hypothesis that differences in positive and negative shock composition between two competing identification schemes could explain the differences between VAR evidence that found support for economic state-dependent multipliers compared to the narrative approach which finds no evidence. The Ramey military news shock distribution was shown to be dominated by very large positive shocks, whereas the recursive identification scheme used by Auerbach and Gorodnichenko (2012a) had positive and negative shocks evenly distributed (this distribution is by construction).

[135] Pragidis et al. (2018) presented evidence that suggests a consumption increase in both regimes. Biolsi (2017) presented results which suggest that a multiplier above one during a recession is not due to an increase in private consumption of nondurable goods or services, but instead due to consumption of durable goods and non-residential investments. This view is contrary to the view that households tend to hold back spending on big ticket items during a recession.

[136] Worth noting that this result is for a deep recession and the reported multipliers were for over three years.

[137] They showed the impact of government spending on inflation to not be significantly different from zero in both regimes in the long run.

they acknowledge is 'consistent with simple Keynesian frameworks, where an increase in aggregate demand (in this case as a consequence of an expansionary fiscal shock) in situations of full employment has no impact on economic activity but increases inflation'. Their results also showed that when government spending is increased during a recession, the driving force behind the output effects are consumption and investments, with net exports and inflation declining. When government spending is reduced in a recession, results suggest consumption, investments and net exports all decline (again results consistent with a simple Keynesian model). However, the behaviour of these components when government spending is reduced in normal times is more consistent with neoclassical models, where it is argued that reduction in government spending crowds in private spending. Overall, what the evidence suggests is that not only is the state of the economy important in determining the impact of government spending on other macroeconomic variables, but the sign of the fiscal impulse is also a key factor.

Table 1.7: State of the economy and the effect of government spending on other macroeconomic variables

	Positive Shock		Negative Shock	
	Slack	Expansion	Slack	Expansion
Investment	+	=	-	=
Consumption	+	=	-	+
Net export	-	+*	-	+
Inflation	-	+	=	=

Source: Summary of results based on Riera-Crichton et al. (2015).
Notes: The table captures the results presented by Riera-Crichton et al. (2015) which shows that the state of the economy is not only important for aggregate output, but also for other macroeconomic variables. '+' indicates a positive effect, '-' indicates a negative effect, and '=' indicates no effect.
* very small effects reported.

To conclude this section, one can rely on the point presented earlier about the effects of fiscal policy dependent on why it is introduced and in what economic environment. While differences in reported multiplier size across model classes and types of government spending tools are generally expected, the differences reported across defence and non-defence spending instruments are still of major contention in the empirical literature, and this is discussed next.

1.7.3 Defence and non-defence instruments

Distinguishing between different types of government spending tools such as purchases and investment is very different from instrumenting for such spending because there is at least a qualitative consensus that multiplier sizes vary across types of government spending tools[138]. The literature on instrumenting for government spending is shaped by a defence and non-defence strand. While there is general consensus that an increase in government spending increases output, the reported magnitude tends to be different between defence and non-defence instruments,

[138]For example, Auerbach and Gorodnichenko (2012) showed for the US that multipliers for infrastructure spending and other types of public investment are larger than those for public consumption. See also the meta-analysis by Gechert (2013).

and it is not simply due to differences between narrative and non-narrative measures. For example, Yang et al. (2012) constructed a narrative instrument from government responses to natural disasters and showed that the reported multipliers were higher than those constructed using military news. In addition, studies that use standard fiscal VARs tend to report a rise in consumption and real wages, while studies that use military spending including those identified via a narrative approach generally tend to show that consumption and real wages fall (Ramey, 2011a). These differences are not only present at the aggregate level; as results presented in chapter four of this thesis show, defence and non-defence spending seem to have different impacts even at the firm level.

Instrumenting government spending with defence spending, Hall (2009) reports a multiplier of 0.5 and negative effect on consumption[139], Barro and Redlick (2011) report multipliers of 0.6 to 0.7[140], results which are consistent with Ramey (2011a), who uses a military spending instrument, reporting negative effects on both consumption and real wages. Although changes in defence spending are widely accepted to be exogenous to economic activity, thus representing good spending instruments, Hall (2009) argued that responses to this type of instrument can be biased downwards because studies don't take into account other factors that occur during periods of significant defence spending. Factors such as rationing and tax increases, which have an influence on private activity, are omitted from the multiplier calculations. Moving away from defence spending, as done by Fidrmuc et al. (2015) using natural disasters, other studies have exploited non-defence spending instruments, which in some cases were constructed using state- or regional-level data so it is difficult to reconcile it with aggregate-level evidence. Nonetheless, these studies tend to find larger output multipliers and positive effects on consumption and wages. I discuss these results in more detail in the next section, which explores local multipliers, but the general message here is that defence and non-defence instruments tend to suggest different multiplier sizes and the final part of this section looks at some further explanations as to why.

The discussion above highlights that there is still an ongoing debate on the differences in results obtained when using defence or non-defence spending instruments. The contribution of Woodford (2011) on the set-up of mainstream theoretical models was very valuable because it provided a simple analysis that was not just focused on discussing the assumptions of the neoclassical and NK models, but instead looked towards understanding why each model would predict the outcomes they do on the effects of an increase in government spending on output and other macroeconomic variables. Thus, the debate in the empirical literature shouldn't be on the fact that defence and non-defence spending generate different output multipliers and different qualitative effects on other macroeconomic variables. Instead, these differences should be expected and the debate should be why they generate such differences, as attempted by

[139]In a VAR setting, the output multiplier ranged from 0.5 to 1.0 and the effect on consumption was positive; the difference could be due to a downward bias in the simple regressions.

[140]Reported negative effect on consumption, although not statistically significantly different from zero.

Perotti (2014). Although he argued that defence spending shocks have contractionary effects while civilian spending shocks have expansionary effects[141], he did not provide a detailed reason why they have such effects other than: 'one plausible hypothesis is that spending on government employment and the remaining component of government spending (mostly purchases of goods) have different effects, and that defense and civilian spending shocks simply differ in the intensities of these two components' (ibid., p. 22), admitting that it is difficult to test the hypothesis. Nonetheless, the hypothesis can be seen as a starting point for more research into the area. For example, results presented by Barnichon and Matthes (2017) suggest that differences in the positive and negative shock composition between the government spending series could explain the differences. Taking into account the state of the economy, they showed that based on the specification of Auerbach and Gorodnichenko (2012a), an expansionary period multiplier was 0.27[142] and a contractionary period multiplier was 1.2. However, based on the Ramey (2011a) data, they estimated an expansionary period multiplier of 0.47 and a contractionary period multiplier of 1.56. Their results further highlight the importance of accounting for the state of the economy given that in this instance, defence spending has a higher multiplier because the fiscal shock is more likely to be positive than negative at a time when the economy most needs fiscal stimulus. This 'shock composition' hypothesis is given further support with the results of Ramey and Zubairy (2018), who used the Ramey news shocks in a recursive identification scheme and found support for state-dependent multipliers.

1.7.4 Local multipliers

TThe need to find instruments for government spending to address the shock identification problem has seen the growth of research in local (state/regional) multipliers because the argument is that 'sizeable components of the sub-national spending are provided by the federal/central government on a basis unrelated to the economic condition in the particular region' (Hristov, 2012, p. 15), so such government spending is seen as truly exogenous. Chodorow-Reich (2018) provides a good review of the cross-sectional fiscal spending multipliers literature, hence this section is a very brief summary of key results. What is worth noting from the outset is that a key aspect of this strand of the literature is how these local multipliers are translated into national multipliers, but as Chodorow-Reich (2018) argues, they can be seen as a 'rough lower bound for the closed economy, no-monetary-policy-response, deficit-financed aggregate multiplier', presenting a lower bound national multiplier of roughly 1.7 for the US.

While early contributions argue that these multipliers are not directly comparable with

[141] By dividing his sample period of 1939q1 to 2008q4 into samples that exclude major war events, he presented evidence that suggests that the composition of total government spending shocks (civilian vs defence) was important in explaining if the reported effects were contractionary or expansionary. Unsurprisingly, defence spending shocks were larger with the inclusion of major war periods, and with such inclusion the reported effect was contractionary; however, the reported effects using sample periods with higher levels of civilian spending starting from 1954 were expansionary.

[142] Twenty-quarter cumulative multiplier.

aggregate multipliers (Clemens and Miran, 2012)[143], the local multiplier studies are seen as very promising given that an increase in discretionary government spending in one region is not automatically or systematically mirrored in other regions, so we are able to investigate multiple contexts that can influence the impact fiscal policy has on economic activities. First, it allows the examination of the effects of fiscal policy in a monetary union, since monetary authorities are less likely to react to a regional increase in spending by the government; thus, by holding the monetary condition constant, we can explore the effects of an accommodating monetary policy in this setting. Second, we are also able to examine the effect of any such increase in spending funded not by the region that experienced the increase, but by other regions. Thus, changes in regional spending in this setting are windfall-financed, i.e. some regions receive more from the federal/central government and as a result other regions receive less, so regions that receive less are funding those that receive more (government spending at national level remains constant). Put differently, increases in spending are not tax or deficit financed.

Contributions to the literature tend to rely on different identification strategies, e.g. local variation in recognised government spending instruments such as military spending (Nakamura and Steinsson, 2014); constructing new instruments from state pension returns (Shoag, 2013); and constructing government spending due to natural disasters or errors in population estimates (Yang et al., 2012; Serrato and Wingender, 2016). In addition, other papers have examined various components of roughly \$800 billion of the ARRA[144] (Chodorow-Reich et al., 2012; Wilson, 2012), offering an opportunity to understand the impact of government spending during a period of slack and accommodating monetary stance[145]. Table 1.8 summarises some of the results from recent contributions to the literature and what it shows is that there is a significant variation in the estimate for the job per \$100K of government spending, so there is no consensus on the size, mirroring the aggregate multiplier literature. Nonetheless, what it shows is that government spending shocks increase both local income and employment, reporting multipliers generally higher than those from aggregate-level studies. As mentioned earlier, the contribution of Chodorow-Reich (2018) shows that it is possible to present a national equivalent of these local multipliers, so future contributions should attempt to provide both local and national equivalent multipliers. Next, I discuss a strand of the literature that hasn't received as much attention as other strands of the literature: the current evidence on the sectoral and industry impact of government spending.

[143] Farhi and Werning (2012) showed in a NK model that large local (windfall-financed) multipliers do not imply large multipliers in other settings, and Dupor (2016) presented that 'local multiplier estimates alone do not provide useful information about the aggregate effects of policy', so this strand of the literature still needs to develop ways to tie local multipliers to aggregate multipliers.

[144] The American Recovery and Reinvestment Act (ARRA) was a response to the financial crisis of 2008. It included new spending, transfers, and tax reductions totalling roughly \$800 billion.

[145] Nakamura and Steinsson (2014) used the fact that US military build-ups resulted in different allocations of federal resources across states to construct a spending instrument. Serrato and Wingender (2016) used the knowledge that federal spending at local level is tied to population size to construct their spending instrument. Shoag (2013) used investment returns earned by public pension plans to extract exogenous government spending.

Table 1.8: Local multipliers

Study	Income/Output	Jobs
Acconcia et al. (2014)	1.5	
Chodorow-Reich et al. (2012)		3.8
Chodorow-Reich (2017)		1.99
Clemens and Miran (2012)	0.29*	
Dupor (2016)	0.38	0.73
Fishback and Kachanovskaya (2010)	0.96***	
Nakamura and Steinsson (2014)	1.43	1.28
Serrato and Wingender (2016)	1.7–2	3.25
Shoag (2013)	1.43	4.5
Wilson (2012)		0.8**

Source: Author's, based on reported multipliers from respective papers.
Notes: Table captures cumulative, unless stated (please see corresponding study for definition of spending). Jobs column captures jobs created per $100K government spending. Nakamura and Steinsson (2014) and Dupor (2016) capture employment multiplier. * impact multiplier. ** Chodorow-Reich (2017) showed that by taking into account other spending then this becomes 1.75. *** Multiplier excludes transfer payments.

1.7.5 Sectoral and industry evidence

The literature on the sectoral and industry effects of fiscal policy is interested in assessing, for example, the short-run effect on the output, employment and wage dynamics of a sector or industry due to a change in discretionary government spending or taxation[146]. Beetsma (2008) rightly expressed that 'fiscal expansion designed to stimulate the economy may have different effects on different sectors of the economy'; however, very few attempts have been made to examine the reasons behind this heterogeneity, especially at industry level. A major challenge when empirically examining the impact of government spending is the identification of exogenous spending shocks, and while it is possible to take advantage of the fiscal policy rule literature to extract discretionary government spending at the aggregate level, use narrative records or utilise a VAR on aggregate-level data to extract exogenous spending shocks, we are not able to easily extend these approaches to sectoral and industry analysis due to data availability. While there are recent contributions to the theoretical literature that look beyond a single sector model set-up, there are far fewer contributions in the empirical literature. The theoretical contribution

[146]Before proceeding, it is important to differentiate between the literature on the effect of the discretional fiscal policy at sectoral level and the literature on industrial/sectoral policies. Using the definition of Chang et al. (2013, p. 9) who defined industrial policy as 'a policy that deliberately favours particular industries/sectors (or even firms) over others, against market signals, usually (but not necessarily) to enhance efficiency and promote productivity growth, for the whole economy as well as for the targeted industries themselves'. It is easy to differentiate the strand of industry policy literature from that of the industry effects of fiscal policy by comparing this definition to that of fiscal policy, which is usually defined as a policy that affects government spending and revenue. When we compare the effectiveness of industrial policy, we look at the relative performance of the targeted sectors against those not targeted, taking into account the specific nature and construct of the policies (which policy instrument is being used). However, when investigating the effectiveness of fiscal policy, we are concerned with a uniform instrument of government spending or taxation. Nonetheless, it is worth noting that changes in government spending might be concentrated on a few sectors and hence there is a sense of targeting, and thus, the magnitude of the policy action is not universal across sectors. Another distinction is also the focus on the short-run effect when looking at the industry effects of fiscal policy compared to long-run effects of industrial policy.

by Acemoglu et al. (2016) showed that government spending shocks can have not only *direct effects*, but also *network effects* through upstream and downstream effects due to input-output industry linkages. With *network effects* having double the impact of *direct effects,* understanding industry-level effects of government spending provides another avenue to gain further insight into the size-varying characteristic of the multiplier given that the *network effects* are dependent on the first round response of individual industry to a government shock, a response which is not a given, as shown in chapter three of this thesis.

It is common in the theoretical literature to rely on the response of households to price levels[147] or foreign demand response to exchange rate movement to explain the sectoral effects of fiscal shocks[148]. Also, capital reallocation and intensity seems to be a key factor in reported effects across sectors, with the assumptions made about how easy labour and capital can move across sectors also being important. With this, the sectoral effect of fiscal policy can be broadly grouped into three categories: firstly, those that interpret it as the difference between the effects of government spending on manufacturing and services (e.g. Monacelli and Perotti, 2008); secondly, those that interpret sectoral as the difference between traded and non-traded (Bénétrix and Lane, 2010); and thirdly, those that interpret it as the difference between durable and nondurable goods (Boehm, 2016). In addition to looking at sector output, it is also possible to examine the aggregate output impact of government purchasing of durable or nondurable goods (Sheremirov and Spirovska, 2015)[149]. Related to this strand of the literature are papers that examine the effects of government spending in open economies, looking at the impact of government spending on trade balance and current accounts etc. (e.g. Beetsma and Giuliodori, 2011). In addition, other papers tend to examine the impact of government spending on the relative prices of non-tradable to tradable goods and services to goods (e.g. Monacelli, and Perotti, 2008). The focus in this section is on the output effects, meaning I don't focus on these

[147]For example, it is readily accepted that the demand for nondurable goods differs from those for durable goods: if let's say prices for durable goods increase as a result of a fiscal shock, then households are able to rely on existing stocks and postpone new purchases until prices decreases. However, households don't enjoy the same benefit from existing goods for nondurable goods given that they are consumed immediately, so a price increase does not affect their demand as much as it does for durable goods. Thus, fiscal shock that increases the price level is deemed to have a greater crowding out effect in durable goods and this translates to a smaller multiplier effect on durable goods.

[148]For example, an appreciation in the exchange rate translates into higher prices for foreign buyers and depresses foreign demands of tradable goods. However, the same does not apply for the non-tradable goods sector; while some crowding out can occur, this sector is not directly exposed to the exchange rate channel, and as a result the multiplier effect can be expected to be greater than that of the tradable sector.

[149]It is worth noting that I made a distinction between papers that separate government spending into government consumption and government investment, so I don't include these papers in this section. While it is generally accepted that government investment can be classified under the durable umbrella, the fact that some expenditure such as military expenditure includes the purchase of durable goods such as tanks and weapons means I choose to include only papers that specifically attempt to create durable goods expenditure series such as that done by Sheremirov and Spirovska (2015). An interesting point to note is that the treatment of the purchase of weapons as a general government consumption can change, as done for the UK in September 2014 when the ONS adopted SNA 2008/ESA 2010. After this adoption, weapons systems became classified as an investment, so they would be classified under government investment series and not consumption. Single-use items such as ammunitions remain intermediate consumptions. Nonetheless, the above rationale given for the focus on the subset of papers remains relevant.

papers. Table 1.9 summarises some of the results from this strand of the literature and what it shows is that the impact of government spending tends to be greater in non-tradable sectors than tradable sectors with results presented by Bénétrix and Lane (2010). Since the service sector is made up of mostly non-tradable industries, there is consistency with the result presented by Monacelli and Perotti (2008), which suggests the impact on services tends to be greater than manufacturing. However, Tagkalakis (2015) focused on government spending cuts in Greece and presented results that suggest a negative impact on non-tradable sectors in the short run, turning positive in the medium term, while the tradable sector seemed to be impacted positively both in the short and medium term. Thus, an avenue for future research is to examine the importance of the sign of fiscal impulse in the reported sectoral impact given that, as the recent contribution to the aggregate effects strand argues, making the distinction between positive and negative fiscal impulse is important.

What is evident in the literature is the very small contribution that splits sectors into durable and nondurable goods, and what table 1.9 shows is that two of the recent contributions presented opposite results. Boehm (2016) used industry-level data and a defence spending instrument for the US to estimate fiscal multipliers for durable and nondurable manufacturing goods industries, concluding that the multipliers for gross output, value added, cost of materials, energy expenditure, and employment are uniformly larger in nondurable goods sectors, with *'nondurable goods industries responding strongly to increased defence spending, suggesting that indeed there is little crowding out in nondurable goods industries but substantial crowding out in durables industries'*. However, although they focused on aggregate output, the results presented by Sheremirov and Spirovska (2015), which shows government spending having a bigger impact when spent on durable goods, suggests there is less crowding out than indicated by the result of Boehm (2016). A possible explanation for this could be that both papers use different sample countries, suggesting further analysis with comparable samples would assist in getting a better understanding of this strand of the literature.

Table 1.9: Sectoral evidence of the effect of government spending

Study	Country	Sample	Identification	Results
Monacelli and Perotti (2008)	US	1954q1–2006q2	BP	Serv>Manu
Benetrix and Lane (2010)	Panel of EMU countries	1970–2006	BP	NT>T
Boehm (2016)	US	1979–2009	OLS–MIL	ND>D
Sheremirov and Spirovska (2015)	Panel of 129 countries	1988–2013	OLS–MIL	D>ND

Source: Author's based on results from papers.
Notes: The table compares the impact between the sector categories in each paper, so for example, does government spending have a bigger impact on the tradable sector compared to the non-tradable sector? Serv = Services, Manu = Manufacturing, T = Tradable, NT = Non-Tradable, D = Durable, ND = Non-Durable. BP = Blanchard and Perotti shock identification scheme. OLSMil = Ordinary least square using military spending series.

Few papers have extended the analysis to look at industry-level effects, as presented by Boehm (2016), who also showed that government spending in durables industries leads to substantially smaller increases in economic activity than spending in nondurables industries. However, this strand of the literature would benefit from more contributions given the opposite results presented by Sheremirov and Spirovska (2015). Looking beyond just output variables, Nekarda and Ramey (2011) presented evidence that suggests industry-specific shifts in government demand raises industry output and hours within the manufacturing sector, but lowers real product wages and labour productivity slightly in the short run. By also examining if industries respond differently by concentration[150] and unionisation[151], they presented results suggesting that output and hours are impacted more in industries with high concentration[152], with the result reversed in the case of unionisation, so greater impacts were reported for industries with low unionisation. Another example of explaining this heterogeneity with industry characteristics was provided by Aghion et al. (2014) . They provided evidence which suggests the growth effects of fiscal policy are greater in financially constrained industries because such policy reduces aggregate volatility; this reduction is argued to be important as volatility tends to discourage credit-constrained industries from making long-term growth-enhancing investments. The natural conclusion of this section is that this strand of the literature would benefit greatly from more contributions, and the few papers in this strand of the literature motivated the contributions of this thesis. Chapter three examines the different output effects of sectoral government purchases for the UK, chapter four moves beyond sectors by examining industry-level effects and the implications for aggregate output effects, while chapter five examines the importance of accounting for sector type in employment and wage effects. Since it is readily accepted that the size of government spending varies across industries, this strand of the literature offers an opportunity to test the hypothesis that the size of government demand is important for the impact it has. I present evidence in chapters three and four that suggests size does seem to be important.

1.8 Conclusion

The debate on the short-run effects of fiscal policy is a complex one. As this chapter has shown, although recent contributions to the literature haven't eased this complexity, they have at least facilitated some sort of consensus on the prerequisites necessary for fiscal policy to be effective on *aggregate demand,* i.e. the view Keynesians and post-Keynesians have always held in that the state of the economy and monetary policy stance has an impact on the short-run effectiveness of government spending. This view is corroborated by recent NK contributions. Nonetheless, the traditional fiscal multiplier formula hasn't been sufficiently developed by Keynesians and post-Keynesians to capture an endogenous multiplier that varies with the state of the economy

[150] A four firm concentration ratio was used to split industries into three terciles; the lower cut-off is 25.8% and the upper cut-off is 44.0%.

[151] A unionisation rate was used to split industries into three terciles; the lower cut-off is 38.6% and the upper cut-off is 51.9%.

[152] Concentration was split into three categories: top, middle and lower terciles.

and monetary policy stance[153], and this is an area that deserves more attention.

In the theoretical literature, the short-run effectiveness of fiscal policy is primarily about macroeconomic perspectives, crowding out and accounting for leakages. The crowding out disagreement feels unresolvable at present as it is based on fundamental underpinnings of respective macroeconomic perspectives that are unlikely to change, even though some of these underpinnings are not fully supported empirically. Although there is a distaste shown by some economists for a single multiplier figure, the importance multiplier figures played in the justification of recent policy actions such as deficit cuts means it is crucial to have a sound theoretical underpinning that forms the basis of multiplier estimates. Unfortunately, as expressed by Palley (2013, p. 3), 'no theoretical paradigm is completely satisfying'. Nonetheless, as shown by Palley (2013), there are three propositions that are applicable to all macroeconomic perspectives; however, essential prerequisites, as stressed by Kahn and Keynes, are often overlooked and in some cases at odds with other macroeconomic perspectives. Thus, if the 'ground-zero' is different across macroeconomic perspectives, pluralism seems the only option at present when discussing the short-run effects of fiscal policy. And as recent contributions to the literature show, when there is general acceptance of prerequisites such as an accommodative monetary authority and slack in the economy, then fiscal policy can be effective in stimulating aggregate demand in the short run, and as such the debate turns to how much above unity the multiplier is. The challenge, however, remains on the actual estimate of 'the multiplier'.

While there is a lack of consensus in the empirical literature on the impact government spending has on key macroeconomic variables, empirical evidence suggests the output multiplier can range from -3 for high debt countries[154] to 1.7 for the US; however, the multiplier for the US appears to be around 1 in recent periods. Also, for most countries other than the US, empirical evidence seems to suggest the multiplier is below 1. New contributions suggest the multiplier to be above one once the state of the economy is taken into account, although this is not true for all countries. Thus, on balance, evidence suggests the multiplier is higher during periods of economic slack compared to normal periods. There is still an ongoing debate about the differences in results obtained when using defence or non-defence spending instruments, with a possible explanation being the different positive and negative shock profiles of both types of spending.

The multiplier is very much context-dependent, with 'context' not only encompassing the state of the economy, monetary policy stance and structural characteristics of the economy in question, but also the sign of fiscal impulse. The time-varying characteristic of the government spending multiplier suggests the size of the multiplier in the 1980s was different from that in the 1990s, and the multiplier during the downturn of the early 1970s was different from that in the

[153] Foresti and Marani (2014) presented a Keynesian multiplier formula that takes into account the effects of the reaction of the monetary authority on investment expenditure and net exports.

[154] As expressed earlier, the results presented by Ilzetzki et al. (2013) are sensitive to sample countries. Chian Koh (2017) presented a multiplier of 0.4 for high debt countries, so the lower bound of the multiplier is close to -0.2 if based on the results of Chian Koh (2017).

late 2000s, which could be due in part to time-varying structural characteristics of an economy and the stance taken by the monetary authority during the mentioned periods. In addition, what results from the new contributions that account for the sign of fiscal impulses suggest is that a negative fiscal impulse (fiscal consolidation) has a contractionary effect on the economy, especially when there is slack in the economy. What the sets of results discussed in this review suggest is that while we can generally conclude that a recession is the worst time to pursue fiscal consolidation in the spirit of Keynes (1937), there is much to be done to understand the mixed results reported for expansionary periods.

New contributions in the local multiplier literature also show that government spending shocks increase both local income and employment, reporting multipliers generally higher than those from aggregate-level studies. However, more contributions are needed to convert these local multipliers to national equivalents, as presented by Chodorow-Reich (2018).

Few papers have extended the empirical analysis to examine sectoral- and industry-level effects; nonetheless, evidence suggests the impact of government spending is larger in non-tradable and service sectors, with mixed results reported for the impact on durable and nondurable goods. The small contribution in this sectoral and industry strand of the literature motivates the contributions in chapters two, three and four of this thesis.

Chapter 2

Imports, the Income-Expenditure Model, and Sectoral Government Spending

2.1 Introduction

The derivation of the fiscal multiplier[1] from the Keynesian income-expenditure model is a major pillar in macroeconomics, yet the widely circulated versions of the model suffer from a significant oversight in its treatment of imports. Clark (1935) recognised eight essential elements in the multiplier process, which are modified and compressed here into the following: i) expansionary expenditure, ii) a resultant increase in income that is subsequently spent by the recipient, iii) leakages arising from the increase in income not being spent and income being spent on imported goods, iv) the resulting multiplier, with leakages assumed to remain constant through the process[2], v) the time it takes for the multiplier process to complete, and vi) counteracting factors. From these elements, what stands out and is of focus in this chapter is the assumption that there is no leakage in the expansionary expenditure as leakages are only expected from subsequent decisions on spending or not spending the additional income. However, this assumption is problematic and encouragingly this treatment of imports in the model has seen renewed interest after being left in a dark corner for decades.

The need to appropriately account for imports in the income-expenditure model has a rich history, from Suits (1970), Benavie (1973) and Bonnici (1987) to more recent contributions by Cherry (2001) and Palley (2009). Unfortunately, these contributions are usually overlooked in the fiscal multiplier debate and in doing so important implications on the effects of fiscal policy are neglected. By moving away from the conventional approach of having a singular marginal propensity to import and instead having marginal propensity to import for each component

[1] Fully described by Keynes (1936), who made use of mechanisms presented by Khan (1931).

[2] Recent contributions such as Charles et al. (2015) and Charles (2016) endogenise 'leakages' to provide a theoretical explanation for an endogenous multiplier.

for aggregate demand, the marginal propensity to import becomes an even more important parameter. Due to globalisation, imports now have a larger role in economic activity, so it is important to appropriately account for imports in macroeconomic models. This larger role motivated the re-specification of the income-expenditure model by Palley (2009), and in doing so revealed significant implications for the size of the expenditure multiplier and fiscal policy[3] that is often not present using the standard and widespread income-expenditure model. This chapter builds on Palley (2009) and in doing so shows that some government spending can have higher expenditure multipliers over others due to fewer leakage via imports. The modification has important implications around what expenditure the government should make-; the estimated multiplier in this chapter shows that the government spending cumulative multiplier can be as high as 1.76 and as low as 0.46.

While the dampening effect of import leakages on the multiplier is well documented, the standard and Palley's re-specified income-expenditure model assumes that all types of government expenditure have the same import content; thus, by capturing an average import propensity of government spending, the re-specified model suffers from the original sin which motivated the re-specification of the model in the first place. A similar attempt to capture the multiplier effect of different types of government expenditure using the re-specified model was provided by Pusch (2012),, who made a distinction between government spending on consumption and construction, presenting that the fiscal spending multiplier for construction is generally higher than the consumption multiplier[4]. The model presented in this chapter provides a framework that appropriately accounts for imports in different types of government expenditure, differentiating between government spending on durable goods, nondurable goods, and services, with a focus on the UK economy. The challenge with analysis of this kind is the lack of government spending data readily available and that is broken down into different sectoral spending. Although it is possible to categorise UK government spending using the UN's Classification of the Functions of Government (COFOG)[5], how this spending spreads across different sectors and industries of the economy is not easily extractable even though it is readily accepted that government spending varies across sectors and industries (Beetsma, 2008; Nekarda and Ramey, 2011). To overcome this issue, this chapter follows the examples of Perotti (2007), Nekarda and Ramey (2011), and Pusch (2012) by making use of data available in the input-output analytical tables (IOAT) for the UK. The much-cited paper by Hijzen et al. (2004) used the same IOAT to investigate the impact of outsourcing on the skill structure of the UK. They used the import use matrices from

[3]Palley (2009) showed that by appropriately accounting for import increases in government spending, there is an even larger relative impact compared to tax cuts, with government spending having a smaller adverse effect on the trade deficit than tax cuts.

[4]Pursh (2012) proposed modifying the multiplier equation to calculate multipliers of specific categories of government spending (using the example of public construction); however, his approach requires inserting each type of spending category at a time. What is being proposed in this chapter is argued to be more flexible as it not only captures the fact that each category having different import content, but can be used to calculate all categories of government spending.

[5]General public services; Defence; Public order and safety; Economic affairs; Environmental protection; Housing and community amenities; Health; Recreation, culture and religion; Education; Social protection.

the IOAT to calculate outsourcing, and this chapter uses the import use matrices to calculate the import content of sectoral government expenditure. The separation of government spending into different industry classifications in these tables allows the extraction of government spending on durable goods, nondurable goods, and services, making it possible to account for the different levels of import content and to calculate multipliers for each type of expenditure. IOATs for 1995, 2005, 2010 and 2013 are used.

The organisation of the chapter is as follows. Section two provides a brief review of recent debate on the output multiplier effect of government spending. Section three presents the re-specified model. Section four provides a justification for the re-specification using input-output data to split government spending into sectoral expenditure. Section five presents estimated output multipliers using the import content calculated in section four. Section six concludes.

2.2 A brief review of the recent debate

The financial crisis of 2008 certainly reignited the debate on the multiplier effects of government spending; however, it did not bring about a consensus on the size or sign of the effect of an increase in government spending[6]. While the debate on fiscal shock identification schemes has shaped the empirical literature (e.g. Perotti, 2007; Ramey, 2011a, 2016), contributions to the theoretical literature have been dominated by the RET and crowding out debate (e.g. Arestis and Sawyer, 2004, chapters 8 and 9; Barro, 1974; Baxter and King, 1993; Linnemann, 2006; Gali et al., 2007), with the ZLB of interest and the importance of an accommodating monetary authority taking centre stage in most recent contributions (see e.g. Eggertsson and Woodford, 2006; Woodford, 2011; Christiano et al., 2011; Davig and Leeper 2011; Fontana, 2009b)[7]. Using and extending the attempt of Charles (2016), we can group empirical studies[8] into those that 1) report positive output effects of an increase in government spending with multiplier effects of above one[9], 2) studies that report positive but a multiplier of less than one[10], 3) studies that

[6]See Hemming et al., 2002; Arestis and Sawyer, 2004, 2005; Arestis, 2011; Auerbach, 2003; Blinder, 2006; Perotti, 2007; Ramey, 2011b; Fontana, 2009a; Hall, 2009; Barro and Redlick, 2011; Fatas and Mihov, 2012; Palley, 2013.

[7]The recent contributions on the role an accommodating monetary authority has on the impact of an expansionary fiscal policy are in effect a confirmation of the prerequisites recognised by Kahn (1931, pp. 174–175) and Keynes (1930, VI, p. 197). The narrative presented by Trevithick (1994, p. 88) provides a good summary of this point: ‘It had always been obvious from the very first stirrings of the Keynesian Revolution that expansionary policies would require the complementary implementation of fiscal expansion with monetary accommodation. This complementarity was clearly present in all of Keynes’s pre-General Theory writings on public works; it was clearly present in Kahn’s multiplier essay; and it was clearly present in its most fully articulated form in Keynes’s post-General Theory writings. Unfortunately, it was not clearly present in the analysis of The General Theory itself, though, from a policy point of view, this should not come as much of a surprise since Keynes’s main concern there was with the working of a market economy without systematic macroeconomic intervention by government.’

[8]Econometric constraints mean these studies tend to be on the effects of changes in discretionary spending that are independent of economic activity; for this reason, as highlighted by Fatas and Mihov (2012, p. 5), the reported effects ‘are not relevant to the potential stabilizing role of government spending. There remains, however, a belief that the findings can still be informative about the potential stabilizing role of countercyclical fiscal policy under the assumption that exogenous discretionary fiscal policy should have similar effects to endogenous discretionary policy.’ Thus, what we understand about the effects of discretionary government spending is relevant to policy.

[9]e.g. De Castro and De Cos, 2008; Beetsma et al., 2008; Edelberg et al., 1999.

[10]e.g. Barro and Redlick, 2011; Blanchard and Perotti, 2002; Corsetti et al., 2012; Gali et al., 2007; Hall, 2009;

report negative multipliers[11], 4) studies that argue that rather than pursuing an expansionary policy, a contractionary policy can actually have an expansionary effect on output[12], and 5) studies that present that the multiplier is context-dependent where 'context' doesn't just encompass the state of the economy and monetary policy stance, but also the structural characteristics of the economy in question and sign of fiscal shock[13]. Alongside these studies that tend to be focused on total government spending, another strand of the fiscal multiplier literature that looks at the relative impact of different sectoral government spending has also received some renewed interest. This chapter contributes to this strand of the literature by theoretically examining the output effects of sectoral government spending with the help of a Keynesian income-expenditure model, arguing that leakages in the form of imports in different types of sectoral government spending can explain the differences in effects. The re-specified model presented in this chapter shows that a simple Keynesian model is able to explain the varying size of the multiplier following the example of Charles (2016), who endogenised imports in a Kaleckian post-Keynesian model of distribution and growth to show how imports varying with the state of the economy can offer an explanation why the size of the multiplier is state-dependent.

The standard one-sector set-up common in neoclassical[14] and NK models would imply that what the government spends money on does not have an impact on economic activity[15]; however, the results from a two-sector neoclassical model of Ramey and Shapiro (1998) suggest otherwise. They showed in a neoclassical model with costly capital reallocation between sectors that the sector that experienced the larger increase in government spending displayed a larger fall in product wage[16] due to a shift in employment from one sector to the other. Even with their results, there is still little understanding of the possible heterogeneity in sectoral multipliers and the determinants of any such heterogeneity. It is recognised that there is a strand of the literature that looks at the effects of fiscal shocks on sectors and the sectoral composition of the economy (e.g. Bénétrix and Lane, 2010; Cardi and Restout, 2011; Monacelli and Perotti, 2008). This chapter differs in its contribution as it is interested in the aggregate output effect of sectoral government spending, i.e. what is the aggregate output multiplier if a spending shock occurs in the durable sector. Boehm (2016), with a two-sector NK model of durable and nondurable goods calibrated to the US, showed that government spending shock has more impact if that shock occurs in the nondurable sector. An increase of 1% in government spending in the nondurable sector is estimated to increase aggregate output on impact by about 0.75, while a 1% increase

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Ravn et al., 2007.

[11]e.g. Dungey and Fry, 2009; Monacelli and Perotti, 2006 (they reported a negative multiplier for Canada, but a positive multiplier below one for Australia, UK and US).

[12]e.g. Giavazzi and Pagano, 1990; Alesina and Perotti, 1997; Alesina and Ardagna, 2010.

[13]e.g. Auerbach and Gorodnichenko, 2013; Corsetti et al., 2012; DeLong and Summers, 2012; Batini et al., 2014, Favero et al., 2011; Ilzetzki et al; 2013.

[14]e.g. Baxter and King, 1993. I follow Fontana (2009b) in labelling this group of real business cycle models as neoclassical models.

[15]Except in cases of productive government spending.

[16]Product wage is defined as the wage received by workers in sector i divided by price of the produce of sector i.

in government spending on the durable sector with service life of about 14 years increases the aggregate multiplier on impact by about 0.37; thus, government spending on nondurables had a bigger impact on aggregate output. The reason for this, as explained by Boehm, is that the demand for durable goods is highly elastic and easily crowded out. The intuition is easy to grasp: if prices go up, then consumers are more willing to wait for prices to come down on bigger ticket items which tend to be durable goods, so any increase in government spending that causes an increase in prices would trigger this behaviour[17]. I show in this chapter that the crowding out argument is not needed to explain this variation in multipliers.

Boehm (2016) empirically confirmed the result of his NK model using industry-level data and a defence spending instrument to estimate fiscal multipliers for durable and nondurable goods industries. However, using a newly constructed international military spending instrument in a single equation model, Sheremirov and Spirovska (2015) reported that the multiplier for durables is larger than the multiplier for nondurables, and also that the multiplier is especially large in recessions and when the government purchases durables[18], a result which is opposite to the prediction of the NK model of Boehm (2016). Sheremirov and Spirovska showed that government military spending on nondurables and services is associated with a multiplier of 1.41 on real GDP, while spending on durables raises this multiplier by an additional 2.70, both statistically significant. The results presented in this chapter are consistent with those presented by Boehm (2016). While Boehm (2016) relies on differences in the intertemporal elasticity of substitution across sectors to explain variation in multiplier size, I show that the differences in import content across sectors is able to explain this variation. I now turn to the model.

2.3 Accounting appropriately for import

It is best to start with a discussion of the standard and re-specified income-expenditure model presented by Palley (2009). Imports occur as a result of the spending behaviour of households, firms and the government; this behaviour is commonly captured in a singular propensity to import that is credited to Samuelson (1948). The general view is that the higher the propensity to import, the higher the leakage, which translates to a smaller multiplier. Most income-expenditure models include an import function that takes the form of $M = mY$ or $M = m_0 + m_1Y$, where m is the propensity to import and Y is income. Although m_0 captures the autonomous import of each component of aggregate demand, and in theory changes in each component of aggregate demand can be accounted for using m_0, it still uses a singular parameter to capture a behaviour that is different across each component, a drawback that is also applicable for an import function such as $M = m(C + I + G)$. And as I also show below, it fails to capture any leakage that can occur in the first round of expenditure and overstates the propensity to import. To show this, I derive two multiplier formulas using two alternative

[17]Barsky et al. (2007) also noted that the intertemporal elasticity of substitution is higher for durables than for nondurables.

[18]They followed Gartzke's (2001) approach of separating total military expenditure into durable (equipment and infrastructure) and nondurable purchases (personnel and other expenditure).

import functions:

$$Y = AD \tag{2.1}$$

$$AD = C + I + G + X - M \tag{2.2}$$

$$C = c_0 + c_1\{[1-t]Y - T\} \qquad c_0 > 0,\ 0 < c_0 < 1,\ 0 < t < 1 \tag{2.3}$$

$$I = I_0 \tag{2.4}$$

$$G = G_0 \tag{2.5}$$

$$X = X_0 \tag{2.6}$$

Where C = consumption (an increasing function of disposable income), c_0 = autonomous spending, c_1 = MPC, G = government spending (government final consumption expenditure), I = investment, X = Export, M = Import, T = lump sum tax, and t = the rate of income tax, i.e. the increase in taxes when income rises by 1 unit. I present the import functions as[19]:

$$M = m_0 + m_1 Y \tag{2.7}$$

$$M = M_C + M_I + M_G + M_X \tag{2.8}$$

$$M_C = \alpha C \qquad 0 < \alpha < 1 \tag{2.9}$$

$$M_I = \beta I \qquad 0 < \beta < 1 \tag{2.10}$$

$$M_G = \gamma G \qquad 0 < \gamma < 1 \tag{2.11}$$

$$M_X = \omega X \qquad 0 < \omega < 1 \tag{2.12}$$

Where M_C = imports of consumption goods, M_I = imports of investment goods, M_G= imports by government, M_X = imports embodied in exports. The coefficients α,β,γ,ω represent the proportion of import content in consumption, investment, government spending and exports, respectively. Equilibrium occurs at $Y = AD$, that is, at this point, total aggregate spending equals current output. Given the investment level is unchanged in the short run, change in Y is due to changes in private consumption and government. We can solve for the fiscal multiplier

[19] Import functions 9 to 12 are from Palley (2009).

with alternate import functions and differentiate with respect to government spending to yield the following multipliers:

$$\triangle Y = \frac{1}{1 - [1 - t]c_1 + m_1} \triangle G \tag{2.13}$$

$$\triangle Y = \frac{1 - \gamma}{1 - [1 - \alpha][1 - t]c_1} \triangle G \tag{2.14}$$

The standard multiplier as shown in equation 2.13 is clear in the message that the higher the propensity to import, the lower the multiplier; however, the re-specified multiplier equation 2.14 highlights two oversights in the standard multiplier. First, it accounts for the fact that there can be leakages in government spending, i.e. government purchase of foreign-produced goods. Second, it doesn't overstate the propensity to import as it appropriately captures only the import content of household consumption. However, the re-specified multiplier also suffers from an oversight in assuming a singular import propensity for all types of government spending. Palley (2009) assumed the import content of government spending for the US to be about 5% (0.05 for γ) based on the logic that government spending is largely made up of wages, salaries and defence goods, which tend to have more domestically produced contents. This figure is slightly lower than those calculated by Bussiere et al. (2013) who used OECD input-output tables to show that the import content of the US government consumption was 3.7%, 6.0% and 6.2% in 1995, 2000 and 2005, respectively. Bussiere et al. (2013) also reported import contents of government consumption for 50 countries and they ranged from 2.2% to 29.2% in 1995[20], 1.8% to 26.3% in 2000[21], and 2.8% to 28.8% in 2005[22]. For the UK, they reported 11.2%, 12.7% and 12.5% for 1995, 2000 and 2005, respectively. Although focused on a group of EU member countries, Pusch (2012) also used the OECD 2005 input-output tables to estimate the import content of government consumption that ranged from 7% to 19%, thus highlighting that import content can vary significantly across countries. This range of import content of government spending indicates that more attention should be given to this parameter due to the significant impact it has on the calculated multiplier. And as I show in section 2.4 and 2.5, the use of input-output calculus by Bussiere et al. (2013) and Pusch (2012) can be problematic as it can hide the fact that changes in government expenditure to be made up of changes in intermediate consumption, which when considered separately highlight different import content compared to those presented by both papers.

As expressed earlier, while the re-specified model does a good job in highlighting that there is a direct import leakage from government spending, it fails to make a distinction between the different types of government spending undertaken by different governments, which could help explain the range of reported import contents. By capturing the average import propensity of government spending, it suffers from the original sin which motivated the re-specification of the model in the first place. The argument here is that the multiplier effects of different types of

[20] Argentina had the lowest import content, while Hungary had the highest.
[21] Argentina had the lowest import content, while Vietnam had the highest.
[22] Argentina had the lowest import content, while Vietnam had the highest.

government spending are not equal: some are more impactful than others given the different levels of import leakages. The re-specified model should reflect this, so to overcome the oversight of the above model, a small modification is needed in the treatment of government spending by decomposing aggregate government spending and import, differentiating between government expenditure on durable goods, nondurable goods and services:

$$G = G_D + G_{ND} + G_S \tag{2.15}$$

$$G_D = \lambda G \tag{2.16}$$

$$G_{ND} = \mu G \tag{2.17}$$

$$G_S = \psi G \tag{2.18}$$

$$\lambda + \mu + \psi = 1 \tag{2.19}$$

Where G_D = government spending on durable goods, G_{ND} = government spending on non-durable goods, G_S = government spending on services, and λ, μ, ψ represents the proportion of government spending on each type of expenditure. The import content of government spending becomes:

$$M_G = M_{GD} + M_{GND} + M_{GS} \tag{2.20}$$

$$M_{GD} = \rho G_D = \rho\lambda G \tag{2.21}$$

$$M_{GND} = \sigma G_{ND} = \sigma\mu G \tag{2.22}$$

$$M_{GS} = \nu G_S = \nu\psi G \tag{2.23}$$

Where M_{GD} = import content in government durable goods expenditures, M_{GND} = import content in government non-durable goods expenditures, M_{GS} = import content in government expenditure on services. The coefficients ρ, σ, υ represent the import content in durable goods, nondurable goods, and services. The re-specified model of Palley (2009) implies that $\gamma = \rho\lambda = \sigma\mu = \nu\psi$, which can be argued convincingly not to be the case. Palley (2009) rightly recognised that the import content of durable goods tends to be larger than that of nondurable goods when discussing the re-specified model in the context of changes in household consumption taxes, but this recognition was not extended to government expenditure. While it is reasonable to assume that the import content of government spending is small given that a high percentage of it goes directly to wages and salaries, the stimulus response to the 2008 crisis shows that governments are not likely to pursue an expansionary policy that is shaped by pay rises or employment drives. Instead, they are more likely to pursue infrastructure projects or increase purchases of goods and services that include goods that are durable, and thus we can expect the import content to be higher based on the previously stated view that import content of durable goods tends to be higher than for nondurable goods and services. Hence, our multiplier equation should be flexible enough to capture the characteristics of different types of expansionary government spending. Incorporating the new decomposed government spending and import into our model and solving for equilibrium, we arrive at steady state, assuming $c_0 = \overline{c_0}$ and $I = \overline{I}$:

$$Y = C - \alpha C + I - \beta I + X - \omega X + (\lambda + \mu + \psi)G - (\rho\lambda + \sigma\mu + \nu\psi)G \tag{2.24}$$

$$Y = \frac{((1-\alpha)(c_0 + c_1 T) + (1-\beta)I + (1-\omega)X + [(1-\rho)\lambda + (1-\sigma)\mu + (1-\nu)\psi]G)}{(1 - [1-\alpha](1-t)c_1)} \tag{2.25}$$

Change in Y following change in G:

$$\triangle Y = \frac{[(1-\rho)\lambda + (1-\sigma)\mu + (1-\nu)\psi]\triangle G}{(1 - [1-\alpha](1-t)c_1)} \tag{2.26}$$

The modification above shows that each type of government spending proportionately adds to the overall import content of government expenditure, so the higher the expenditure towards a category with low import content, the higher the multiplier. To illustrate the importance of the above specification, it is a useful to show what a change in government spending looks like:

$$\Delta G = \Delta G_D + \Delta G_{ND} + \Delta G_S \tag{2.27}$$

Expanding ΔG_D as an example yields:

$$\frac{\Delta G_D}{G_D} = \frac{\Delta G}{G} + \frac{\Delta\lambda}{\lambda} \tag{2.28}$$

$$\Delta G_D = \left(\frac{\Delta G}{G} + \frac{\Delta\lambda}{\lambda}\right) G_D \tag{2.29}$$

So the change in government spending takes the form:

$$\Delta G = \left(\frac{\Delta G}{G} + \frac{\Delta\lambda}{\lambda}\right) G_D + \left(\frac{\Delta G}{G} + \frac{\Delta\mu}{\mu}\right) G_{ND} + \left(\frac{\Delta G}{G} + \frac{\Delta\psi}{\psi}\right) G_S \tag{2.30}$$

A change in government spending doesn't just reflect changes in the size, but also the composition of expenditure, which is reflected above showing that choices have to be made on which category of spending gets the increase. If we consider the stimulus spending implemented around the world during the crisis that started in 2008, it becomes very apparent that the focus of such increase in spending was different across countries, further strengthening the need to account for this as it can provide some explanation as to why multipliers are different across countries.

If we take it that the increase in government expenditure for some countries was spent only on services then $\Delta\lambda + \Delta\mu = 0$, thus, the multiplier would rightly be:

$$\frac{\triangle Y}{\triangle G} = \frac{1-\nu}{(1-[1-\alpha](1-t)c_1)} \tag{2.31}$$

Equation 2.31 is simply the re-specified model of Palley (2009). If, however, the increase is split evenly in the form of expenditure on nondurable goods and services, indicating that $\Delta\lambda = 0$, while $\Delta\mu = \Delta\psi = 0.5$, then our multiplier rightly becomes:

$$\frac{\triangle Y}{\triangle G} = \frac{(1-\sigma)0.5 + (1-\nu)0.5}{(1-[1-\alpha](1-t)c_1)} \tag{2.32}$$

Thus, the model presented in this chapter allows us to appropriately account for the import content of each category of government spending, and in doing so prevents understanding/overstating leakages arising from imports. The fiscal multiplier presented above is based on a very simple model, with three key elements: the rate of tax, the propensity to save, and the propensity to import. By focusing just on imports for the purpose of arguments presented in this chapter, the other two elements are not explored, but this doesn't mean they have less of a role to play in the multiplier. In line with the views expressed by Charles (2015), the focus is on the variations on the propensity to import to explain variation in multiplier values, especially during recessions when imports tend to change significantly.

There are additional limitations to the model that are worth highlighting. In the model, we take investment, public spending and exports as endogenous, all of which can be endogenised. For example, the accelerator principle developed by Aftalion (1908) and Clark (1917)[23] can be introduced to capture how investment can react to changes in economic activities caused by changes in government expenditure, thus capturing a feedback loop that can result in a greater multiplier effect even if the import content of sectoral expenditure is high. Using the terminology of Archer (1976), the formula above is an 'instantaneous' multiplier as it doesn't take into account the effect of either (a) any extra investment which might take place as a result of increased output or (b) additional flows of exports, induced by changes in exchange rates as a result of monetary authority response to fiscal stimulus. In addition to this, the formula doesn't account for any productivity gains that could arise as a result of the additional expenditure. So, the formula treats the building/repairing of a bridge the same as buying stationery for government officials. This is obviously incorrect, as the impact of the bridge could be that new businesses are attracted to an area that has become more accessible due to the bridge or businesses are able to move their goods more efficiently, both of which will have an impact on output and, ultimately, the multiplier size. This becomes very relevant as shown in section

[23]The accelerator principle is often attributed to Samuelson (1939). As explained by Vercelli and Sordi (2009), 'Samuelson's 1939 contributions may be considered as the first rigorous model able to specify the conditions under which the interaction between the multiplier and the accelerator principle may explain economic fluctuations. We thus take this model as a prototype for the subsequent literature in the sense that it set the language and the approach dominating the debate on business cycles and related issues for decades.'

2.5.3 because although durable goods tend to have higher import contents, by not accounting for dynamic effects that are more likely when the government spends on durable goods, we get small multiplier values that need to be interpreted with caution.

Also, the model is very mute on many other interactions and markets in the economy that can affect the size of the multiplier even after accounting for imports. For example, the model does not capture real sector/financial sector interactions, and as the recent financial crisis has shown, this interaction is quite important. In addition, the model neglects expectations and is passive on the supply side; thus, market factors are ignored, which has important implications especially when it comes to capacity constraints. Nonetheless, as explained in chapter one of this thesis, a presupposition for Keynesians and post-Keynesians is that there is slack in the economy when fiscal stimulus is implemented, thus there is spare capacity.

Although the limitations of the income-expenditure model and the re-modified multiplier formula used in this chapter have been presented, the question that is yet to be answered is just how much should we be worried about different types of government spending if as asserted earlier that government spending tends to be largely made up of wages, salaries, and defence goods which tend to have more domestically produced contents. I answer this question in the next section, showing that a significant amount of government spending is not in the form of wages, salaries and defence goods that are easily argued to contain low import contents. I split government final consumption expenditure for the UK into its different components using the European System of Accounts (ESA 2010), presenting the different import content of this expenditure with the help of data from the UK's IOATs.

2.4 Government final consumption expenditure

Government final consumption expenditure (GFCE) is made up of different types of expenditure and it is common to see it split using the UN's COFOG. However, this split doesn't shed any light on government expenditure to include a type of expenditure that is different from that commonly discussed in the fiscal multiplier literature. While the term 'intermediate consumption' is often associated with the production accounts as it is defined as the goods and services that are used up in the production process, ESA 2010 provides a useful framework that splits government expenditure into different expenses, which includes 'intermediate consumption', and in doing so offers an opportunity to gain further insights usually absent in the fiscal multiplier literature. ESA 2010 defines GFCE as:

> ***GFCE (P.3)*** *= compensation of employees (D.1) + intermediate consumption (P.2) + consumption of fixed capital (P.51C1) + other taxes on production payable (D.29U) – other subsidies on production receivable (D.39R) + net operating surplus (B.2n) – sales of goods and services (P.11+P.12+P.131) + social transfers in kind via market producers (D.632)*

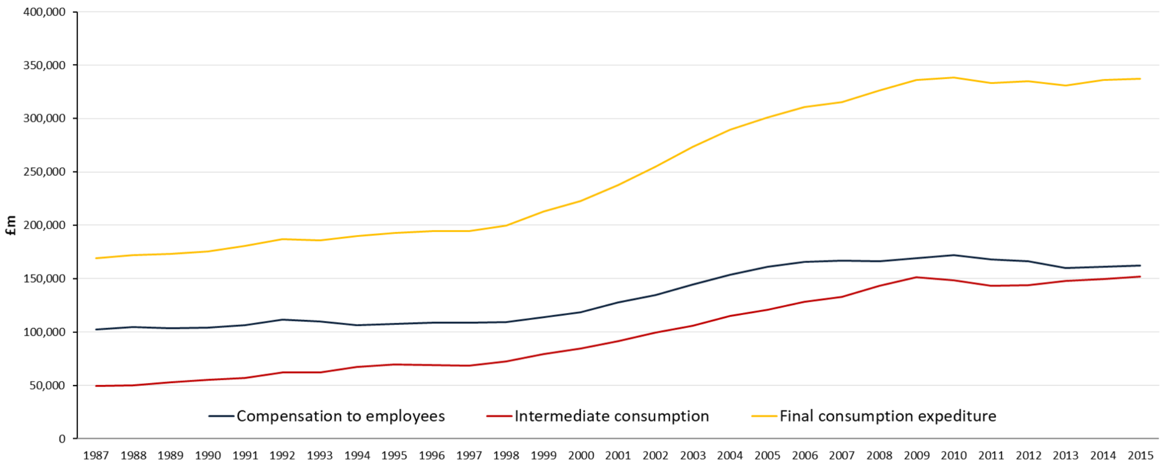
From this definition, it is clear that GFCE is made up of different types of expenditure, but for the purpose of this chapter, the focus is on expenditure on intermediate consumption given that it captures purchases by the government[24]. The intermediate consumption expenditure is essentially the government's procurement of goods and services. Under the ESA 2010 framework, there are two main types of intermediate consumption purchases. The first type of this expense is the purchase of goods and services for the government's own use, e.g. computers and stationery. The second could be, for example, the National Health Service (NHS) purchasing medicine, medical equipment, ambulances and electricity from private sector companies. Before turning attention to how the intermediate consumption expenditure is presented using the IOATs, allowing us to get an idea of its import content, it is worth examining the proportion of this expenditure in GFCE.

Using quarterly expenditure data from UK'S ESA 2010, we can construct yearly GFCE as shown in figure 2.1, while figure 2.2shows the percentage share of final consumption expenditure for both compensation of employees and intermediate consumption. Not only does figure 2.2 show that expenditure on intermediate consumption makes up a significant part of government expenditure[25], but this part of government spending has been increasing in share, and if this trend continues then we can expect it to account for a higher proportion of final consumption expenditure than compensation of employees. Thus, more attention should be given to this component of government spending given that table 2.1 shows that the proportion of intermediate consumption has increased from about 29% in 1987 to 45% in 2015. Another point worth making is that the year-on-year change of expenditure on compensation of employees and intermediate consumption tends to be different, as shown in figure 2.3, so strengthening the case made earlier that changes in government spending is as much about the change in types of government expenditure as it is the level.

[24]Consumption of fixed capital is also important as highlighted earlier, but the lack of government fixed capital expenditure data in the Supply and Use Tables and Input-Output analytical tables makes it difficult to match them to the industry level required for our analysis, hence they are excluded in the discussion. Consumption of fixed capital includes for example, dwellings, other buildings and structures, including major improvements to land and roads, computer software and databases. The static model described in this chapter fails to capture are the dynamic effect of these capital expenditure, further highlighting the need to be cautious when interpreting the results discussed in later sections of this chapter.

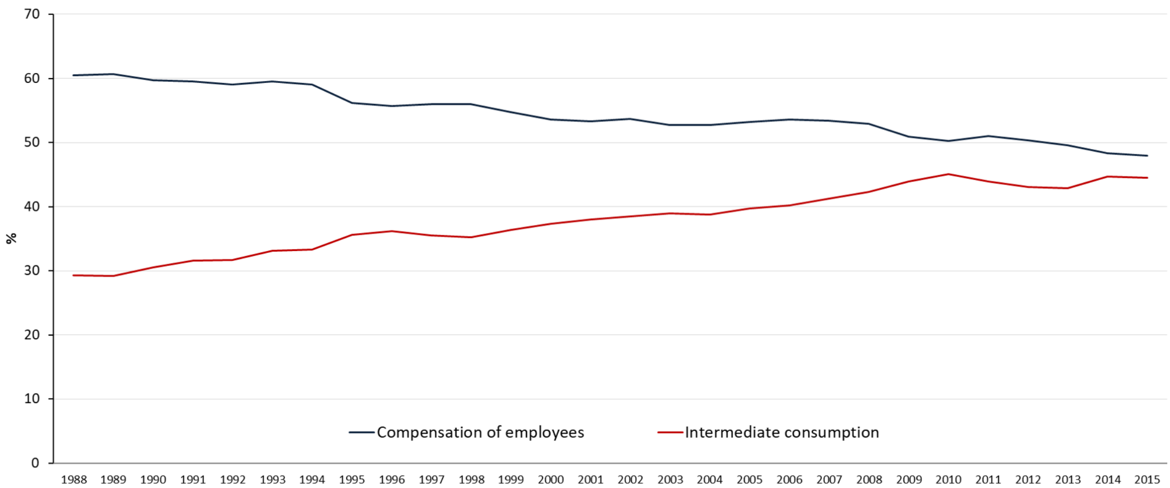
[25]As the definition indicates GFCE is made up of different types of expenditure, but for the purpose of this chapter the focus is on expenditure on intermediate consumption.

Figure 2.1: Government final consumption expenditure in current price (£m)



Source: *Author's calculation using ONS ESA table published January 2017. Deflated using GDP deflator with 2010 set as base year.*
Note: Figure shows government final consumption for each type of expenditure.

Figure 2.2: Government final consumption expenditure by type (%)



Source: *Author,s calculation using ONS ESA table published January 2017.*
Note: Figure shows the proportion of government final consumption for each type of expenditure.

Table 2.1: Government final gonsumption expenditure split by type 1987–2015

		% Split of Total Expenditure		
Year	GFCE (£ amount)	Compensation to employees	Intermediate consumption	Others
1987	85,826	60.51	29.31	10.18
1988	92,561	60.71	29.22	10.07
1989	100,185	59.72	30.57	9.72
1990	109,532	59.49	31.56	8.96
1991	120,255	59.00	31.66	9.34
1992	128,288	59.51	33.15	7.35
1993	130,646	59.06	33.31	7.63
1994	135,069	56.18	35.58	8.24
1995	140,513	55.67	36.15	8.18
1996	147,278	55.98	35.54	8.48
1997	150,171	55.96	35.22	8.83
1998	156,261	54.76	36.33	8.91
1999	167,723	53.61	37.32	9.08
2000	179,299	53.31	37.97	8.72
2001	193,163	53.72	38.43	7.84
2002	211,500	52.76	39.00	8.25
2003	232,194	52.77	38.73	8.50
2004	252,001	53.17	39.76	7.07
2005	268,971	53.60	40.18	6.23
2006	286,006	53.36	41.29	5.35
2007	297,324	52.93	42.26	4.81
2008	316,831	50.95	43.93	5.12
2009	331,264	50.23	45.08	4.69
2010	338,179	50.96	43.90	5.13
2011	339,763	50.38	43.07	6.55
2012	346,944	49.61	42.87	7.52
2013	349,292	48.30	44.71	7.00
2014	360,463	47.97	44.46	7.57
2015	363,650	48.04	45.04	6.91

Source: *Author's calculation using ONS ESA table published January 2017. Deflated using GDP deflator with 2010 set as base year.*
Notes: Table shows the proportion of government final consumption expenditure for each type of expenditure. Using 2010 as an example, the table indicates that 50.96% was spent on the compensation of employees, 43.90% was spent on intermediate consumption, with the remaining 5.13% spent on other expenditure, including consumption of fixed capital.

Figure 2.3: Y-o-Y change in government final consumption expenditure by type (%)

Source: *Author,s calculation using ONS ESA table published January 2017. Deflated using GDP deflator with 2010 set as base year.*
Note: Figure shows the yearly change in government final consumption for each type of expenditure.

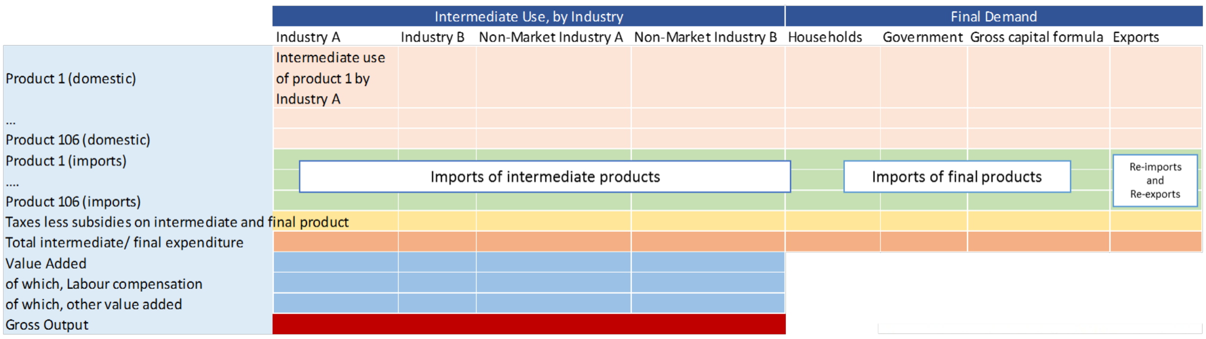
The last paragraph is the first step in justifying the need to account for different types of government spending in our multiplier formula. While the case has been made to pay more attention to government intermediate consumption expenditure, the evidence to show how this expenditure proportions of import content is different compared to expenditure on employee compensation is still outstanding. If we take it that expenditure on employee compensation is simply payment for services, and assume that the expenditure on intermediate consumption is only made up of payment for services, then the re-specified model of Palley (2009) will appropriately account for the import content of government expenditure. However, as I show next using the IOATs of 2010 for the UK, government intermediate consumption encompasses payment for goods and services, goods that are durable and nondurable, with varying import contents.

2.4.1 Mapping government intermediate consumption expenditure to industries

It is not straightforward to map the UK government intermediate consumption purchases to industries; nonetheless, the IOAT is a source of rich information to get an understanding of how this expenditure is split across industries, and in doing so we are able to calculate the import contents of the expenditure. The IOATs are derived from the supply-use tables which provide a detailed picture of the supply of goods and services by domestic production and imports, and the use of goods and services for final use and intermediate consumption. The IOAT is made up of a number of tables, including the 'supply table', 'use table', and 'imports table'. It is from the 'use table' and 'imports table' of goods and services that we can extract just how much of a particular good or service the government consumes because the tables show the relationships between inputs and outputs that are required to produce a given amount of goods and services[26].

[26]See Mahajan (2006) for a good summary of the development, compilation and use of Input-Output (I-O) in

Figure 2.4: Example of a basic input-output table



Source: *Author's*

Figure 2.4 provides an example of a basic input-output table, highlighting the three key components of intermediate demands, final demand, and value added (or primary inputs), and what it shows is that products are consumed by industries, households, governments, and also exported. In addition to this, the figure also shows that a proportion of this consumption is met via imported products, meaning we are able to extract just how much of the imports are in total consumption of a product.

In these tables, general government is treated as a non-market sector in the national account, meaning it provides goods and services not for profit[27]. This makes it distinct from the private sector, where goods and services are provided for profit. To capture this in the IOAT, the ONS separates out both the private and public sector in the 'use table', labelling government industries as non-market. Within the Input-Output (I-O) literature, these are usually labelled as service industries of government and are represented in the IOAT by standard industry classification (SIC) codes 38, 59, 60, 84, 85, 86, 87, 88, 90, 91 and 93. Descriptions of these service industries of government are presented in table 2.2, and they include for example education and human health services that the government provides to the public. The provision of these public services is not only carried out by government employees; in many cases, these services are purchased from the private sector. So, the private sector provides services on behalf of the government. For example, the NHS provides public health services; however, the government also purchases some health services from the private sector for the general public. In addition to this, and as explained earlier, the NHS purchases, for example, medicine and medical equipment from the private sector to deliver its service. These purchases are captured in the IOAT, and a key provision of the table is the split of government procurement into detailed product levels. The ONS doesn't provide a detailed step of how this mapping is done, but the ONS explains that 'the relevant data for central government were obtained from HM Treasury's COINS sys-

the UK national accounts and the difference between the I-O tables.

[27]While it is recognised that the government does produce some market output, according to the ONS, this amount is very small and most of the output of government is non-market.

tem, classified according to COFOG (classification of functions of government) which allowed a split by industry to be derived[28]. Total output for Local Government was available from returns submitted to NISRA; these were also categorised by function and hence could be classified by industry. These sources provided information on pay, procurement, capital expenditure and revenue receipts by central and local government.' This explanation doesn't highlight the limitations described by Dey-Chowdhury and Tily (2007) in that for the 'central government, the intermediate consumption breakdown for some government industrial categories is informed using the patterns of intermediate consumption for the market sectors (where the product allocation is derived from the ONS Purchases Inquiry)' (p.35-36. However, they also acknowledge that detailed product information is available for some departments that allows for a good industry split. Using this industry split, we are able to assess how many industries the government purchases from.

The analysis in this section is based on the 2010 IOAT, and the point is to illustrate how government expenditure is split across industries using the year 2010 as a sample year. There are 106 unique market products in the IOAT[29]; these are presented using two-digit and three-digit SIC codes so we are able to map government expenditure by industries, and in doing so are able to group them into expenditure on durables, nondurables and services. Table 2.2 presents the service industries of government in the IOAT tables as well as the number of industries each service industry of government makes purchases from. Based on the IOAT table for 2010, this comes to 88 industries (products). This number is significantly higher than the nine industries the government makes final demand purchases from, as presented in the final demand columns of the 'use tables' in the IOAT.

As shown in figure 2.5, government intermediate consumption expenditure (GICE) by each government service industry is quite varied, with purchases by 'public administration and defence; compulsory social security (SIC 84)' making up a significant amount, followed by 'human health services (SIC 86)'. By matching the numbers in figure 2.5 and table 2.2, it is clear that 'public administration and defence; compulsory social security (SIC 84)' not only makes the most purchases, but also purchases from a wider range of industries. Figure 2.5 also shows that there is significant import content in these purchases. What is striking, as shown in table 2.3, is that 24.6% of GICE is made up of imports; 36% of intermediate consumption purchases by SIC 86 is made up of imports, followed by SIC 59–60 with 28% of imports. Also, how GICE is split by size as shown in figure 2.6 indicates that many industries receive varying sizes of purchases from the government, confirming the views of Beetsma (2008) and Nekarda and Ramey (2011); 75 industries get at least £100m from government purchases, 52 industries get at least £500m, 38 industries get at least £1bn, and 23 industries get at least £2bn. Thus, the question becomes how the expenditure and import contents are spread across the industries the government

[28]COFOG can be mapped to industry classifications.

[29]Including non-market brings the number up to 127 products (government and Non-profit institutions serving households).

purchases from. Before explaining this, it is worth discussion of how these import contents are calculated.

As explained earlier, the IOAT separates both private and public sector demand for intermediate inputs based on market and non-market activities. This separation is made in two important 'use' matrices: the 'domestic' and 'import' use matrices. The import use matrix shows the imports used by market or non-market sectors in production processes, thus making it possible to calculate the proportion of imports in the intermediate consumption of government. Table 2.4 provides a hypothetical example of what data from the market and non-market split looks like. The table shows the consumption of products (goods and services) and primary inputs in the production process. The boxed area of the first two columns shows the domestic use (so inputs produced domestically), while the last two columns of the table show total import use. What is also important is the highlighted row of imports of goods and services; these figures are the same as the sum of the last two columns. This is because the last two columns are a further disaggregation of the import use for market and non-market production. The disaggregation is very useful as it allows us to identify which inputs are driving the import content in the production process. As can be seen with this example, the market production is less reliant on imports compared to non-market production; a unit of output requires approximately 0.13 units of imports for non-market production, compared to just 0.08 for market production. While the table is an example, the general principle can be extended to the full 106 products in the IOAT, and the 12 different government non-market service industries, and in doing so we are able to calculate the import content in government intermediate consumption.

By examining what each government service industry purchases, we can explore the different levels of imports in their intermediate purchases. As an example, using 2010 data, I examined how the purchases made by 'public administration and defence; compulsory social security (SIC 84)' is split across industries, and compared this to purchases made by other government service industries. What the data revealed was that there are more industries receiving higher proportions of the total intermediate purchases made SIC 84 compared to the other government service industries. The point here is that there is a need to account for the different profiles of government intermediate expenditure, so if there is an increase in government spending it would be incorrect to simply assume that the expenditure is spread across industries evenly. Even more important is how the import content of each government service industry varies. 'Basic pharmaceutical products and pharmaceutical preparations (SIC 21)' and 'Computer, electronic and optical products (SIC 26)' stand out as two industries that make up a significant amount of the import content of GICE, making up just over 27% and 28%, respectively, of total import content, so combined they make up over 55% of total government intermediate consumption imports. By comparing the import content of SIC 84' with other government service industries, as shown in table 2.15 in the appendix of this chapter, the need to take into account their differences is again evident because what the figures from the table reveal is that their import contents are very different. The point here is that if the government decides to increase spending and that spending falls SIC 84, then it would be wrong to assume an average import propensity of the government to calculate our multiplier because not only is how the spending is spread across industries different SIC 84 compared to other government service industries, but the import contents of SIC 84 purchases are also different[30]. At this stage, the second and concluding step in justifying the need to account for different types of government spending in our multiplier formula is complete. The next task is to group industries into our three sectors of interest: durable goods, nondurable goods and services.

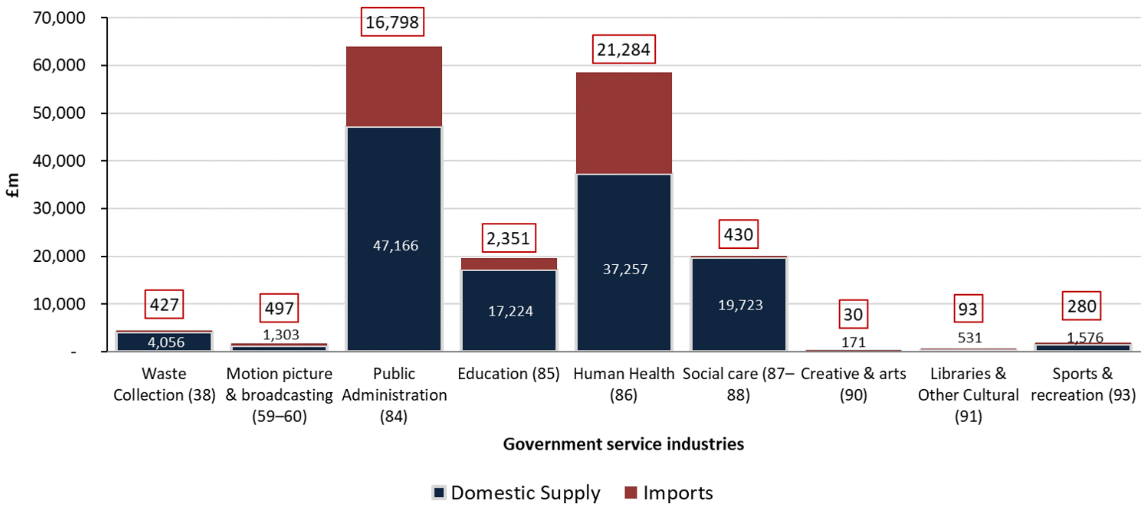
Table 2.2: Number of purchases by government service industries

SIC Codes	Government Service Industries	No. of Industries with Government Intermediate Purchases
38	Waste Collection, Treatment And Disposal Services; Materials Recovery	39
59—60	Motion picture, video and TV programme production services, sound recording & music publishing & programming and broadcasting services	44
84	Public Administration And Defence; Compulsory Social Security	85
85	Education	67
86	Human Health Services	62
87—88	Social care services	51
90	Creative, Arts And Entertainment Services	15
91	Libraries, Archives, Museums And Other Cultural Services	31
93	Sports services and amusement and recreation services	47
	Unique Total	**88**

Source: *Author's calculation using ONS IOAT 2010.*
Notes: The table presents the service industries of government in the IOAT tables, and the number of industries each service industry of government make purchases from. For example, the government made purchases from 85 industries to provide Public Administration and Defence services to the public.

[30]Please see table 2.15 in appendix for a table that provides a full list of all import contents split by industries.

Figure 2.5: Government intermediate consumption expenditure by service industries



Source: *Author's calculation using ONS IOAT 2010.*
Notes: The figure shows government intermediate consumption expenditure (GICE) by each government service industry. It also shows the amount of imports. For example, Public Administration expenditure in 2010 was £64bn, with £16.8 of this in the form of imports.

Table 2.3: Import content of government intermediate consumption expenditure

SIC Codes	Government Service Industries	Total Intermediate Consumption Expenditure (£m)	Imports (£m)	% Import
38	Waste Collection, Treatment And Disposal Services; Materials Recovery	4,483	427	9.5
59—60	Motion picture, video and TV programme production services, sound recording & music publishing & programming and broadcasting services	1,800	497	27.6
84	Public Administration And Defence; Compulsory Social Security	63,964	16,798	26.3
85	Education	19,575	2,351	12.0
86	Human Health Services	58,541	21,284	36.4
87—88	Social care services	20,153	430	2.1
90	Creative, Arts And Entertainment Services	201	30	14.9
91	Libraries, Archives, Museums And Other Cultural Services	624	93	14.9
93	Sports services and amusement and recreation services	1,856	280	15.1
	Total	**171,197**	**42,190**	**24.6**

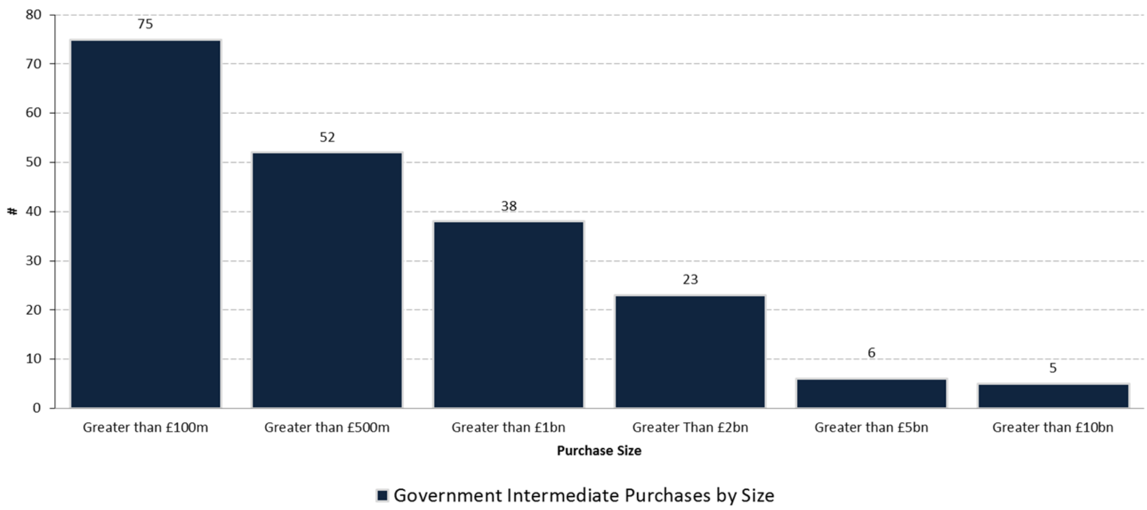
Source: *Author's calculation using ONS IOAT 2010.*
Notes: The table shows the amount of intermediate purchases by each government service industry. It also show the amount of imports they consume, and the proportion of imports in total intermediate purchases.

Table 2.4: Domestic and import use in production process

Product	Domestic Use (£m) Market Production	Domestic Use (£m) Non-market Production	Import Use (£m) Market Production	Import Use (£m) Non-market Production
Agriculture	23	46	1	3
Production	5,404	17,375	3,925	32,034
Construction	1,080	5,047	9	28
Distribution, transport, hotels and restaurants	2,687	10,724	3,181	1,912
Information and communication	1,775	5,073	45	676
Financial and insurance	1,579	4,133	129	209
Real estate	509	4,116	48	180
Professional and support activities	4,051	18,175	725	3,708
Government, health & education	8,250	36,055	11	1,202
Other services	867	2,373	234	911
Total consumption	26,225	103,117	**8,308**	**40,863**
Imports of goods and services	**8,308**	**40,863**		
Taxes less subsidies on products	1,278	18,253		
Taxes less subsidies on production	510	0		
Compensation of employees	59,813	147,653		
Gross operating surplus	14,837	12,889		
Total output	110,971	322,775		

Notes: Table shows how domestic and import use by market and non-market industries are split in the IOAT. The domestic use firgus are from the 'domestic use' table and it shows the amount of inputs used by the industry that is supplied domestically. The import use figures are from the 'import use' tables, it shows the imported inputs used in the production process. All figures are in £ millions.

Figure 2.6: Government intermediate consumption expenditure split by size



Source: *Athur's calculation using ONS IOAT 2010.*
Notes: The figure is split by size, so the pound amount shows thedemand industries received from the government. For example, it shows that 23 industries receive demand of over £2bn from the government in 2010.

2.4.2 Grouping industries into durable goods, non-durable goods, and services

This section describes the process taken to classify each industry as durable, nondurable, or services, and it is worth stating from the outset that it is a challenging task grouping industries into these categories. There is little controversy in classifying an industry as either goods or services; while it can be argued that services are embodied in components of goods, using the SIC to sort industries into goods or services is relatively straightforward. However, the splitting of goods into durable and nondurable goods is not as easy because there is no standard classification readily available. Although the Classification of Individual Consumption According to Purpose (COICOP) provides classification by type of product denoted by either 'nondurable', 'semi-durable' or 'durable', this classification is not available for government final and intermediate consumption. And while the COICOP is not easily mapped to SICs, there are great examples of such mapping taking place as shown by Yogo (2006) and Gomes et al. (2009) in their study of the durability of output and expected stock returns. Unfortunately, their mapping was done for the US, so it is not easily applicable to the UK, and also the COICOP is used for households; for these reasons, a mapping exercise is done here for the UK with some additions. The main point of contention in the mapping carried out here is that we treat government intermediate consumption as final consumption as the government is not transforming intermediate inputs into outputs[31], and also argue that goods that are durable for households are also durable for the government.

The UK's ONS constructs IOATs that relate the COICOP with the 123 industry/product groups. Using this table, we are able to assign 'nondurable', 'semi-durable' or 'durable' to industries (this matrix is presented in table 3 in the IO tables)[32]. Table 2.5 provides a visual aid for the classification process. For example, using the 2010 IOAT, the ONS maps 'food' (COICOP code 01.1) to nine industries, and using this mapping and the COICOP classification of food as 'nondurable', we classify all nine industries as nondurable goods industries. The food example is a very straightforward case, but it becomes clear that more steps are required in the classification process if we take, for example, COICOP code 09.2 which represents 'other major durables for recreation and culture'. Under the COICOP, code 09.2 is classified as durable goods and services, and is mapped to seven industries in the IOAT, one of which is 'products of

[31] This way we avoid the issue of goods transformed by the production process. This assumption is not unrealistic as the government does not have a production line where it buys goods to transform into other goods. If a producer buys steel, which is classified as a durable final good and used in vehicle production, we can argue that the steel itself is nondurable as it was used within a year. A durable good is defined as 'all goods which have longer shelf life, vehicles, furniture, major household appliances, telephone etc.' (ONS), while intermediate consumption is simply inputs consumed by the process of production. Taking the assumption that longer shelf life means anything above three years, the fact that some durable inputs are transformed in the process of production that is typically less than three years would mean classifying those products as nondurable, which is incorrect, e.g. classifying steel as nondurable because of its use as an input in vehicle production. So by treating all government consumption as final goods consumption, we avoid the possibility of this misclassification. In the IOAT for 1984, the government was only represented in the final demand column, meaning that both the intermediate consumption and final demand expenditure were grouped together, so the assumption is not as controversial as one would think.

[32] The number of industry/product splits in the UK IOAT means I am not able to map to four-digit SIC codes, as done by Yogo (2006) and Gomes et al. (2009) using the US tables.

agriculture, hunting and related services' which we have already classified as nondurable as it falls under food. To overcome this issue, a simple rule is put in place to classify each SIC industry into mutually exclusive product types. For each SIC, the classification is based on the COICOP classification of highest final consumption expenditure value; the example in table 2.5 provides a visual aid. For example, while textiles appears under a durable good label under COICOP 05.1, it is classified as semi-durable in four other COICOP codes, and more importantly the highest value of £6.31bn appears in COICOP code 05.2, which is classified as semi-durable and in doing so makes textiles a semi-durable good.

There is a difficult case of COICOP code 09.3, which has three product type classifications and is mapped to a SIC that includes a broad list of products, i.e. SIC 32 which represents 'other manufactured goods'. Products in this COICOP group include games, toys and hobbies, all classified as semi-durable, but this group also includes gardens, plants and flowers that are nondurable. With this example, a judgement was made by examining the full list of sub-sectors[33] within the industry, and by doing this it was clear that the industry is predominantly made up of semi-durable and durable goods. Finally, for industries that have zero household final consumption expenditure or cases where the COICOP mapping to SIC wasn't provided by the ONS in IO table 3, a judgement was made by going through the list of sub-sectors within these industries and reading through the descriptions of the activities within these sectors.

Once each SIC industry is mapped into mutually exclusive product type, semi-durable goods are then grouped into durable goods for the purpose of the analysis here. As expressed earlier, the COICOP product type to SIC mapping was done using the 2010 IOAT which is based on the SIC 2007[34], but rather than carrying out the same mapping process for the other years of available data, the SIC 2007 was simply mapped backwards to SIC 2003, SIC 1992, SIC 1980 to match the standard industry classifications in the IOATs for 1995, and 2005[35].

[33] 32120 Manufacture of jewellery and related articles; 32130 Manufacture of imitation jewellery and related articles; 32200 Manufacture of musical instruments; 32300 Manufacture of sports goods; 32401 Manufacture of professional and arcade games and toys; 32409 Manufacture of other games and toys, n.e.c.; 32500 Manufacture of medical and dental instruments and supplies; 32910 Manufacture of brooms and brushes; 32990 Other manufacturing n.e.c.

[34] SIC 2007 is a version of the UK's SIC and became effective from 1 January 2008. Details of UK SIC can be found at: https://www.ons.gov.uk/methodology/classificationsandstandards/ukstandardindustrialclassificationofeconomicactivities.

[35] UK SIC of economic activities was revised in 1958, 1968, 1980, 1992, 2003 and 2007. UK SIC became available from 1948.

Table 2.5: Visual example of classification

	Expenditure by COICOP Code							
SIC Code	01.1	03.1	05.1	05.1	05.2	09.2	09.3	Classification
01	**13,717**					151	2,868	ND
02							216	ND
03	413							ND
10.1	16,256							ND
10.2–3	10,256							ND
10.4	1,156							ND
10.5	11,054							ND
10.6	2,612							ND
10.7	7,188							ND
10.8	11,251							ND
13		2,526	4,086	4,086	**6,305**		442	SD
14		39,576						SD
31			9,941	9,941			56	D
32		552	1,677	1,677		146	**11,563**	SD

Source: *Data from table 3 of 2010 IO table.*
Notes: COICOP Codes: 01.1 (Food); 03.1 (Clothing); 05.1 (Furniture, furnishings, carpets etc.); 05.1 (Furniture, furnishings, carpets etc.); 05.2 (Household textiles); 09.2 (Other major durables for recreation and culture); 09.3 (Other recreational equipment etc.). D = Durable goods, ND = Non-durable goods, S = Services. COICOP = Classification of individual consumption according to purpose. The table provides a visual aid for the classification process used to map government expenditure to industries.

2.5 Government expenditure multipliers

This section presents government expenditure multipliers using data and classifications discussed in previous sections; I estimate GFCE multipliers, GICE multipliers, and government sectoral expenditure multipliers. Before presenting these multipliers, a preliminary discussion on other parameters in our multiplier formula is needed. For convenience, the multiplier formula is presented again:

$$\triangle Y = \frac{[(1-\rho)\lambda + (1-\sigma)\mu + (1-\nu)\psi]\triangle G}{(1-[1-\alpha](1-t)c_1)} \tag{2.33}$$

Where λ, μ, ψ represent the proportion of government spending on each type of expenditure, and ρ, σ, υ represent the import content in durable goods, nondurable goods, and services. c_1 is the MPC, t is the rate of income tax, and α represents the import content in household consumption. Estimates of household parameters are from different sources. Just as with government expenditure, the import content of household consumption was calculated using data from the IOAT. The MPC is a very tricky parameter even though it is common to assume a figure such as 0.8. However, such an assumption would be problematic especially in the case of the UK if we go by the evidence provided by Bunn et al. (2012) who showed, based on a survey conducted in 2012, that the average MPC for both negative and positive income shock is around 0.43[36], with negative income shock causing the highest response. While MPC tends to

[36]Findings were similar to a survey done the previous year and presented by Kamath et al. (2011).

vary by income group, how credit-constrained households are[37], and if the change is temporary or permanent (see Bunn et al., 2012; Kamath et al., 2011), the general message taken from the survey was that average MPC is below 0.5. Although it can be argued that this figure varies over time and should be reflected in the period covered in this paper, the lack of similar surveys or evidence for earlier periods means an MPC of 0.5 is assumed for all periods[38]. The survey asked households whether their 'post-tax income' was higher, lower or the same as they had expected a year ago and how they had adjusted their spending in response, meaning the value is the tax-adjusted MPC. Table 2.6 shows the baseline values for the household parameters.

Table 2.6: Household parameters

	$(1-t)c_1$	α
1995	0.5	0.12
2005	0.5	0.15
2010	0.5	0.13
2013	0.5	0.12

Source: *Import content calculated using ONS IOAT* .
Notes: The table shows the baseline parameter values for the household. It shows the figures out of a possible maximum of one.

2.5.1 The government final consumption expenditure multiplier

This section is very brief as the results presented are in line with the general consensus that leakages due to imports dampens the size of the multiplier. Table 2.7 shows how GFCE is split by expenditure on durables, nondurables and services[39]. Service expenditure accounts for a significant amount for all the years with an average of about 81%, and unsurprisingly its import content accounts for a lower proportion of total import content, as shown in table 2.9. A point worth making is the significant jump in the import content in GFCE between 2005 and 2010, with import content in 2010 more than double that of 2005. And if we compare the import

[37]Survey results showed that credit-constrained households have higher MPC (Kamath et al., 2011, p. 313).

[38]This has implications for the size of the calculated as, all else being equal, a higher MPC equates to a higher multiplier. Nonetheless, assuming a fixed MPC does not dampen the implication of the import content of government spending.

[39]To calculate this for years 1995, 2005 and 2010, I used final government consumption expenditure provided in the final demand columns of the IOAT, and from this the intermediate consumption expenditure is subtracted leaving behind what is labelled final demand consumption expenditure (this way there is no double counting of expenditure). For the purpose of the analysis, this expenditure is classified as 'service' expenditure based on the final demand column for the government in the IOAT showing that the government only purchases services and these purchases have zero import content. There are two problems with this approach. First, GFCE contains capital expenditure which would include all three sector types and most probably have a high proportion going to the goods sector (there is no available data split by industry). With the data showing that the import content of goods is higher than that of services, and some service sectors having import content, the assumption of zero import content for all other expenditure excluding intermediate consumption potentially biases our multiplier estimates upwards. Second, GFCE also includes social transfers in kind via market producers which are 'government expenditure financing goods and services provided to households by market producers. Typical examples are health care, and goods and services provided by doctors and pharmacists, financed by government units, through social security schemes or social assistance programmes' (ESA, 2010, p. 432). Again it is very likely that this expenditure is split across all three sectors with varying import content. While it was tempting to assume how this expenditure is split across sectors and estimate import content, doing so would introduce more questions than answers, thus a simple approach of assuming zero import content was taken. As with the first case, our estimated multiplier is potentially biased upwards.

content of GFCE to the import content of other aggregate demand components as presented in table 2.8, it becomes clear that this figure is not unrealistic. However, it is a break from the standard belief that government consumption tends to include substantially fewer imports than households (which is the case for the other years). So, there were more leakages in GFCE during a period when the UK was recovering from the financial crisis of 2008/2009. Using the estimated import contents, table 2.9 also shows multipliers for GFCE and what it confirms is that our calculated multiplier decreases as the import content in government expenditure increases. The calculated multipliers range from 1.68 in 1995 to 1.55 in 2010. The decline in total import content in the 2005 GFCE is not translated into a higher multiplier because household import content increased in 2005, and in doing so counteracted any potential upside impact on the multiplier size. The high proportion of imports in durable goods is a drag on the multiplier, so the higher government expenditure on durable goods, the lower the multiplier. As I show in section 2.5.3, considering each expenditure separately reveals an even bigger impact on the size of the multiplier.

Table 2.7: GFCE split by sector

Year	λ	μ	ψ
1995	0.091	0.092	0.817
2005	0.085	0.094	0.820
2010	0.089	0.127	0.783
2013	0.108	0.085	0.807

Source: *Calculated using ONS IOAT.*
Notes: The table shows how government final consumption expenditure (GFCE) is split by sector type. Sum of all sectors for each year equals one, so the figures capture the proportion in GFCE. Multiplying by 100 gives the percentange equivalent. For example, in 2010, 78.3% of GFCE was on services.

Table 2.8: Import content in components of aggregate demand

Year	GFCE	Household	Investment	Export
1995	0.067	0.111	0.243	0.037
2005	0.061	0.143	0.189	0.102
2010	0.125	0.130	0.153	0.061
2013	0.095	0.119	0.142	0.067

Source: *Calculated using ONS IOAT.*
Notes: The table shows the proportion of consumption that is met via imports. For example, in 2010, 12.5% of GFCE was made up of imports.

Table 2.9: GFCE multiplier

		Weighted import content			Multiplier
Year	Total Iimports	$\rho\lambda$	$\sigma\mu$	$\nu\psi$	k_{GFCE}
1995	0.063	0.037	0.012	0.014	1.68
2005	0.058	0.032	0.019	0.007	1.64
2010	0.125	0.054	0.042	0.029	1.55
2013	0.095	0.061	0.009	0.025	1.62

Source: *Import content calculated using ONS IOAT .*
Notes: The table shows the total import contents in each category of government expenditure and estimated multiplier for each year. The weighted import content shows the import contribution of each sector to total imports.

2.5.2 The GICE multiplier

While the previous sections provided multipliers for general government expenditure that are comparable to other multipliers in the literature, this section argues that more attention needs to be paid to differences in spending categories as it has implications on the size of the multiplier. Table 2.10 shows the percentage of GICE spent on each sector, and unsurprisingly again for our three periods, the government spends a significant amount on services. However, what it also shows is that this percentage has been declining, from 66% in 1995 to 57% in 2013, with the government spending more on goods, i.e. the decline is more significant than shown in table 2.7. This decline has important implications, as table 2.11 shows that the import content of goods is quite high; although expenditure on goods is less than half of GICE, it accounts on average for about 79% of the total import content of GICE. And by further examining 2005, where the import content of services was even smaller, the import content of goods accounted for 87.7% with just 37.4% of expenditure. The rise of the import content in GICE from 11.5% in 1995 to 21.5% in 2013, combined with the increase of GICE as a proportion of final government consumption expenditure as shown in table 2.1,and the fact that GICE includes expenditure on goods, means import content becomes an even more important parameter if expansionary government spending occurs in this category of government consumption expenditure. Using the estimated import content, table 2.11 shows multipliers for GICE. Again, just as the case of GFCE, the import content in durable goods dampens the size of the multiplier, and the fact that the import content is higher means the GICE multipliers are lower than those of GFCE. An important point that was not discussed about the figures from table 2.9 in section 2.5.1 is that once we consider all government spending, the percentage of import content declines significantly due to the fact that the final demand component of government expenditure has no import content. However, using this percentage of import content could be misleading as an increase in government spending might not be in the final demand component and might only be in intermediate consumption, hence our calculated multiplier would be biased upwards[40]. The differences in multipliers based on which import content calculation is used becomes clear when we compare multipliers for GICE and GFCE, as shown in table 2.12. For 2010, the multiplier is just over 16% lower if the import content of GICE is used, and this is a significant

[40]For example, as shown in figure 2.3, for the year 2008, compensation to employees declined by 0.27%, but government intermediate consumption increased in by 7.7%.

difference, further highlighting the importance of the import parameter and using appropriate import content estimates. As I show next, when we consider the sectoral import content, then differences in estimated multipliers are quite striking.

Table 2.10: GICE split by sector

Year	λ	μ	ψ
1995	0.167	0.169	0.664
2005	0.178	0.196	0.626
2010	0.176	0.240	0.584
2013	0.246	0.181	0.573

Source: *Calculated using ONS IOAT .*
Notes: The table shows how government final consumption expenditure (GICE) is split by sector type. Sum of all sectors for each year equals one, so the figures capture the proportion in GICE. Multiplying by 100 gives the percentange equivalent. For example, in 2010, 58.4% of GFCE was on services.

Table 2.11: GICE multiplier

		Weighted import content			Multiplier
Year	Total imports	$\rho\lambda$	$\sigma\mu$	$\nu\psi$	k_{GICE}
1995	0.116	0.068	0.022	0.025	1.59
2005	0.121	0.067	0.039	0.015	1.53
2010	0.246	0.107	0.083	0.057	1.33
2013	0.215	0.138	0.021	0.056	1.40

Source: *Import content calculated using ONS IOAT .*
Notes: The table shows the total import contents in each category of government expenditure and estimated multiplier for each year. The weighted import content shows the import contribution of each sector to total imports.

Table 2.12: Multipliers for GICE and GFCE

	Import content		Multipliers		% Diff in k
Year	$GICE$	$GFCE$	k_{GICE}	k_{GFCE}	% Diff in k
1995	0.116	0.068	1.59	1.68	0.060
2005	0.121	0.067	1.53	1.64	0.071
2010	0.246	0.107	1.33	1.55	0.161
2013	0.215	0.138	1.40	1.62	0.153

Source: *Import content calculated using ONS IOAT .*
Note: The table compares multipliers from tables 2.9 and 2.11.

2.5.3 Government sectoral expenditure multiplier

The multipliers calculated thus far have used import content that has been weighted by taking into account the percentage share of a sector in either GFCE or GICE. What is presented in this section is a scenario where total expenditure occurs only in one sector. So if, for example, the government decided to increase spending just on durable goods, then the import content provided in table 2.13 would be the appropriate content to use as it only captures the import content of total durable goods expenditure, i.e. $\Delta\lambda = 1$, while $\Delta\mu = \Delta\psi = 0$. Table 2.13 shows the import content of each sector in this scenario, and what is striking is just how different the impact on sectoral spending is. If we take 2010 as an example and assume the government increases spending on just durable goods, then what table 2.13 shows is that 60.1% of that spending leaks out due to imports, so the actual amount that stays in the domestic economy is just about 40%, which results in a multiplier of 0.7[41]. To get an idea why this is the case, we need to look at some specific examples for 2010. The government spent £15.3bn on 'computer, electronic and optical products (SIC 26)' and 77.8% of this purchase was made up of imports; the high level of imports is repeated for 'air and spacecraft and related machinery (SIC 30.3)', with 82.9% of government purchases made up of imports (see table 2.15 in appendix for full list). So although the 2010 import content seems high compared to 2005 and 1995, the general message here using data from IOAT is that what the government spends its money on is important, and the multiplier can be as high as 1.76 or as low as 0.78. The below one multiplier does not come about because of the crowding out of private household consumption but because a significant amount of the spending leaks out of the multiplier process. The multiplier for service expenditure is always above one, but the multipliers for goods can be about or below one, with the multiplier for durable goods lowest of all three expenditure types.

Furthermore, lower multipliers are reported when government intermediate consumption is adjusted to exclude *taxes less subsidies on products*. This adjustment was made given that some might argue that capturing taxes in government expenditure is misleading as it is not really expenditure since it is the government paying itself, so using the unadjusted government expenditure as done thus far to calculate the percentage of import content would give an inaccurate picture. As table 2.14 shows, when adjusted for tax, the multiplier for durable goods is significantly lower at 0.46. This result must be taken with caution because as discussed in section 2.3 when presenting the limitations of the income-expenditure model presented in this chapter, the model does not account for dynamic effects. Durable goods tend to be produced by capital-intensive industries; given that the model used in this chapter mutes the accelerator principle, as discussed earlier, which is dependent on the capital/output ratio, the model fails to capture the feedback loop of any increase in output on the investments of these industries, and in doing so we are probably capturing the lower bound of this multiplier.

[41]The fact that 60.1% leaks out seems high but this is not a surprise as a similar point was made about investment grants by Broadberry and Leunig (2013, p. 26) who stated that '*there were particular problems with investment grants to the shipbuilding industry, where it was later discovered that more than three quarters of the £609 million paid out in investment grants for shipbuilding between April 1967 and March 1978 was paid for ships constructed outside of the United Kingdom (Hansard, 13 July 1978, written answer)*'.

Table 2.13: Government sectoral expenditure multiplier

	Import content			Multipliers		
Year	ρ	σ	ν	k_λ	k_σ	k_Ψ
1995	0.410	0.131	0.017	1.06	1.56	1.76
2005	0.377	0.198	0.009	1.08	1.40	1.73
2010	0.606	0.333	0.037	0.70	1.18	1.70
2013	0.560	0.110	0.031	0.78	1.57	1.72

Source: *Import content calculated using ONS IOAT .*
Note: The table shows the total import content in each category of government expenditure and estimated multipliers for each year.

Table 2.14: Government sectoral expenditure multiplier *(excluding expenditure attributed to taxes)*

	Import Content			Multipliers		
Year	ρ	σ	ν	k_λ	k_σ	k_Ψ
1995	0.378	0.136	0.026	1.12	1.55	1.75
2005	0.419	0.290	0.009	1.01	1.24	1.73
2010	0.742	0.403	0.038	0.46	1.06	1.70
2013	0.743	0.130	0.032	0.46	1.54	1.71

Source: *Import content calculated using ONS IOAT.*
Note: The table shows the total import contents in each category of government expenditure and estimated multiplier for each year.

2.5.4 Replicating the results empirically

A natural question from the presented multipliers is if the results can be replicated empirically. As discussed in chapter one of this thesis, the lack of government spending data at sectoral and industry level means there are few papers that have empirically examined the impact of government spending for durable goods, nondurable goods and services. Monacelli and Perotti (2008) presented results for the US that suggest the impact on services tends to be greater than manufacturing. As discussed in section 2.2, Boehm (2016) estimated fiscal multipliers for durable and nondurable goods industries using a defence spending instrument. His results suggest multipliers for gross output, value added, cost of materials, energy expenditure, and employment are uniformly larger in nondurable goods sectors. Although focused on aggregate output and a panel of countries, the results presented by Sheremirov and Spirovska (2015) were opposite to those presented by Boehm (2016). They showed government spending having a bigger impact when spent on durable goods, suggesting less crowding out than indicated by the results of Boehm (2016). Thus, there is still an ongoing debate in the empirical literature; I contribute to this literature in chapter three of this thesis, and focusing on the UK, I briefly discuss the implications of the results in chapter four.

Using newly constructed industry-specific government demand to examine industry effects, I estimate output elasticity to government demand individually for 87 industries[42]. Of these

[42]See chapter three for the empirical approach and industry-specific government demand construction.

industries, 27 are classified as nondurable, 19 as durable, and 41 as services. The argument presented in chapter three is that the story of the government spending multiplier is one that not only needs to take into account the input-output linkages in the economy, but also the initial responses of industries. Thus, if it is the case that durable goods industries are less likely to respond to government demand, then the small multipliers in the simple theoretical model presented in this chapter are likely to be replicated in an empirical setting.

As will be explained in chapter three, the majority of industries in the UK don't seem to respond to government demand; only 26 out of 87 industries have output elasticities to government demand statistically significant from zero: a mix of nondurable (11), durable (4) and services (11). The 26 significant elasticities are both positive and negative for each industry type. The results also show that there are larger negative elasticities for durable goods industries; of the four durable goods industries with significant elasticities, the impact of government demand is negative for two industries, with elasticities of -0.3 and -0.56. When compared to the nondurable goods industry, we get a different story in that only two out of the 11 elasticities were negative, with elasticities of -0.12 and -0.21. So not only does government demand have more positive impact on nondurable goods industries, but the negative impact cases are not as severe as those of durable goods. Thus, suggesting government demand on nondurable goods would result in larger aggregate multipliers. Similarly, when we focus on the service industries, even though three out of the 11 industry elasticities were negative, their magnitude was smaller than those of the nondurable and durable industries, and the positive elasticities were much larger. These estimates suggest that the multiplier effect of government demand on services is greater than those of nondurable and durable goods.

While the presented elasticities seem to suggest that the theoretical prediction in this chapter would hold in an empirical setting, what these results don't provide is an explanation for a few industries responding to government demand. This is discussed in detail in chapter four with the hypothesis that the UK government is not spending enough at industry level to generate a significant impact. For most industries, government demand made up less than 10% of their total demand, which seems to be an important factor based on the positive relationship between the estimated elasticities and the ratio of government demand.

2.6 Conclusion

In this chapter, the modified income-expenditure model has been extended to account for sectoral government spending, and in doing so we can see the impact the different import content has on the size of the government spending multiplier. This approach deviates from the role given to the intertemporal elasticity of substitution across sectors to explain variation in multiplier size. Leakages have a fundamental role to play in the multiplier process, and the simple model presented in this chapter shows that more attention should be given to it in the fiscal policy literature.

Distinguishing between government spending on durable goods, nondurable goods and services, and using data from the IOATs, the estimated multiplier in this paper shows that the government spending cumulative multiplier can be as high as 1.76 and as low as 0.78. The differences in import content across sectoral expenditure are responsible for this variation, and when taxes are excluded from government expenditure, then the multiplier can be as low as 0.46. For the period considered, the multiplier for services expenditure is always above one, but the multipliers for goods can be about or below one, with the multiplier for durable goods lowest of all three expenditure types.

The results presented suggest that the government should spend more on services and less on goods, especially durable goods; however, it is not as straightforward as the results would suggest. First, the results present the government with a dilemma given that it is readily recognised that the durable goods sector is very cyclical, so it tends to decline more during a crisis, a period with which stimulus from the government would most likely be recommended. Thus, the government has to decide on whether it stimulates the sector even though it knows the multiplier on such spending is smaller compared to alternatives. Second, as discussed, the static model extended in this chapter to highlight the importance of imports to explain variation in multiplier values fails to account for dynamic effects, especially in the case of capital expenditure present in GFCE. The model is mute on any effect these types of expenditure can have on the productive capacity of the economy, so while the leakages might be higher compared to other expenditure, the impact of, for example, building a bridge or transport infrastructure is not captured. Thus, while the data used shows the type of expenditure that has higher import content, hence suggesting lower multipliers, not accounting for the dynamic effects of the expenditure types means the reported impact of these is biased downwards. So, although the results might suggest spending less on durable goods to reduce leakages from imports, considering the dynamic effects of the expenditure means there is a balance to be struck.

Appendix C2: Tables

Table 2.15: Import content split by sic code in IOAT 2010

		% Import in		
SIC Code	Sector	SIC 84	GICE	Diffs
01	ND	0.000	0.062	-0.062
02	ND	0.000	0.000	0.000
03	ND	0.000	0.000	0.000
05	ND	0.000	0.000	0.000
06 & 07	ND	0.000	0.000	0.000
08	ND	1.000	1.000	0.000
09	ND	0.000	0.000	0.000
10.1	ND	0.049	0.057	-0.008
10.2-3	ND	0.022	0.017	0.005
10.4	ND	0.000	0.212	-0.212
10.5	ND	0.000	0.100	-0.100
10.6	ND	0.000	0.077	-0.077
10.7	ND	0.000	0.050	-0.050
10.8	ND	0.000	0.055	-0.055
10.9	ND	0.000	0.000	0.000
11.01-6	ND	0.000	0.000	0.000
11.07	ND	0.143	0.148	-0.005
12	ND	0.000	0.000	0.000
13	D	0.242	0.290	-0.047
14	D	0.640	0.629	0.010
15	D	0.507	0.507	0.000
16	D	0.000	0.214	-0.214
17	ND	0.166	0.178	-0.012
18	ND	0.000	0.000	0.000
19	ND	0.427	0.406	0.021
20A	ND	0.000	0.460	-0.460
20B	ND	0.455	0.400	0.055
20C	ND	0.000	0.044	-0.044
20.3	ND	0.135	0.131	0.004
20.4	ND	0.008	0.033	-0.025
20.5	D	0.619	0.722	-0.103
21	ND	0.582	0.710	-0.128
22	D	0.566	0.290	0.276
23OTHER	D	0.211	0.185	0.027
23.5-6	D	0.000	0.004	-0.004
24.1-3	D	0.000	0.000	0.000
24.4-5	D	0.000	0.000	0.000
25OTHER	D	0.148	0.086	0.062
25.4	D	0.097	0.097	0.000
26	D	0.773	0.778	-0.005
27	D	0.471	0.452	0.019
28	D	0.542	0.542	0.000
29	D	0.641	0.476	0.165
30.1	D	0.000	0.000	0.000
30.3	D	0.828	0.828	0.000
30OTHER	D	0.571	0.073	0.498
31	D	0.189	0.111	0.078
32	D	0.257	0.291	-0.033
33.15	ND	0.000	0.000	0.000
33.16	ND	0.000	0.000	0.000
33OTHER	ND	0.000	0.000	0.000
35.1	ND	0.034	0.012	0.021
35.2-3	ND	0.136	0.033	0.103

Source: *Import content calculated using ONS IOAT* . Notes: the table shows the proportion of imports in government final consumption expenditure compared to human health services provided by the government. It shows how much of each input used by the government is made up of imports. Figures are scaled to one, so multiplying by 100 gives the percentage equivalent. *D = Durable goods, ND = Non-durable goods, S = Services.*

Table 2.16: Import content split by sic code in IOAT 2010 (continued)

		% Import in		
SIC Code	Sector	SIC 84	GICE	Diffs
36	ND	0.069	0.038	0.031
37	ND	0.000	0.000	0.000
38	ND	0.365	0.238	0.127
39	ND	0.000	0.000	0.000
41-43	ND	0.004	0.005	0.000
45	S	0.012	0.012	0.000
46	S	0.000	0.000	0.000
47	S	0.000	0.000	0.000
49.1-2	S	0.315	0.330	-0.015
49.3-5	S	0.279	0.063	0.216
50	S	0.577	0.596	-0.018
51	S	0.971	0.974	-0.002
52	S	0.703	0.607	0.097
53	S	0.042	0.039	0.003
55	S	0.756	0.728	0.028
56	S	0.110	0.111	-0.001
58	S	0.049	0.054	-0.005
59-60	S	0.323	0.369	-0.046
61	S	0.019	0.014	0.004
62	S	0.204	0.133	0.071
63	S	0.000	0.000	0.000
64	S	0.045	0.045	0.000
65.1-3	S	0.050	0.055	-0.005
66	S	0.107	0.107	0.000
68.1-2	S	0.036	0.039	-0.002
68.2IMP	S	0.000	0.000	0.000
68.3	S	0.250	0.120	0.130
69.1	S	0.022	0.024	-0.001
69.2	S	0.011	0.016	-0.006
70	S	0.016	0.015	0.001
71	S	0.246	0.168	0.077
72	S	0.270	0.309	-0.039
73	S	0.054	0.058	-0.004
74	S	0.358	0.359	-0.001
75	S	0.000	0.000	0.000
77	S	0.462	0.233	0.229
78	S	0.045	0.043	0.002
79	S	0.114	0.088	0.025
80	S	0.002	0.001	0.001
81	S	0.000	0.000	0.000
82	S	0.357	0.354	0.004
84	S	0.004	0.004	0.000
85	S	0.026	0.023	0.003
86	S	0.012	0.087	-0.075
87-88	S	0.063	0.000	0.062
90	S	0.614	0.493	0.121
91	S	0.498	0.486	0.012
92	S	0.000	0.000	0.000
93	S	0.414	0.390	0.024
94	S	0.000	0.000	0.000
95	S	0.252	0.244	0.008
96	S	0.028	0.016	0.011
97	S	0.000	0.000	0.000

Source: *Import content calculated using ONS IOAT* . Notes: the table shows the proportion of imports in government final consumption expenditure compared to human health services provided by the government. It shows how much of each input used by the government is made up of imports. Figures are scaled to one, so multiplying by 100 gives the percentage equivalent. *D = Durable goods, ND = Non-durable goods, S = Services.*

Chapter 3

Industry Output and Price Response to Government Demand: Evidence for the UK

3.1 Introduction

'*The great attraction of the Keynesian system is its simplicity, which is, at the same time, its danger and its limitation. I propose to indicate how we may relax its cruder aggregative aspects without too hopelessly complicating matters. To accomplish this step we naturally turn to the Leontief matrix as an adequately simple representation of general equilibrium.*'

(R.M. Goodwin, 1949, p. 1)

As the quote above illustrates, there is a rich history of the input-output (I-O) framework developed by Leontief (1936) being used to further our understanding of the government spending multiplier. This chapter carries on the tradition by focusing less on matrix algebra and instead takes advantage of the data in the I-O tables to understand the effects of industry-specific government demand. The financial crisis of 2008 motivated a renewed interest in the output effects of fiscal policy[1]; however, apart from the general conclusion of a lack of consensus on the size of the output effects of government spending, what also stands out with recent empirical contributions is that while there is a good amount of contribution to the aggregate- and local-level effects literature, the same cannot be said for the sectoral and industry effects strand of the literature. Thus, the aim of this chapter is twofold: first, to document the heterogeneous effects of government demand across industries; and second, to assess the output multiplier implications of this heterogeneity using a simple I-O model.

Until quite recently, as discussed below, mainstream neoclassical and NK models have neglected the I-O industry structure of the economy, with a common treatment of grouping indus-

[1]See for example Gechert and Will (2012), Hebous (2011), Ramey (2011b) and Spilimbergo et al. (2009).

tries into buckets of intermediate or final goods/service-producing sectors. With this treatment, not enough attention has been given to an avenue that can enhance our understanding of the transmission mechanism of fiscal policy. As argued in this chapter, the impact of government demand is heterogeneous across industry and this plays an important role on overall aggregate effects. Thus, fiscal policy actions should not be taken with aggregate effects in mind only; rather, these should be complemented with disaggregated effects in the form of sectoral and industry effects. Unsurprisingly, one can point to the availability or lack of disaggregated government spending data at sectoral and industry level as a major reason why there are few empirical contributions. Using a new government demand measure constructed from the I-O accounts of the UK, this chapter investigates the output and price effects of industry-specific government demand. This approach was conceptualised by Perotti (2008) using the US input-output accounts and this chapter extends this new measure to UK I-O accounts. Even with this new measure, there is still the challenge of developing and testing strong hypotheses for the heterogeneous effects of fiscal policy across industry as, for example, done by Aghion et al. (2014); nonetheless, an attempt is made.

Even with the limited contributions, we can group the industry and sectoral fiscal literature into two broad areas. The first group emphasises the sectoral composition of the economy, with the impact of fiscal policy dependent on sector characteristics or interactions among sectors. For example, Ramey and Shapiro (1998) rely on the importance of costly capital reallocation between sectors, while Boehm (2015) relies on the crowding out argument where some sectors such as durables can experience larger crowding out, so the government buying durable goods would be expected to have a smaller impact on the economy. As discussed later, elements of this group of studies can be linked to a strand of the business cycle literature that place key importance on sectoral linkages in explaining aggregate fluctuations (e.g. Horvath, 1998; Acemoglu et al., 2012), with some sectors more important than others in explaining aggregate fluctuations (e.g. Calvaho, 2014; Pesaran and Fan Yang, 2016). The second group of studies, which has seen fewer contributions, tends to be more focused on providing key sets of industry characteristics that determine if government spending has an impact on the industry's output; it is therefore less concerned with aggregate effect and more interested in individual industry effects. For example, Aghion et al. (2014) provided evidence which suggests the growth effects of fiscal policy are greater in financially constrained industries because such policy reduces aggregate volatility; this reduction is argued to be important as volatility tends to discourage credit-constrained industries from making long-term growth-enhancing investments. This chapter fits within the second group as the focus is on estimating the heterogeneous effect of government spending across industries, with an attempt made at providing a possible explanation for this heterogeneity. After which the output multiplier implication of the results is examined using a simple input-output model.

As discussed in chapter two of this thesis, the fact that fiscal instrument data suffer from

Table 3.1: Heterogeneous effects of government demand at industry level

	Output	Price	No of Industries
Group 1	Yes	Yes	15
Group 2	Yes	No	8
Group 3	No	Yes	26
Group 4	No	No	32

Notes: The table shows four scenarios captured with the estimated impact of government demand on output and prices. For example, the first group indicates that government demand had a significant impact on the output and price level of industries in the group.

reverse causation with other macroeconomic variables like GDP means the identification of exogenous spending shocks is a major challenge when empirically examining the impact of government spending. While it is possible to take advantage of the fiscal policy rule literature to extract discretionary government spending at aggregate level, use narrative records or utilise a VAR on aggregate-level data to extract exogenous spending shocks, we are not able to easily extend these approaches to sectoral and industry analysis due to data availability. Few studies have taken advantage of the IO accounts to overcome this challenge, constructing industry-specific government demand instruments, but these have so far only been done for the US (see Perotti, 2008; Nekarda and Ramey, 2011; Belo et al., 2012). This chapter uses similar data for the UK, but instead of constructing a government demand instrument as done in the aforementioned studies, unique data provided by the UK's Office of National Statistics (ONS) is used to explore the heterogeneous output and price responses of industries to government demand. Government demand is constructed using government current spending on goods and services, a series which captures wage and non-wage components of government consumption expenditure.

As table 3.1 shows, four scenarios play out with results presented: 1) for some industries, government demand has an impact on both output and price, 2) for some it affects only output and not price, 3) for some the reverse holds true, so government demand impacts prices and not output, and 4) for a lot of industries government demand has no significant impact on output or price. This heterogeneous response seems to be correlated to imports and the proportion of industry output consumed by the government, and given that the proportion of government demand varies over time, results presented here suggest another possible explanation to the varying size of UK fiscal multipliers as presented by Cimadomo and Benassy-Quere (2012), Rafiq (2014) and Glocker et al. (2017). This heterogeneous response across industries also offers a possible explanation why empirical output multiplier evidence reported for the UK tends to be either below unity or just above; if government demand has first order effects only on a few industries, then any further rounds of effects can be expected to be much smaller than if government demand initiates significant output response from a majority of industries. The interlinked production structure of the economy means the size of the multiplier is ultimately linked not only to household response, but also to how firms within industries respond to any increase in government demand. Thus, if these firms are not increasing production, all else being equal, then it means they are not demanding either additional labour or inputs from other firms, which also has an impact on the labour demands of these firms. Put simply, the multiplier process is muted if firms within industries don't respond to government demand by increasing production. Thus, the story of the *government spending multiplier is one that not only needs to take into account the input-output linkages, but also the initial response of industries.* Using estimated industry output elasticities to government demand, a simple input-output model is used to estimate output multipliers, with cumulative multipliers ranging between 0.74 and 1.44.

The multiplier process is well understood, as discussed in chapter one, and we can modify and condense the eight essential elements recognised by Clark (1935) into the following: i) expansionary expenditure, ii) a resultant increase in income that is subsequently spent by the recipient, iii) leakages arising from the increase in income not being spent and income spent on imported goods, iv) the resulting multiplier, with leakages assumed to remain constant through the process, v) the time it takes for the multiplier process to complete, and vi) counteracting factors. Focusing simply on element (ii), it is clear in our case that the recipients are both firms and government employees (receiving wages), so if firms are not responding by increasing production to meet government demand, then an important element of the process is not fulfilled, which ultimately impacts the size of the multiplier. Results presented in this paper suggest aggregate government spending policies should be made with their industry impacts considered as it could be the case that an approach of making sure government demand has the desired effect on specific industries might yield better aggregate effects.

The remainder of the chapter is organised as follows. Section two discusses relevant literature. Section three describes the government demand measure construction process. Section four presents the empirical model. Section five discusses the results. Section six uses a simple input-output model to explore the implications of the results presented in section five. Section seven concludes.

3.2 Some preliminaries: relation to other recent literature

Literature on the sectoral and industry effect of fiscal policy is interested in assessing, for example, the short-run effect on the output, employment and wage dynamics of a sector due to a change in discretionary government spending or taxation. The standard one-sector set-up common in neoclassical[2] and NK models would imply that what the government spends money on does not have an impact on economic activity[3]; however, the results from a two-sector neoclassical model of Ramey and Shapiro (1998) suggest otherwise. They showed in a neoclassical model with costly capital reallocation between sectors that government spending increases have different aggregate effects than they would in a one-sector model, with a magnified effect on out-

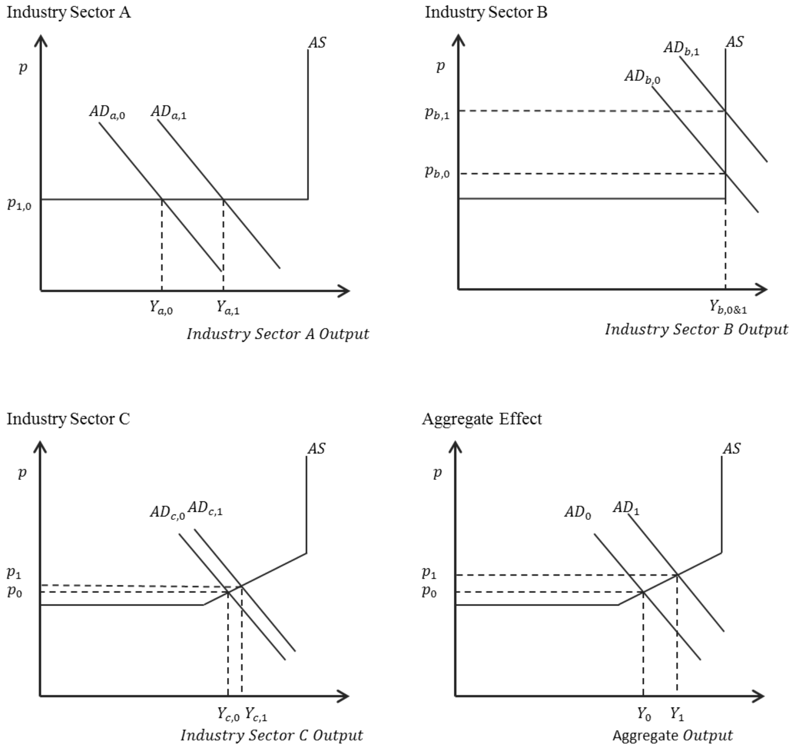
[2]See, for example, Baxter and King (1993). I follow Fontana (2009b) in labelling this group of real business cycle models as neoclassical models.

[3]Except in cases of productive government spending.

put and employment. In addition, rather than a higher interest rate as common in neoclassical models, their model showed that government spending increases can lead to temporarily lower interest rates. Their results also showed that wages and price effect differ significantly across sectors, which is consistent with those presented in this paper. Even with their results, there is still little understanding on the possible heterogeneity in sectoral and industry responses to government demand and the determinants of any such heterogeneity.

Beetsma (2008, p. 16) rightly expressed that 'fiscal expansion designed to stimulate the economy may have different effects on different sectors of the economy', and since an important part of the aggregate effect of changes in government spending is through shifts in the demand across sectors of the economy (Ramey and Shapiro, 1998), understanding the possible heterogeneous output and price effects of fiscal policy across sectors will undoubtedly better our understanding of aggregate effects. To illustrate the possible heterogeneous effects, I extend the two-sector example provided by Palley (2015) to three sectors to demonstrate the difficulty of achieving the same effect across industries using an aggregate policy instrument, which in our case is government spending. Figure 3.1 shows changes in prices and output for three different industry sectors in response to an increase in *aggregate demand*. Given that sectors can be at different points in terms of employment levels, one sector can experience an increase in output with no effect on price level (industry sector A), another sector experiences an increase in price with no impact on output (industry sector B), while the other sector experiences an increase in both price and output (industry sector C), with the aggregate effects a combination of all industry sector conditions. As the diagram shows, the fortunes of industry sectors are different even though the overall aggregate effect is of an increase in output and price level.

Figure 3.1: A three sectors economy



Source: Palley (2015), with minor modifications.

The theoretical literature also tends to rely on the response of households to price level to explain the sectoral effects of a fiscal shock. For example, it is readily accepted that the demand for nondurable goods differs from that for durable goods: if prices for durable goods increases as a result of a fiscal shock[4], then households are able to rely on existing stocks and postpone new purchases until prices decrease. However, households don't enjoy the same benefit from existing goods for nondurables given that they are consumed immediately, so a price increase does not affect their demand as much as it does for durable goods. Thus, a fiscal shock that increases price level is deemed to have greater crowding out effect in durable goods and this translates to a smaller multiplier effect on durable goods. This view of a smaller multiplier effect in one sector compared to the other is also applicable when sectors are identified as either tradable or non-tradable. It follows that if a fiscal shock causes an appreciation in the exchange rate (this translates into higher prices for foreign buyers), this appreciation can depress foreign demand for tradable goods and as a result any increase in domestic demand from an increase in government spending can be seen as simply replacing this decline in foreign demand. However, the same does not apply for the non-tradable goods sector: while some crowding out can occur, this sector is not directly exposed to the exchange rate channel, and as a result the multiplier effect can be expected to be greater than that of the tradable sector[5]. By combining the effects

[4]The assumption here is that the shock is temporary; if the shock is permanent, then households won't postpone their durable goods purchase.

[5]It is worth noting that relative price between tradables and non-tradables can alter the pattern of production

on the defined sectors, the aggregate effect can be described as being dependent on the amount of crowding out that occurs in each of our defined sectors, with aggregate effect greater the smaller the crowding out in each sector[6]. Next I discuss the empirical evidence, focusing first on aggregate effects before discussing industry and sectoral effects.

As expressed earlier, the crisis of 2008/09 reawakened interest in the economic impact of government spending, but very few papers have empirically assessed the output effects of government spending specifically for the UK. Most studies tend to be focused on the US, and when UK data is used, it tends to be part of a panel (e.g. Ravn et al., 2007; Qazizada and Stockhammer, 2015). Nonetheless, for papers that have focused specifically on the UK, the results seem to point to a multiplier of below unity and in some cases below zero. Another commonality seems to be that the output effects of government spending change over time. In the often cited paper, Perotti (2005) presented annualised cumulative multipliers at -0.70 and -1.33, for a one- and three-year horizon, respectively[7]. His results also showed that pre-1980s, the multiplier although below one was positive, but post-1980 the multiplier became negative. Similar below unity multipliers were presented by Pappa (2009), who reported cumulative multipliers of 0.39 and 0.07 at one- and three-year horizons, respectively[8]. However, she did not find significant differences between subsamples as reported by Perotti (2005). The differences in reported results is possibly due to the fact that both used different VAR approaches[9]. In addition, both papers used different sample periods[10], and as recent evidence suggests, this has significant importance in the varying size of reported multipliers[11]. More importantly, recent evidence also takes into account differences between recessionary and expansionary periods. For example, Rafiq (2014) presented evidence for the UK that shows the period-varying nature of government spending, with multipliers spiking during crisis episodes, and more importantly the multipliers were below unity. This result was broadly consistent with those presented by Cimadomo and Benassy-Quere (2012), who reported positive fiscal multipliers in the 1970s and 2000s but insignificant multipliers in the 1980s and 1990s. However, both papers miss out the recovery period of the crisis of 2008/09[12], a period Glocker et al. (2017) included.

Glocker et al. (2017) presented evidence showing a two-year horizon, average cumulative multiplier above one (1.15) for a recessionary period and below one (0.33) for non-recessionary periods after a 1% GDP rise in government spending, with the average multiplier for the entire

and expenditure in both sectors. See Guest and Makin (2011, p. 5).

[6]While this level of sectoral aggregation is useful, it is not possible to examine the different responses of industries within these sectors with such aggregation. This chapter attempts to shed some light on this, showing that there are heterogeneous responses across industries within the same sector.

[7]See table 6 of Perotti (2005).

[8]See table 2 of Pappa (2009).

[9]Pappa (2009) utilised a sign restriction which places a positive restriction on the response of the output to government spending, while Perotti (2005) didn't place any such restrictions.

[10]Perotti's sample period: 1960 to 2001; Pappa's: 1970 to 2007.

[11]Monacelli and Perotti (2006) also presented multiplier evidence for the UK, but they did not provide cumulative multipliers.

[12]Data used by Rafiq (2014) runs from 1960 to 2010, while data for Cimadomo and Benassy-Quere (2012) runs from 1971 to 2009.

sample period 0.43. Their results also showed the multiplier to vary across periods: the multiplier was on average 0.98 in the 1970s, 0.21 in the 1980s, 0.27 in the 1990s, and 0.45 in the 2000s[13]. They provided evidence that suggests cyclical factors (output gap and the real monetary policy rate) and structural factors (government interest payments to GDP and import ratio) are behind these variations, a result consistent with other empirical contributions (see, for example, Ilzetzki et al., 2013). The last two periods are of interest for this chapter as they capture the sample period used in this chapter and what it seems to suggest is that the government spending multiplier for the UK is below one, and even during the recession in 2008 it was just above one[14,]. Looking further back, Crafts and Mills (2012) reported a spending multiplier of between 0.5 and 0.8 during the Great Depression of the 1930s, thus suggesting that for the UK, the output multiplier tends to be positive, but below unity[15]. Results presented in this chapter offer a possible explanation for this below unity multiplier, especially in light of the literature that stresses the importance of input-output linkages in explaining aggregate fluctuations, discussed in section 3.2.1.

While it is the case that some cyclical and structural factors[16] have received attention in attempt to explain the varying size of the impact of government spending, as mentioned earlier, there is still little research on the importance of what the government buys, i.e. there is a sense that what the government buys is not important, a view recent empirical results show not to be the case. It is worth noting that these results tend to be focused on the US and industries tend to be grouped, for example, into durable goods, nondurable goods and service-producing sectors, so the focus is on the sector composition of the economy and not the *structure of production*, an important omission, as discussed in section 3.2.1. Boehm (2016), with a two-sector NK model of durable and nondurable goods calibrated to the US, showed that government spending shock has more impact if the shock occurs in the nondurable sector. His results showed that an increase of 1% in government spending in the nondurable sector increases aggregate output on impact by about 0.75, while a 1% increase of government spending on the durable sector with service life of about 14 years increases the aggregate multiplier on impact by about 0.37. Thus, government spending on nondurables had a bigger impact on aggregate output. The reason for this, as explained by Boehm, is that the demand for durable goods is highly elastic and easily crowded out. The intuition is easy to grasp: if prices go up, then consumers are more willing to wait for prices to come down on bigger ticket items which tend to be durable goods, so any increase in government spending that causes an increase in prices would trigger this behaviour.

Boehm (2016) empirically confirmed the results of his NK model using industry-level data and a defence spending instrument to estimate fiscal multipliers for durable and nondurable

[13]They provide evidence that suggests cyclical factors (output gap and the real monetary policy rate) and structural factors (government interest payments to GDP and import ratio) are behind these variations.

[14]See figure 1 of Glocker et al. (2017). This result shouldn't be a surprise given the lack of spending stimulus by the UK during the 2008 recession, as mentioned earlier.

[15]It is worth noting that in an earlier paper focused on the Great Depression, Thomas (1983) reported multipliers above one, with multipliers ranging from 1.60 to 1.63.

[16]See, for example, Batini et al. (2014) and Ilzetzki et al. (2013).

goods industries. However, using a newly constructed international military spending instrument[17] in a single equation model, Sheremirov and Spirovska (2015) reported that the multiplier for durables is larger than the multiplier for nondurables, and also that the multiplier is especially large in recessions and when the government purchases durables[18], a result which is opposite to the prediction of the NK model of Boehm (2016). They showed that government military spending on nondurables and services is associated with a multiplier of 1.41 on real GDP, while spending on durables raises this multiplier by an additional 2.70, both statistically significant. Other papers[19] have also investigated the sectoral/industry effects of government spending shocks and report mixed results, so it is an area of the literature that can benefit from more contributions. Results presented in this chapter are more consistent with those presented by Boehm (2016) because more industries within the nondurable and service sectors respond to government demand, suggesting that for the UK, government spending on nondurables and services would have a bigger impact.

3.2.1 Industry response, input-output linkages, and multiplier implications

Although the aforementioned papers provide some insights into the importance of what the government buys, they don't directly address the key role the *structure of production* can play in determining the size of the government spending multiplier. Nonetheless, the argument here is that these papers are related to a strand of the complex networks literature. Relying on the results presented, for example, by Contreras and Fagiolo (2014)[20], one can link these studies focused on the sector composition of the economy to the economic networks literature. It could be that the government buying nondurable goods results in larger multipliers because industries within the nondurable goods sectors are more connected to other industries in the economy and as a result have larger propagation effect. So to further highlight the importance of understanding the industry/sectoral effects of government spending, I turn to this strand of the complex networks literature which stresses the importance of networks in the diffusion and propagation of shocks.

The financial contagion literature has made use of complex networks to provide useful insights on the importance of the structure of interbank linkages in determining the fragility of financial systems (e.g. Allen and Gale, 2000; Iori et al., 2006), and recent contributions discussed next have extended this approach to the *structure of production* and productivity shocks[21]. Fig-

[17] Constructed using data from 129 countries during 1988 to 2013. For NATO members, the data goes back to 1970.

[18] They followed Gartzke's (2001) approach of separating total military expenditure into durable (equipment and infrastructure) and nondurable purchases (personnel and other expenditure).

[19] See, for example, Bénétrix and Lane (2010), Cardi and Restout (2011), Makin (2013) and Wesselbaum (2014).

[20] Their results showed that industries have different cascading effects, so how many industries are affected when a given industry is hit with a shock. Shocks to some industries affect all other industries in the economy, while shocks to some industries didn't seem to cascade to other industries in the economy.

[21] It is worth noting that there is a large body of literature that looks at international trade linkages and how this link synchronises business cycles across countries (see, for example, Johnson, 2014, for a multi-sector multi-country model).

ure 3.2 shows the complex network structure of industry-to-industry flow for the UK in 2015[22], and what it shows is that the economy is far from a simplistic horizontal, vertical or star economy, as illustrated in figure 3.4[23]. Restricting the network to inter-industry networks where input transaction is above 5% of the total input purchases of an industry returns a less complex structure, as shown in figure 3.3, and comparing both structures reveals the role inter-industry assumptions play in the structure of the economy in models and what it means for the propagation of shocks. I condense figure 3.2 to a more digestible histogram form; figure 3.5is a histogram of the distribution of non-zero row and column connections between industries in the UK. The top half of the figure shows how many industries are connected into a given industry and the bottom half shows how many industries a given industry is connected into. As the figure shows, there is a clear asymmetry between the numbers of industries a given industry sells to compared to the numbers of industries selling into the given industry, and more interestingly this asymmetry changes through time, as can be seen when we compare 1997 with 2015. The importance of this asymmetry has a rich history with early contribution from Goodwin (1949) who argues that it is a determinant of the business cycle, emphasising the importance of the *structure of production*. More recent contributions include Acemoglu et al. (2012) who, using a multi-industry general equilibrium model, also stress the importance of input-output linkages in explaining aggregate fluctuations, with some sectors more important than others as presented, for example, by Carvalho (2014)[24]. Production elasticity has an important role to play in these results, as shown by Atalay (2017); when sectoral production functions are not assumed to have non-unitary elasticity of substitution across inputs, then industry-specific shocks have a bigger role to play in explaining aggregate fluctuations. Nonetheless, the results presented by Pesaran and Fan Yang (2016) showed that while sector-specific shocks have aggregate effects, the effects do not seem to be sufficiently strong to be long-lasting.

Specifically for the UK, Caiado and Ormerod (2012) using the same data used in this chapter expressed that 'short-term fluctuations in aggregate output, the defining feature of the business cycle, are in part caused by the relations of production between the different sectors of the economy', hence, if an '*event* takes place in any given industry, the consequences will generally be quite different depending on the extent to which that industry is connected by the structure of production to the others' (Caiado and Ormerod, 2012, p.50 , emphasis added). However, from a government spending multiplier perspective, an assumption that follows from the above is that the industry in question responds to an '*event*' (*a fiscal shock*). Thus, a natural question becomes 'does such an industry *respond* in the *event* of an *increase/decrease* in government

[22]Data explained in section 3.

[23]It is worth noting that the purpose of the diagram when used by Carvalho (2014) wasn't to provide an exhaustive list of production network, but instead to highlight the bearing a particular shape of the production network has on aggregate volatility, with the star economy yielding the highest volatility out of the three examples.

[24]Carvalho presented that sectors such as real estate, management of companies and enterprises, advertising, wholesale trade, telecommunications, iron and steel mills, truck transportation, and depository credit intermediation alongside a variety of energy-related sectors are seemingly key to US aggregate volatility as they sit at the centre of the production network.

demand?' As results presented in this paper suggest, not all industries respond to government demand by increasing output and as such there has to be an additional step when considering the impact of government spending even after accounting for the structure of the economy. To understand why accounting for this initial response is important, we need to turn to the evidence presented by Acemoglu et al. (2016) who specifically included government spending as a shock in their model.

Most contributions to the multi-industry general equilibrium models have tended to focus on productivity shocks (supply-side shocks), but a recent contribution by Acemoglu et al. (2016) included demand-side shocks in their model, with government spending one of the shocks. In the model, shocks can have not only a *direct* effect on industry value added growth, but also upstream and downstream effects due to input-output linkages that can amplify the impact of government spending; these are *network* effects[25]. Separating the impact of government spending into *direct* and *network* effects, their result showed that the *network* effect (due to the input-output linkages) had double the impact the direct effect government spending had on industry value added growth. This result suggests that by excluding input-output linkages from current neoclassical and NK models[26], we are underestimating the impact of government spending because these models tend to only report direct effects.

However, looking closely at the intuition behind the structure of the model suggests that the network effect is probably biased upwards and suggests room for improvement; the intuition provided by Acemoglu et al. (2016) for the propagation of demand shocks is as follows: '*with government spending shocks, affected industries have to increase their production to meet the increased demand from the government*' (pp. 9–10, *emphasis added*). What this assumption suggests is that an industry will always respond one for one by changing output quantity to reflect the change in government demand; this assumption is captured in their construction of the downstream and upstream shocks (see Acemoglu et al., 2016, p. 16). In the construction of the shocks, it is assumed, for example, that industries supplying input to the industry hit with a government shock will supply inputs to meet the full size of the demand shock. What is left out is the possibility that an industry might choose to increase production not by the full amount of the shock, but by a fraction, choosing instead to sell less to other customers to satisfy government demand. By doing this, the network effects, although non-trivial, are probably overstated. An initial step of calculating industry demand elasticity to government demand can address this issue. Using government spending to calculate other elasticities is not problematic, as shown by Atalay (2017), who used military spending as an instrument when estimating two key elasticities for his model[27].

[25]The network shocks are computed from the interaction of the vector of shocks hitting other industries and a vector representing the interlinkages between the focal industry and the rest of the industries (see Acemoglu et al., 2016, p.15).

[26]Real business cycle and NK general equilibrium models.

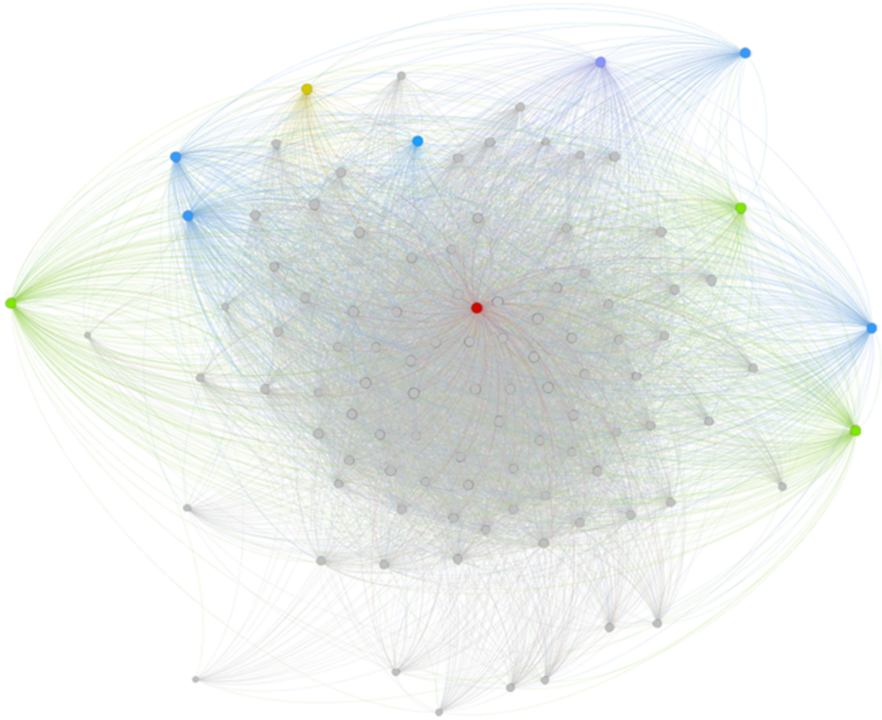
[27]The elasticity of substitution between factors of production and the elasticity of substitution between intermediate inputs.

There are also other routes in which government spending can play a role in these models; building on the model of Acemoglu et al. (2012) by incorporating financial constraints on firm production, Bigio and La'o (2016) presented evidence that suggests the production network has an important role in propagating and amplifying financial shocks. This result suggests the financial constraint factor as argued by Aghion et al. (2014) is not only important in determining the impact of fiscal policy on the growth of an industry, but also fiscal policy aimed at financially constrained industries might yield larger aggregate effects, especially in complex production structures common in advanced economies. Thus, government spending can be modelled to have a bigger impact on financially constrained industries, and as more key industry characteristics become known, these can be added to the model. For example, results presented in this model suggest there is a positive correlation between industry output elasticity to government demand and the ratio of government demand in total industry output. Modelling the probability of an industry responding to a government shock is important because it dictates the *network* effects.

To summarise, the financial crisis did renew interest in the multiplier effects of government spending. While there is no consensus on the size of the multiplier, there is agreement that the size is dependent on the state of the economy, the accommodating stance of the monetary authority, the sign of fiscal impulse and the structural characteristics of the economy in question. Unfortunately, the industry and sectoral fiscal literature is yet to enjoy the same attention received by other strands of the literature. Yes, recent contributions suggest that what the government buys is important but what this means in the context of the structure of production is yet to be fully explored. The main takeaway from the discussion above is that an industry that increases output production in response to an increase in government demand will most likely require an increase in inputs from other industries, which subsequently means these industries requiring inputs from other industries, and so on. However, an industry doesn't necessarily respond one for one to changes in government demand, and you can have a muted response. A mute output response is possible because to meet an increase in government demand, an industry has few options; for example, it can shift some of the output allocated to households/exports in the previous period to government demand; it can rely on inventories; or it can increase prices. Bénétrix and Lane (2010) presented results that showed that while fiscal shocks lead to an increase in the relative size of the non-traded sector, it had no significant impact on the level of production in the tradable sector; instead, the level of imports increased and the level of exports declined. This result backs up the view taken in this paper in that to meet a change in government demand, an industry would simply reallocate its current output, shifting it away from those going to the export market, especially when the demand doesn't make up a significant proportion of the industry's output[28]. Furthermore, as shown in figure 3.6, data seems

[28]It is worth noting that this argument is based on the assumption of a temporary change in government demand; if the change is permanent, then it would be anticipated that an industry would not be expected to continuously reallocate export share to the government, and instead such an industry would increase production.

Figure 3.2: The production network corresponding to uk input–output data in 2015



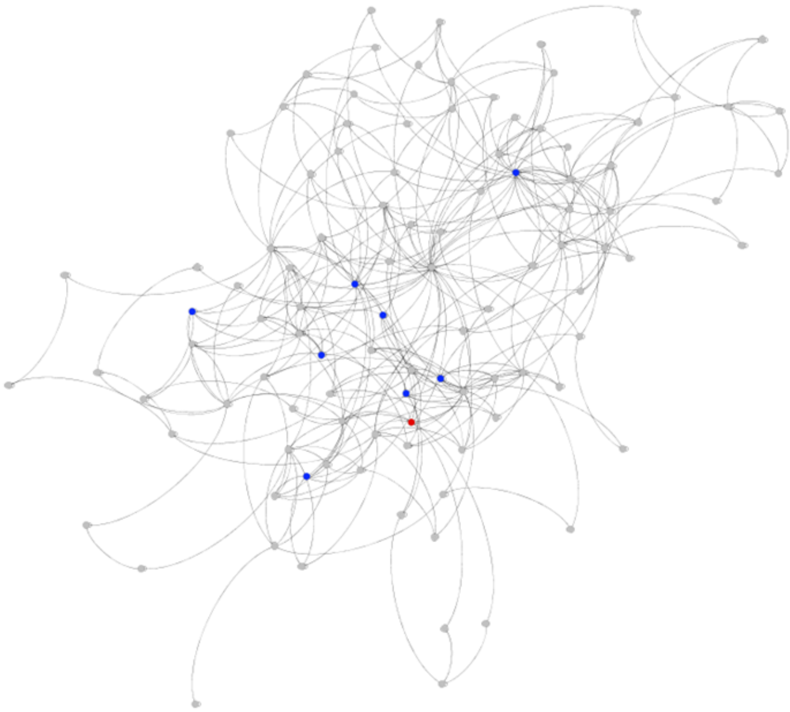
Source: Author's using detailed IO table for 2015 from the ONS.
Notes: The figure is drawn with the software package Gephi. Notes: Each node in the network corresponds to an industry in the 2015 input-output data. Each edge corresponds to an input-supply relation between two industries. Coloured nodes of the network represent industries supplying inputs to the highest numbers of other sectors. The red node is SIC 85 which is Education services; it buys input from 90 other sectors. The other top five sectors are SIC 59 & 60 (Motion Picture, Video & TV; 89), SIC 47 (Retail trade services e.t.c; 87), SIC 41, 42 & 43;55; 84;(Construction; Accommodation services; Public admin; all with 85 input connections).

to suggest greater fluctuations in the proportion of exports in industry output when compared to households[29].

The story of the *government spending multiplier is one that not only needs to take into account the input-output linkages, but also the initial response of industries*, because if there is a mute output response from an industry that experiences an increase in government demand, then any multiplier effect is muted before it can start. Thus, it is possible that recent evidence suggesting government spending multipliers being larger when there is slack in the economy is simply capturing the fact that industries are more likely to respond one for one to government demand during economic slack, whereas during a normal period the response is not one for one. Looking specifically at the UK, one can argue that the empirical evidence pointing to government spending multiplier below one can be due in part, as results presented in this chapter show, that most industries in the economy don't seem to respond significantly to government demand. To examine the output and price responses to government demand, I describe next the data and the process of constructing the industry-specific government demand.

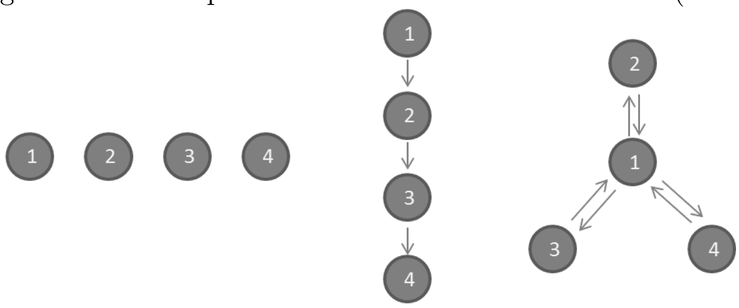
[29]Data used to construct figure 3.6 is explained in section 3.3.1

Figure 3.3: The production network corresponding to uk input–output data in 2015 (restricted)



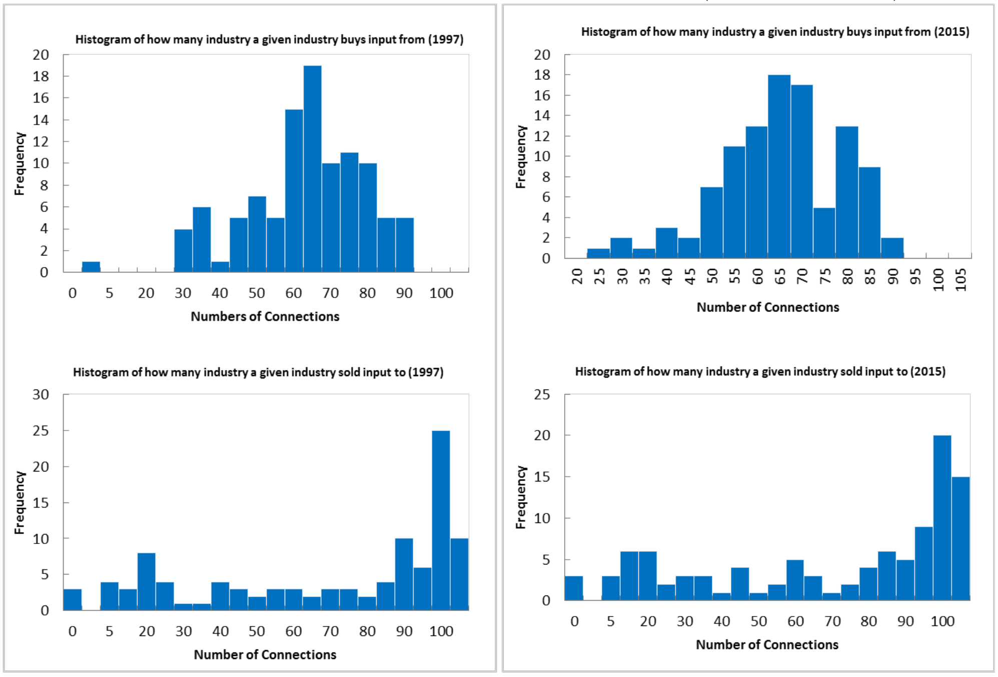
Source: ONS, detailed IO table for 2015.
The figure is drawn with the software package Gephi. Notes: Each node in the network corresponds to an industry in the 2015 input-output data. Each edge corresponds to an input-supply relation between two industries. The diagram is restricted to just inter-industry networks where input transaction is above 5% of the total input purchases of a sector. Coloured nodes of the network represent industries buying the most amounts of inputs from other industries.

Figure 3.4: Three production networks on four sectors (nodes)



Source: Carvalho (2014).
Note: From left to right: a horizontal economy with no input trade, a vertical economy with a source and a sink, and a star economy with a central node.

Figure 3.5: UK input–output linkages using ioat (1997 and 2015)



Source: ONS, detailed IO table for 2015.
Note: The top half of the figure shows how many industries are connected into a given industry and the bottom half shows how many industries a given industry is connected into.

3.3 Government expenditure and industry specific demand

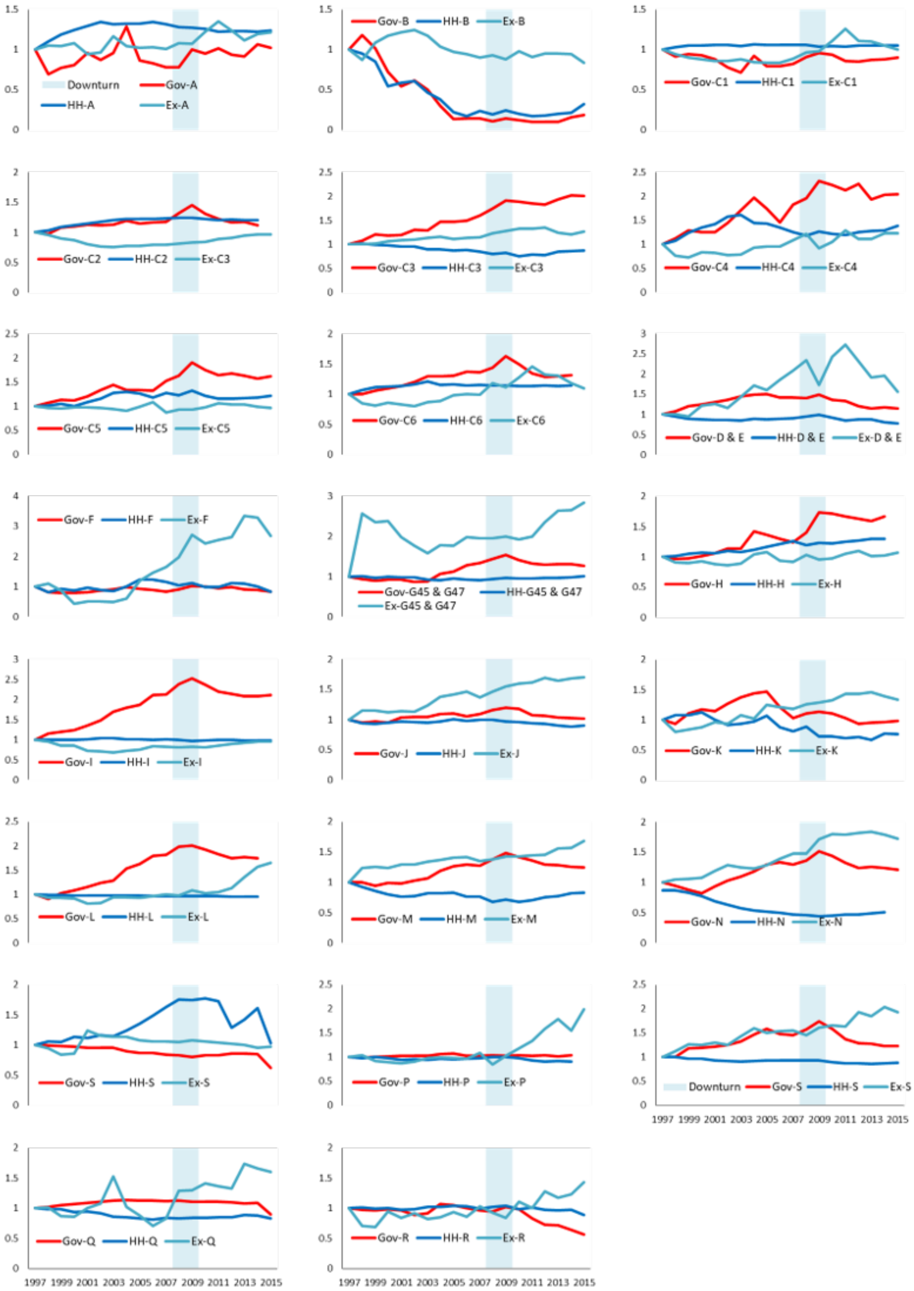
The empirical fiscal literature is shaped by the need to identify exogenous fiscal shocks; this challenge is commonly addressed either by relying on narrative records of fiscal actions, using government military expenditure, or extracting the exogenous component of government expenditure on goods and services using econometric methods[30]. Although all three mentioned approaches are very useful at the aggregate level, they are not ideal when discussing disaggregated effects at industry level for different reasons. First, at present it is impossible to compile a narrative record of government expenditure across all industries of the economy because such detailed documentations of spending announcements don't exist for all industries. Second, it is readily accepted that military expenditure falls only on a subset of industries, so it would be a case of capturing only the indirect effects of such expenditure on the majority of industries. Third, while it is useful using the econometric approach to extract the exogenous government expenditure component, the extracted expenditure would relate to the whole economy and not capture the individual industry demand[31], so in effect we would be capturing both direct and indirect government demand.

To capture industry-specific government demand, I rely on annual IO tables. As mentioned

[30] See Perotti (2007) and Ramey (2011a). Another approach that has seen increased contribution is the use of novel instrumental variables (see, for example, Acconcia et al., 2014; Chodorow-Reich et al., 2012; Shoag, 2010).

[31] For example, papers by Bénétrix and Lane (2010) and Monacelli and Perotti (2008) used this approach when exploring the impact of government spending on manufacturing and services.

Figure 3.6: Proportion of industry output consumed by government, household and export



Notes: The chart shows the proportion of output that is consumed by the government, household, and export market. The series is normalised to 1 with 1997=1. The purpose is to show that export share of export fluctuates more than household share, so an industry is more likely to sacrifice export to meet changes in government demand.

Data used to construct the figure is explained in section 3.3.1.

earlier, the approach used to construct industry-specific government demand is different from Nekarda and Ramey (2011) in that I do not calculate the direct and indirect government demand to get a final demand for each industry; instead, I calculate only the direct government demand using unique data provided by the ONS[32] that shows the UK government's intermediate and final demand split by industry. This data runs from 1997 to 2015[33]. I provide a brief explanation of the IO tables before describing the steps of constructing industry-specific government demands.

As discussed in chapter two of this thesis, the IO table is a source of rich information which provides a detailed picture of the supply of goods and services by domestic production and imports and the use of goods and services for final use and intermediate consumption. It is from the use table of goods and services that we are able to extract just how much of a particular good or service the government consumes. There are 106 unique market products in the IO tables (see tables 3.3 and 3.4); these are presented using classification of product activity that can be mapped to two-digit and three-digit SIC codes so we are able to map government expenditure by industries and in doing so group them up to the ONS's 24 industry sectors. Not all industries supply goods or services to the government; taking this into account means we are left with 96 industries, and once aggregated up results in 23 industry sectors (see appendix for the industries which make up each industry sector, table 4.5). To map government expenditure to individual industries, some groundwork needs to be laid out.

The yearly IO tables present government demand in the final demand columns of the use tables (see chapter two). These are disaggregated by the services/products the government consumes, but once aggregated they equal an amount equivalent to final government consumption expenditure (P3) of general government in the ESA 2010 national accounts. Under national accounting frameworks, government demand is presented in such a way that it appears to be the final consumer of its own non-market output because the demand is aligned to the service industries of the government[34]. Put simply, the final demand column captures the expenditure of the government across public services on behalf of the people. However, what the final demand column doesn't show is that the fulfilment of this demand from the government is carried out by government employees and in many cases, by the private sector. For the cases where they are fulfilled by the private sector, these are also recorded as intermediate consumption

[32]A request can be made to the ONS for specific dataset: (https://www.ons.gov.uk/economy/nationalaccounts/supplyandusetables/adhocs/008076intermediateconsumptionbygovernment1997to2015).

[33]At the time of analysis, the ONS only has tables spanning from 1997 to 2015 produced on a consistent basis. There are older versions of the supply and use tables, but these have not been compiled on a consistent basis to what was published for 1997–2015. For example, the older tables were constructed on the SIC2003 and CPA02 classification rather than the SIC2007 and CPA08 classification. Also the more recent tables are compiled on a European System of Accounts 2010 (ESA10) basis whereas most of the older tables are on an ESA95 basis. Thus, while it would have been ideal to have a longer period of data to analyse, the lack of consistency by including older periods in the dataset would affect the validity of any results.

[34]See chapter two of this thesis for a discussion of these service industries of government. General government is treated as a non-market sector in the national account, meaning it provides goods and services not for profit. This makes it distinct from the private sector where goods and services are provided for profit. To capture this in the IO tables, the ONS separates out both the private and public sector in the 'use table', and labels government industries as non-market. Within the input-output literature, these are usually labelled as 'service industries' of government.

expenditure by the government, essentially capturing the procurement of goods and services from the private sector, as discussed in chapter two of this thesis. So, while the IO tables show the government making final demands from 12 services, what it fails to show is that to meet this demand, inputs from all types of industries in the economy are needed, many of which are made up of private companies. Being able to separate this out makes it possible to estimate industry-specific demands from the government.

As shown in chapter two of this thesis, the majority of final government consumption expenditure is made up of compensation of employees and intermediate consumption (procurement of goods and services); thus, if we had a series that splits out government intermediate consumption by the products/services it purchases, then we do not need to rely on I-O calculus to estimate industry-specific demands. The ONS has provided such a series after a request: they provided data on the amount of intermediate consumption of each service industry of the government, disaggregated by the products/services they buy. By combining this intermediate consumption series with the data from the final demand column of the I-O table, we can calculate a measure of government industry-specific demand. Before combining both series, it is worth explaining one of the main qualities of the intermediate consumption series.

As discussed in chapter two of this thesis, intermediate expenditure by government service industries are represented in the IO using SIC codes 38, 49.3–5, 52, 59–60, 84, 85, 86, 87–88, 90, 91 and 93. Some basic examination of the intermediate expenditure data series reveals that the government purchases from a large list of industries and this number varies across years. Based on the IO table for 2014, this comes to 94 industries (products), which is significantly higher than the 12 industries that the government makes final demand purchases from. In addition, the government's final demand across these industries varies significantly, with each government industry spending varying amounts on intermediate consumption. What is also clear in the data is that the size of government intermediate demand varies significantly across industries, with a range of £4m to £16.9bn[35]. We can take advantage of this quality of the data to extract how government demand varies across industries over the sample period. Next, I describe how government industry-specific demand is constructed.

3.3.1 Constructing industry specific demand

To construct industry-specific demand, I combine data from the intermediate consumption expenditure series with the data from the final demand columns in the yearly I-O tables. As explained earlier, the national accounting framework dictates how government expenditure is presented in the final demand columns of the IO tables, so if, for example, the government final demand of £60bn is recorded for healthcare service industry of the government (SIC 84), this is not a true reflection of what is procured from the industry, because to meet this demand,

[35]This data is available on request, or can be viewed at (https://www.ons.gov.uk/economy/nationalaccounts/supplyandusetables/adhocs/008076intermediateconsumptionbygovernment1997to2015).

the majority of the £60bn is spent on many services/products that are not produced by the industry; this amount is captured in the intermediate consumption series. Put differently, the final demand column captures what is spent to provide the service to the public, but not the services/products needed to deliver it. Taking advantage of this fact, we can subtract the total intermediate consumption expenditure of the government service industry to arrive at a figure that reflects what was delivered by the service industry itself. So, in our example, if we assume that £40bn was delivered by other industries in the economy (this is captured in the intermediate consumption expenditure series), then £20bn of services was delivered by the healthcare service industry of the government[36]. However, there is still a missing component as the ONS's intermediate consumption expenditure series shows that the service industry tends to make intermediate purchases from the healthcare industry, which could be the NHS buying services from private healthcare providers. Since both the government and private sector healthcare providers are classified by the same SIC code, this amount is captured in a single combined government and non-government entry in the intermediate consumption expenditure series. By taking this into account, we arrive at an amount that is a better reflection of the actual final demand of the government from the healthcare industry. Table 3.2 provides a schematic of the hypothetical healthcare example. It shows that the government healthcare industry procures from ten industries, including £13bn of services from the healthcare industry (second column). The third column of the table shows the I-O final demand amount of £60bn that would be recorded by the ONS in the I-O table's final demand columns. The last column in the table shows the government's 'industry-specific demand' once all the appropriate corrections are made and it shows that the actual demand to the healthcare industry is £33bn. This figure is less than the £60bn recorded in the final demand columns of the I-O tables. These steps can be repeated for other service industries of the government, and by doing this we can sum up all demand allocations to get a government demand for each industry in the economy.

This way of constructing industry-specific demand means we have a non-inflated industry-specific and aggregate demand. Another benefit of this approach in constructing industry-specific demand is that we avoid making any assumptions about the input-output linkages of industries, so we don't need to assume it takes a certain amount of input from industry A to produce the final output of industry B. This industry relationship is paramount in IO tables and it dictates any multiplier effects of changes in the demand for an industry's output. Thus, by using the Nekarda and Ramey (2011) approach, we are in effect already capturing multiplier effects of any increase in government demand. So formally we need to proceed as:

[36] A simple assumption could be made that this amount captures compensation of employees of the government that work within the service industry (nurses and doctors) given that from an accounting framework standpoint, government expenditure is mostly a combination of intermediate consumption and compensation of employees.

Table 3.2: Constructing government specific-industry demand

	Government Service Industry: Human Health (£m)		
Industry	Intermediate Expenditure	I-O Final Demand	Industry Specific Demand
Computer, electronic & optical products	2		2
Telecommunications services	5		5
Computer programming & consultancy	3		3
Financial services, exc insur & pension funding	2		2
Real estate services,	4		4
Public administration	1		1
Education services	1		1
Human health services	13	60	33
Residential care services	5		5
Social work services without accommodation	4		4
Total	40	60	60

Notes: The table shows a simple hypothetical example of government service industry expenditure disaggregated across ten industries.

$$G^{d}_{i,t} = \sum_{j=1}^{12} G^{ID}_{ij,t} + (G^{F}_{i,t} - G^{IP}_{i,t})$$

Where $G^{d}_{i,t}$ is direct government demand of industry i, $G^{ID}_{ij,t}$ is government service industry j intermediate demand for industry i, $G^{F}_{i,t}$ is government final demand for industry i, and $G^{IP}_{i,t}$ is the sum of government intermediate purchases by the government service industry i. The formula shows that *direct government demand for industry i in year t is the sum of intermediate and final demand, corrected for any intermediate purchases made by government service industries.* For the majority of industries, only the first term of the formula is applicable. The last two terms capture what was described in the hypothetical example; data from the GICE series is summed up for each government service industry before being subtracted from corresponding government service industry data from the final demand columns in the IO tables. $G^{d}_{i,t}$ is the industry-specific demand and is the main measure of interest. The sum of all $G^{d}_{i,t}$ would equate to total government expenditure on goods and services as captured in the national accounts.

Aggregating the data up to 23 industry sectors shows that some industry sectors get a larger share of government demand, as shown in table 3.5. Unsurprisingly, Public Administration, Education, and Health & Social Work account on average for about 60% of total government demand, with a downward trend in Public Administration[37]. For the sample period, approximately 19% of UK GDP is government consumption each year, and as shown by table 3.5, the amount purchased across industries is not uniform. However, what the average figure presented in table 3.5 hides is the fact that there are variations in amount spent with each industry sec-

[37] This data, disaggregated to two- and three-digit SIC codes, is available on request. Table 3.5 has the average for the sample period at industry-sector level.

tor for each period, as shown in figure 3.7, and similar to observations reported for the US by Ramey and Shapiro (1998), what table 3.5 and figure 3.7 show is that the variation in government spending represents a significant shift in the demand for some industry sectors.

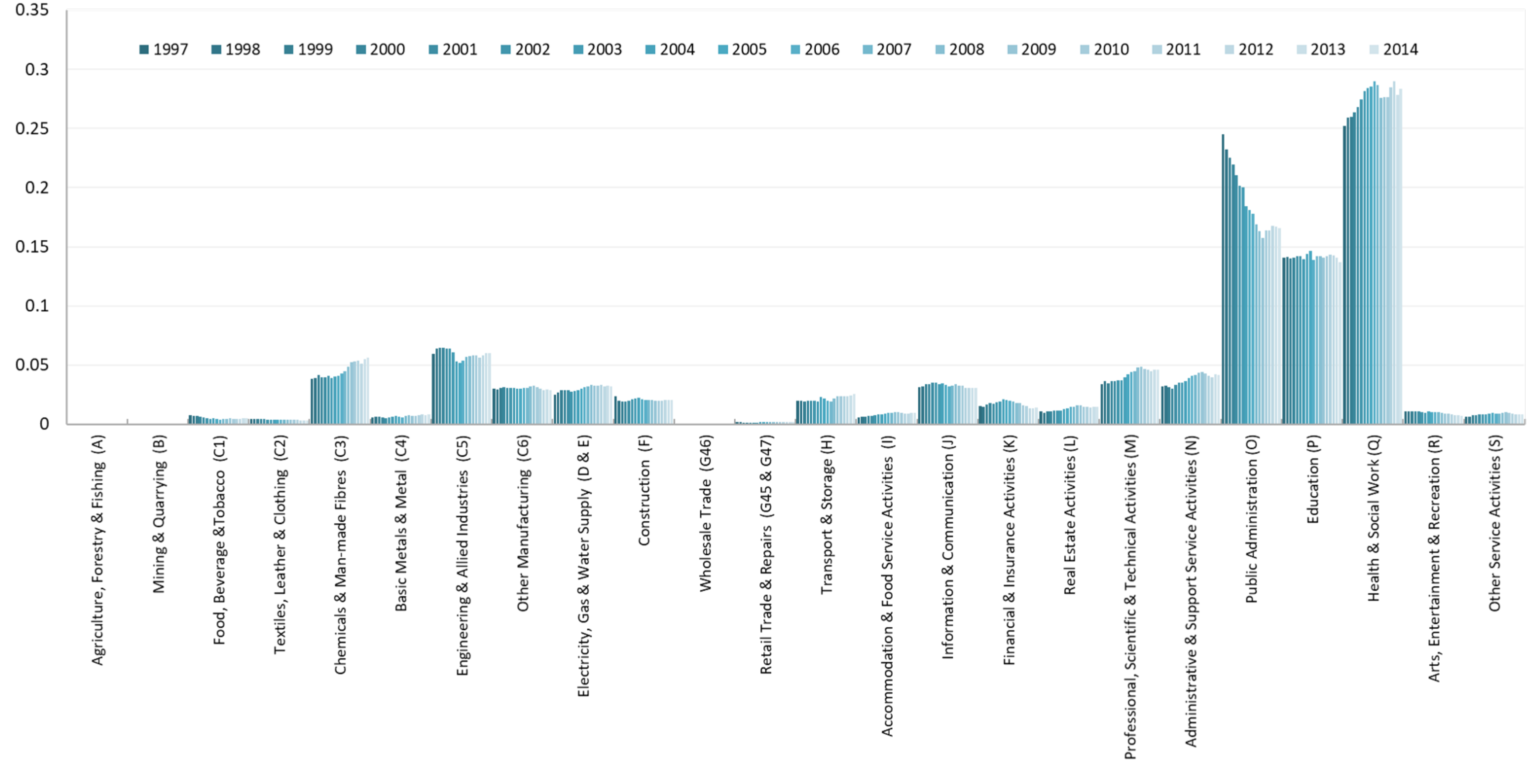
The disaggregated characteristic of the data offers an opportunity to look beyond just two sectors of the economy as common in the literature, and in doing so, we avoid losing potentially important information about the role industry characteristics play in the response to fiscal shocks. Although government consumption tends to be concentrated on non-tradables, this consumption is not evenly spread across industries within the non-tradable sector, so looking at the government's specific demand of an industry's goods or services within the non-tradable sector might give a clearer indication of the effects of fiscal shocks. The same argument of non-even spread of consumption also holds when we consider distinctions between the effect of fiscal shocks on durable or nondurable goods, and services and manufacturing. Taking the conclusion of Sheremirov and Spirovska (2015, p. 2) that '*contrary to the implications of many stylized models, it does matter what the government spends on: the multiplier of spending on durables is larger than the multiplier on non-durables and services, especially in recessions'*, a government's industry-specific demand data allows us to explore further if the industry and not just the sector the government spends on matters[38]. Thus, we are able to achieve a better understanding of sectoral effects by investigating industry effects, and in doing so gain a greater understanding of the aggregate effects of fiscal shocks. I provide results at industry level in section *3.5.2*.

As mentioned earlier, the extraction of exogenous government spending shocks shapes the empirical literature, so the question that naturally arises is if the data used in this paper can be argued to be exogenous. While it is readily accepted that aggregate government consumption expenditure is not exogenous, the industry data used is disaggregated into two- and three-digit SIC codes, so it is not plausible to assume that industry-specific demand drives aggregate government spending or when the government decides on its aggregate fiscal budget that each of the 106 industries were allocated spending based on the growth prospects of the industries. To assess this, a simple t-test was carried out between changes in aggregate government spending and individual industry spend, with the null hypothesis that both series had unequal variances. At the broad industry sector level, so for the 23 sector groups, only two sectors fail to reject the null hypothesis: Mining and Quarrying, and Public Administration. The fact that the hypothesis is not rejected by Public Administration is not a major surprise given the alignment of the sector to the government; however, it is more of a surprise that Mining and Quarrying expenditure seems to have the same variance as aggregate government spending. Looking further at the disaggregated level, of the 87 industries with government spending data for the full sample period, only six failed to reject the null hypothesis of unequal variances[39]. These results suggest

[38]It is worth noting as discussed earlier that the results presented by Boehm (2016) suggest nondurables effects to be larger. Results presented in table 3.11 of this chapter are presented with industries marked as durable, nondurable and service-producing.

[39]These include Coal and lignite, Dairy products, Employment services, Public administration and defence services, Compulsory social security services, Scientific research and development services, and Services auxiliary

Figure 3.7: Yearly government demand split by industry sector



Source: Author's, based on constructed industry–specific demand using IO tables.
Notes: The chart shows the proportion of total government consumption expenditure received by an industry sector. So, for example, in 2015, industry sector Q (Health & Social Work) received 20% of total government consumption expenditure.

the industry-specific demands and aggregate government spending don't move in tandem, so each industry seems to experience different changes in government demand compared to aggregate demand.

An issue that hasn't been addressed thus far is the fact that the IO data is annual and not quarterly, as common in the government spending VAR literature[40]. Ramey (2006) argued that SVARs should be estimated using annual data even though there are two main problems using annual data, as highlighted by Perotti (2007). First, the assumption that governments don't respond to macroeconomic news is argued to be less plausible with annual data. Second is the issue of quality of data when using data from further back in time; looking further back in time is necessary when using annual data to ensure that we have a good amount of observations, but the issue is that the further we go back in time, the lower the quality of the data. Nonetheless, these two problems can be addressed, and once addressed we can be more confident of the results given that Born and Muller (2012) presented similar results using quarterly and annual data. Following Beetsma and Giuliodori (2011), it is reasonable to argue that new fiscal impulses do not take place at a quarterly frequency but more likely in a new budget (which occurs yearly and possibly in mid-year budgetary revisions), so using annual data to uncover fiscal shocks might be closer to the actual shock. Also, the anticipation effect criticism of Ramey (2011a)[41] is less relevant with yearly data because uncovered shocks are more likely to be truly unanticipated: '*a given policy shock is less likely to be anticipated one year before it actually takes place than one quarter before it actually takes place*' (Beetsma and Giuliodori, 2011, p. 11, *emphasis added*). With annual data, there is less of a need to be concerned with the details of institutional setting relied upon by Blanchard and Perotti (2002), thus avoiding the criticisms commonly placed on their assumptions, i.e. government decisions on purchases occur in a different quarter to when the actual purchase takes place. In addition, in annual data we can be confident that seasonality issues are absent from the data. The second problem raised by Perotti (2007) can be addressed by using panel data rather than going too far back and making assumptions about the data. As shown in section 3.5.3 of this chapter, a panel approach is also considered as part of a robustness exercise.

3.4 Data and empirical approach

As highlighted in the introduction of this chapter, the approach of using the I-O table in current fiscal debate was ignited by Perotti (2007), who used simple arithmetic averages of industry output and government spending to argue that industries that experienced increase in government

to financial services and insurance services.

[40]See, for example, Bénétrix and Lane (2010), who used annual data in alternative structural VAR set-ups, with one a four-variable set-up which included total government spending, value added in the tradable sector, value added in the non-tradable sector, and fiscal complement or debt feedback.

[41]However, the anticipation effect might not be such a major issue according to Mertens and Ravn (2010) given that they found that anticipation effects did not overturn the results of a standard fiscal VAR where shocks are assumed unanticipated.

purchases experienced large increases in output. This was further extended by Nekarda and Ramey (2011), who used I-O calculus to obtain industry-specific demand for the manufacturing sector before using this measure in a single equation set-up to estimate the effects of government spending at industry level. The empirical approach taken in this chapter is more in line with the approach taken by Nekarda and Ramey (2011); however, the approach is extended to capture the majority of industries in the economy, so not just focused on manufacturing[42]. In addition, this chapter makes use of a new dataset that avoids the need to rely on input-output calculus to estimate industry-specific demand. Another difference with the Nekarda and Ramey (2011) model is that it was estimated using panel data, whereas the model in this chapter is estimated for each individual industry in the sample set.

As discussed earlier, the aim of this chapter is to examine if there are heterogeneous effects of government demand across industries, before assessing the output multiplier implications of this heterogeneity using a simple input-output model. To enable the first part of this goal, we start with a simple argument that industry output is described by the function:

$$E(y_t x_t) = f(x^{'}\beta) \tag{3.1}$$

Equation 3.1 captures the conditional expectation of y given x, where $x = [1, x_1, x_2, \ldots x_p]$ is a vector of covariates and $\beta = [\beta_0, \beta_1, \beta_2, \ldots \beta_p]$ are the corresponding coefficients, and the product is:

$$x^{'}\beta = \beta_0 + x_1\beta_1 + x_2\beta_2, \ldots + x_p\beta_p \tag{3.2}$$

Assuming a simple case of a single independent variable and a normal distribution of our data, then an expression for the function $E(yx) = f(x^{'}\beta)$ is:

$$E(y_t x_t) = \beta_0 + \beta_1 x_t \tag{3.3}$$

The model says the conditional expectation of y given x is a linear function of x, which in our case is industry output and government spending. This written with an error term takes the form:

[42] Perotti's (2007) focus on the manufacturing sector was driven by the period of his analysis. He focused on the Ramey–Shapiro war episodes, and during this period the manufacturing sector received a disproportionate share of the increase in government spending. The focus of Nekarda and Ramey (2011) on manufacturing seems to be driven by data availability for other variables of interest they examined, such as wages, hours, prices, mark-ups and return to scale.

$$y_t = \beta_0 + \beta_1 x_t + \varepsilon_t \tag{3.4}$$

The specification above assumes past output levels of an industry are not important, an assumption which is too restrictive, so introducing a lagged endogenous variable and government spending notation into the model achieves the final base specification:

$$y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 g_t + \varepsilon_t \tag{3.5}$$

Where y_t is the variable of interest such as industry output, g captures government spending, ε_t is the unobserved error term. For the purpose of this chapter, the key variable of interest is government spending, i.e. how does government spending impact the output response of an industry, so we are interested in parameter β_2.

Before estimating the model, both the industry output and government spending are log transformed. The log transformation is useful for two reasons. First, inspection of the dataset shows the series to be skewed; however, the skewness disappears once the data is log transformed, with distribution much more like a normal distribution. Second, log transforming our data means we can interpret β_2 as elasticity. To show how we get this, we differentiate equation 3.5 w.r.t to g:

$$\frac{dy}{dg} = \beta_2 \frac{y}{g} \tag{3.6}$$

Solving for β_2 we get:

$$\beta_2 = \frac{dy}{dg}\frac{g}{y} \tag{3.7}$$

In our case, output elasticity of demand measures the responsiveness of industry output to a change in government demand. It is calculated as the ratio of the percentage change in output to the percentage change in government demand.

Equation 3.5 is a lagged dependent variable model (LDV) that can be estimated using ordinary least square estimators (OLS). For potential specification issues, see for example Achen (2000) and Keele and Kelly (2006). As explained by Beck and Katz (2011), 'the LDV model with iid (independent and identically distributed) errors is optimally estimated by OLS. However, it is also well-known that OLS yields inconsistent estimates of the LDV model with serially correlated errors. . . . It is often the case that the inclusion of a lagged dependent variable eliminates almost all serial correlation of the errors.' (p.339) However, if this is not the case then 'the use of a LDV with serially correlated errors only requires care in using a correct estimation method; it causes no other econometric problems'. This motivates the estimation of equation 4.1 using OLS with Newey–West standard errors (see Wooldridge, 2009, chapter 12.).

While equation 3.5 does a good job of estimating the elasticity we are interested in, the model fails to control for any other factors that could affect industry output, thus potentially biasing our results. To assess if the results are biased, I re-estimate equation 3.5 by including different control variables. The small amount of available observations with our sample running from 1997 to 2015 means we are restricted on the number of control variables that can be included in the specification, so control variables are included one at a time. I control for the economy by including GDP in the baseline specification. The reason for this is that the connected structure of industry sectors means the growth of, for example, industry sector A can have an impact on industry sector B if it provides inputs directly or indirectly to industry sector A. Although the IO tables can be used to construct a variable that captures this relationship, I use GDP as it means we avoid the assumptions inherent in the IO tables. A major contribution to the literature since the financial crisis of 2008 is the need for model specifications to account for a monetary authority's stance when investigating the impact of fiscal policy, so accounting for a central bank's adjustments to interest rates to counter fiscal actions. To capture this, I use two alternative controls: first I use Bank of England short-term base rate and then alternate with a ten-year/medium-term government bond yield[43]. The specification of equation 3.5 in yearly terms motivates the use of medium-term rates rather than just the short-term rates common in the fiscal literature that uses quarterly data. All control variables are in logarithm except the interest rate variables, which are in levels.

As mentioned earlier, the model is estimated for 23 industries individually. The motivation for this is that the estimated elasticities from the chapter can potentially be used in the new class of models being developed that account for the input-output linkages in the economy, as done for example by Acemoglu et al. (2016). As I show in section 3.6 of this chapter, these elasticities can be used to examine the multiplier implications in an input-output model set-up. Nonetheless, the robustness of the results are examined with the help of a panel model in section 3.5.3.

The flexibility of equation 3.5 means we can also use it to estimate other variables of interests there is data for, so, for example, the impact of government demand on industry gross value added (GVA) and household consumption is also examined.

The data used is from a few sources. The government demand instrument is constructed using the IO tables. In addition to this, the remaining variables used in this paper for each industry are also constructed using the IO tables; these includes industry GVA, imports, profits, and household consumption of industry output. The government yields are from the Bank of

[43]Both series are provided by the Bank of England and are the calendar year average %.

England, and for GDP we use data from the ONS. I deflate industry output, GDP, government expenditure, and household consumption with the GDP deflator, while industry GVA is deflated using the GVA deflator. Both deflator series are from the ONS. Full information on variable definitions and data sources are provided in the data appendix.

3.5 Results

This section presents results from the baseline model, focusing first on the aggregated industry sector before discussing results using the disaggregated data. It is worth noting that the disaggregation quality of the data means we are not able to estimate elasticities for all industries; this is explained more in section 3.5.2.

3.5.1 Baseline results: aggregated industry sectors

Figure 3.8 summarises the findings for each of the industry sectors for which the estimated elasticity is statistically significant with 95% confidence intervals, and it suggests industry sectors respond heterogeneously to government demand (results of all sectors are presented in Table 3.7). The result in figure 3.8 is sorted based on the size of the industry sector, so the largest industry sector is presented first, and doesn't seem to be a pattern of large or small industries responding in a specific way. Among the 23 industry sectors, only 11 have significant output response to government demand, with three of these negative (with Mining & Quarrying showing the largest negative response). However, we can see that for some of these industry sectors, the 95% confidence interval is quite wide. Nonetheless, these 11 industry sectors are split between Production, Manufacturing and Services, further highlighting the need to look beyond the two-sector approach in the literature because although it could be the case that the aggregate manufacturing sector shows little or no response to government demand, industry sectors within manufacturing can experience different outcomes, as shown in results presented here.

Unsurprisingly, Public Administration, Education and Health & Social Work respond positively to direct government demand, confirming expected results given that government demand makes up a significant amount of the output of these industry sectors. From this, the question that naturally arises is whether the ratio of government demand to industry output is important. Before tackling this, it is worth checking how robust these results are across the different sets of controls. The results are presented in table 3.8. The table shows that the reported response of Basic Metals & Metal Products and Other Service Activities is quite sensitive to the inclusion of control variables, suggesting that the government demand is not as important as other factors for this industry sector. The results of four of our industry sectors remain significant with the inclusion of our control variables, with the size of effect remaining consistent. It is worth noting that table 3.8 also shows that the inclusion of GDP as a variable in the baseline model means some results become significant, suggesting government demand has a negative output response for these industries, but if we control for monetary stance, then these results become insignificant.

I also consider the impact of indirect government demand on industry sector response, thus replacing direct government demand with indirect government demand, which is constructed by subtracting industry-specific government demand from total government demand[44]. Results in table 3.7 also suggest that a similar number of industries respond to indirect government demand, 12 compared to 11; it is worth noting that it is the same set of industry sectors that respond to direct government demand that also seem to be responsive to indirect government demand, with Public Administration (O) the only industry sector of this group that is unresponsive to indirect government demand. This result seems to suggest that government spending on one industry sector doesn't necessarily have an automatic knock-on effect on another industry sector because if that was the case, then the constructed indirect government demand instrument should return statistically significant results across most industry sectors, but this doesn't seem to be the case. In addition, the result suggests almost half of the industry sectors do not respond to either direct or indirect demand, with Agriculture, Forestry & Fishing responding only to indirect demand.

Turning the attention back to the baseline results, I next explore the question raised earlier about how important the ratio of government demand to industry output is to the reported responses. Plotting the estimated elasticity of each industry sector to the ratio of government demand to industry output, as shown in the plot to the left of figure 3.9, one can make a crude conclusion that the size of government demand matters given that all of the insignificant results are for industry sectors receiving less than 10% of their output demand from the government. The plot to the right of figure 3.9 plots the estimated elasticity to household (HH) consumption of output, and what the result suggests is that HH consumption also matters; plotting only the industry sectors with significant results as shown in the left plot of figure 3.10 suggests the reported impact of government demand is positively related to the ratio of government and HH demand in industry sector output, but the limited number of observations means we have to be cautious with such conclusions. Nonetheless, the results suggest there is a balance to be struck between government and HH consumption. Disregarding the statistical significance of the estimated elasticity, figure 3.10 plots the elasticity against the respective ratios and interestingly the result suggests that there is a point where the trend line crosses[45]; this result is explored further in the next section.

Another key factor that is often discussed in the literature concerns the role imports play in the impact of government spending, so the impact of leakage in the form of imports on industry response. The left plot of figure 3.11 shows the estimated elasticities plotted against the ratio of imports in output. It confirms the general consensus that the leakages due to imports

[44] $G^{\text{id}}_{i,t} = G_t - G^d_{i,t}$, where $G^{\text{id}}_{i,t}$ is indirect government demand of industry i, G_t is total government demand, and $G^d_{i,t}$ is direct government demand of industry i.

[45] Including the statistically insignificant results turns the positive relationship between HH ratio and elasticity into a negative one, which is quite important when we discuss further disaggregated results in section 3.5.2.

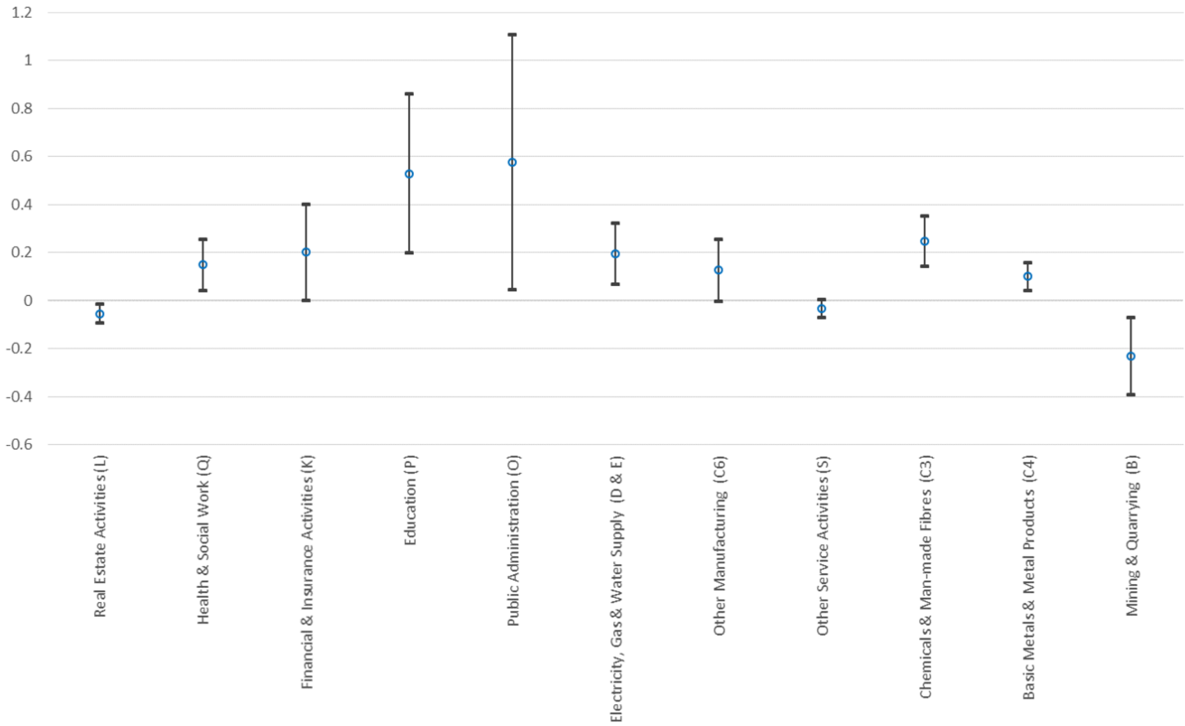
can dampen the impact of government demand. A similar pattern is present when estimated elasticities are plotted against the ratio of profits in industry sector output; the right plot of figure 3.11 suggests the higher the profits ratio, the smaller the reported response of an industry sector to government demand. The interest in the profit ratio is motivated by the wage-led vs profit-led growth literature, a major feature of post-Keynesian/Kaleckian growth theory[46]. This distinction offers an avenue to assess how economic activity reacts to changes in income distribution. As described by Palley (2016), 'in a wage-led economy, an increase in the wage share (i.e. a decrease in the profit share) increases economic activity and growth, whereas in a profit-led economy it has the reverse effects'[47]. The total effect of a decrease in the wage share on economic activity depends on 'the relative size of the reaction of consumption, investment and net exports to changes in income distribution' (Onaran and Galanis, 2013, p. 1). An important point to emphasise is that the wage-led vs profit-led literature tends to be at country level, while this chapter focuses on sector and industry level, so the results are not comparable. Nonetheless, the potential role income distribution has on industry output response to changes to government demand is worth examining.

To be more confident in the revealed correlation of import/profit and the estimated elasticities, in the next section I examine if these results are repeated with further disaggregation of the analysis, so moving from 23 industry sectors to 87 industries. Before doing this, I estimate the baseline model for other variables of interest.

[46]As described by Onaran and Galanis (2013, p. 1), 'Mainstream macroeconomic models... treat wages merely as a component of cost, and neglect their role as a source of demand. On the contrary, post-Keynesian/post-Kaleckian models, as has been formally developed by Rowthorn (1981), Dutt (1984), Taylor (1985), Blecker (1989), Bhaduri and Marglin (1990), reflect the dual role of wages affecting both costs and demand, and while they accept the direct positive effects of higher profits on investment and net exports emphasized in mainstream models, they contrast these positive effects with the negative effects on consumption.'

[47]See, for example, Lavoie and Stockhammer (2012), Stockhammer and Onaran (2013) and Blecker (2016) for a review of the literature. For classification of G20 and OECD countries, see Onaran and Galanis (2013) and Kiefer and Rada (2015), respectively.

Figure 3.8: Industry sector output elasticity to government demand



Notes: The chart shows the estimated elasticities with 95% confidence intervals. It shows only statistically significant estimates at the 1%, 5%, and 10% level. The letters and numbers in the parentheses are standard industry classification codes.

Figure 3.9: Industry sector output elasticity to government demand plotted against government and household consumption ratio

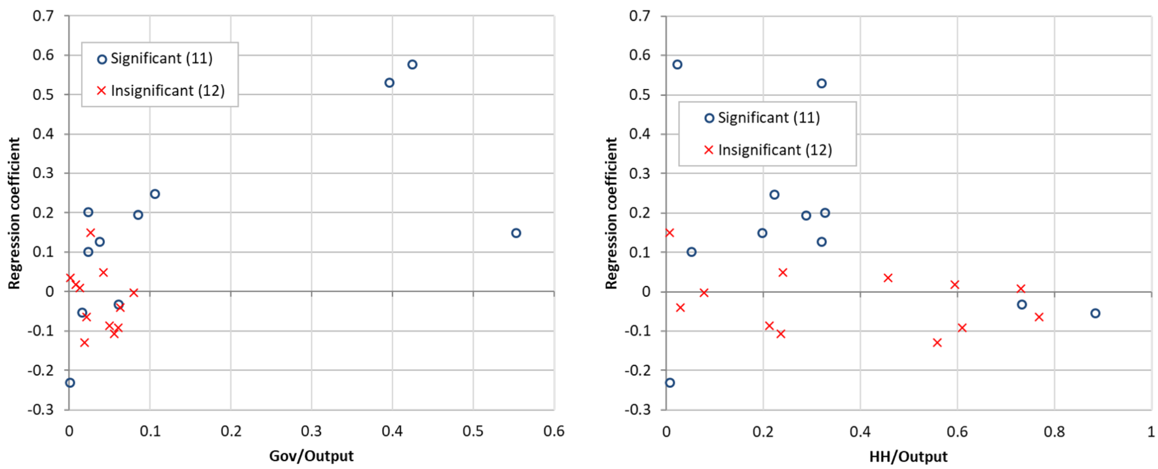


Figure 3.10: Industry sector output elasticity to government demand plotted against government and household consumption ratio (with trend line)

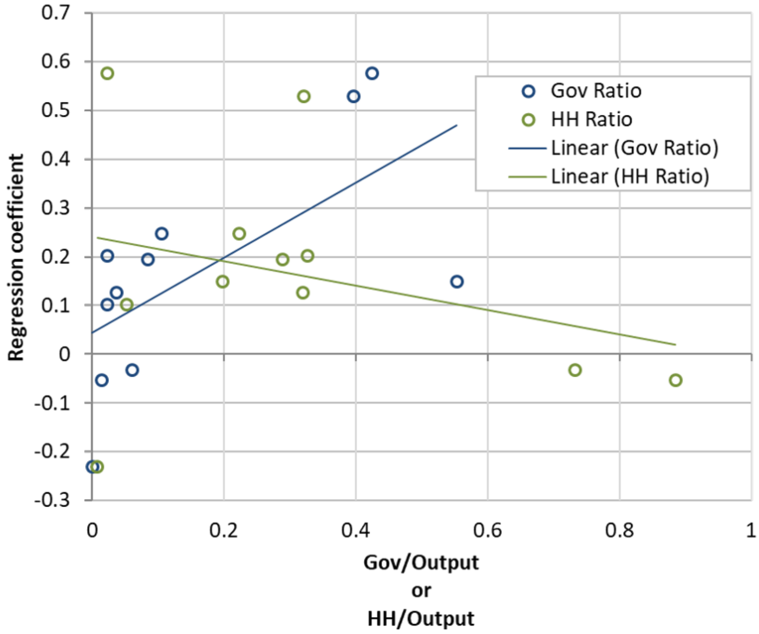
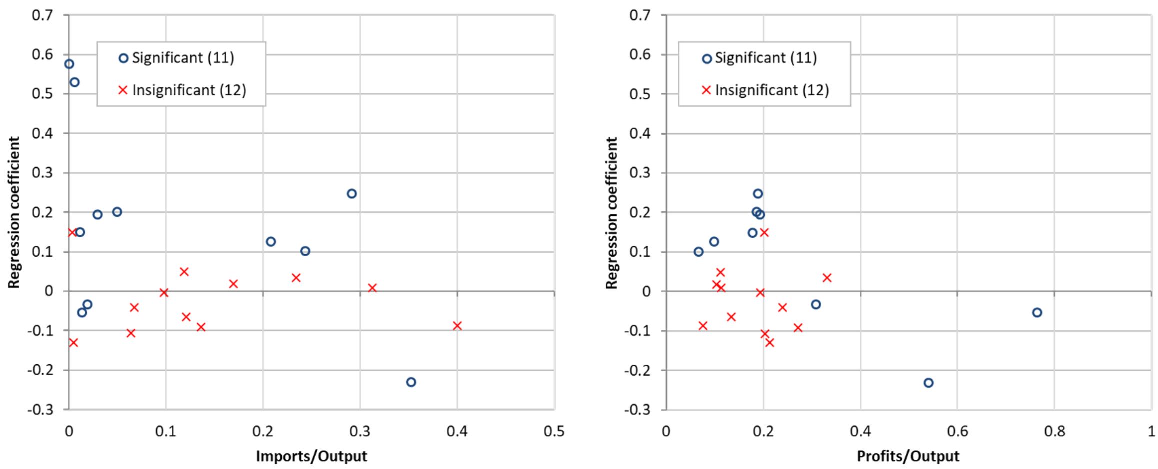


Figure 3.11: Industry sector output elasticity to government demand plotted against imports and profits ratio



I estimate the baseline model (equation 3.5) replacing industry output with industry GVA and household consumption of industry output; results are represented in columns 2 and 3 of table 3.9. Overall, what the results show is that there is indeed heterogeneous response of output and GVA across industry sectors to government demand. Table 3.9 also presents the response of HH consumption to government demand (column 3). So the question here is whether government demand crowds out or crowds in HH consumption. The result suggests in most cases that household response is not statistically different from zero. However, five industry sectors experience some crowding in, while Agriculture, Forestry & Fishing and Real Estate Activities experience some crowding out.

3.5.2 Further disaggregation: output and price effects

It is common in empirical papers to carry out a robustness exercise by including additional controls in the baseline specification or using an alternative empirical approach. This is not the approach taken in this paper given the data used; instead, robustness of the heterogeneous effects presented in the previous section is argued using disaggregated data, running the baseline model for the individual industries as presented in the IO tables. Since a key question this chapter aims to answer is on the heterogeneity of industry response to government demand, further disaggregation provides an opportunity to test the response of another variable for which data is only available at the two- and three- digit SIC code level: industry output ***price***.

I estimate the model only for industries that supply goods or services to the government for the whole period of our analysis; with this restriction, we are left with 87 industries[48]. The estimated elasticity of the output response of industries to direct government demand is presented in table 3.11, and as with the case with results discussed in the previous section, the majority of the elasticity is statistically insignificant from zero. Figure 3.12 captures the estimated coefficient, plotting their respective t-statistics, and it shows elasticities ranging from -0.6 to 0.6. The results show that only 26 industries are statistically significant with varying size of elasticities and these are presented in figure 3.13 with the 95% confidence interval, confirming the case of heterogeneous industry output response to government demand. The results in figure 3.13 are sorted based on the size of the industry, so the largest industry is presented first, and it seems there is no pattern of large or small industries responding in a specific way. Similar to the previous section, I plot the estimated elasticities to the ratio of government demand to output; the same exercise is carried out for HH, imports, and profit share. Figure 3.14 shows that when disaggregated to two- and three-digit SIC codes, 92% of the insignificant output elasticities are for industries receiving less than 10% of their output demand from the government. However, this conclusion is not as definitive as the previous section because there are about five industries where government demand makes up over 10% of output yet the responses are not statistically different from zero[49]. This result is important as it suggests that while it is possible to generalise

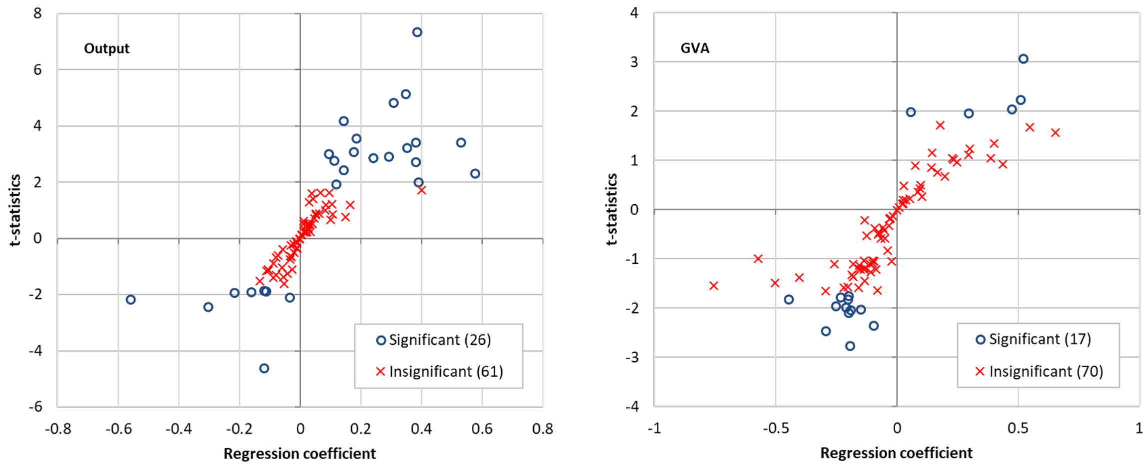
[48]It is worth discussing a particular industry that makes intermediate purchases on behalf of the government. SIC 52 (Warehousing and support services for transportation) proved to be a difficult sector due to how the demand instruments were constructed. There were two years where the sector made more intermediate demands than it received final demand, so data for this industry is not strictly positive for the entire sample period. Since our model is estimated in logs, it means the option was to either discard all demand data for this industry or discard the affected two periods. An experiment estimation of just using data for periods with strictly positive values returns elasticity that was not statistically different from zero, which is not a surprise given that on average government demand makes up 0.9% of the total output produced by the industry. So for this industry, the assumption is that elasticities were not estimated.

[49]The sectors and the proportion of government demand are shown in parentheses: Rail transport services

about a threshold, the uniqueness of each industry means we have to be careful with such generalisations[50]. The figure also shows that a few industries receiving less than 10% of their output demand from the government respond significantly to such demand, strengthening the case against a threshold argument. Nonetheless, there is generally a positive relationship between the estimated elasticity and the ratio of government demand to output, as shown in figure 3.15. Figure 3.15 captures only the statistically significant elasticities, and plotting these against the ratio of government and HH demand[51] seems to suggest there is a balance to be struck between government and HH demand. What is consistent with both the aggregated industry sector and disaggregated industry results is that there is a positive relationship between the estimated elasticities and the ratio of government demand.

The results for import leakage are similar to those reported in the previous section. There seems to be a negative relationship between the estimated elasticities and the ratio of imports in an industry's output (see figure 3.16). The results for the profit ratio as shown in the right plot of figure 3.16 are not replicated with more disaggregated data in that the relationship between elasticity and profit ratio is as negative as presented in the previous section.

Figure 3.12: Industry output/GVA elasticity to government demand plotted against t-statistics

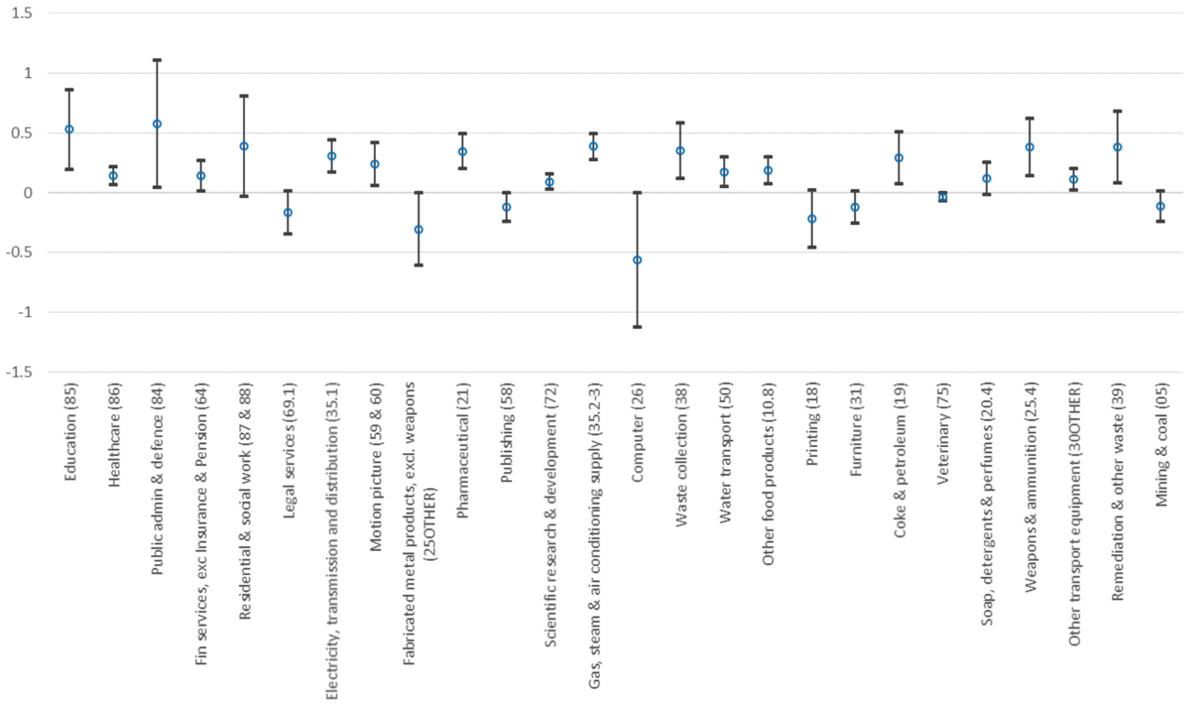


(0.13); Security and investigation services (0.23); Services to buildings and landscape (0.16); Libraries, archives, museums and other cultural services (0.18); Repair services of computers and personal and household goods (0.3).

[50]It is worth noting that the five industries are within the service sector.

[51]See the right plot of figure 3.14 for both the significant and insignificant elasticity plotted against the ratio of HH demand.

Figure 3.13: Industry output elasticity to government demand (disaggregated results)



Notes: The chart shows the estimated elasticities with 95% confidence intervals. It shows only statistically significant estimates at the 1%, 5%, and 10% level. The letters and numbers in the parentheses are standard industry classification codes.

Figure 3.14: Industry output elasticity to government demand plotted against government and household consumption ratio

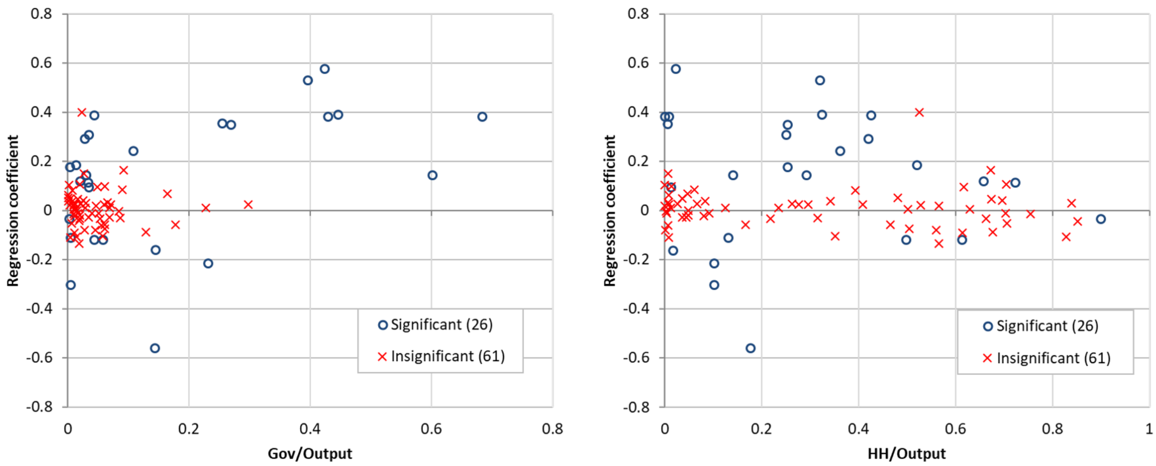


Figure 3.15: Industry output elasticity to government demand plotted against government and household consumption ratio (only statistically significant results)

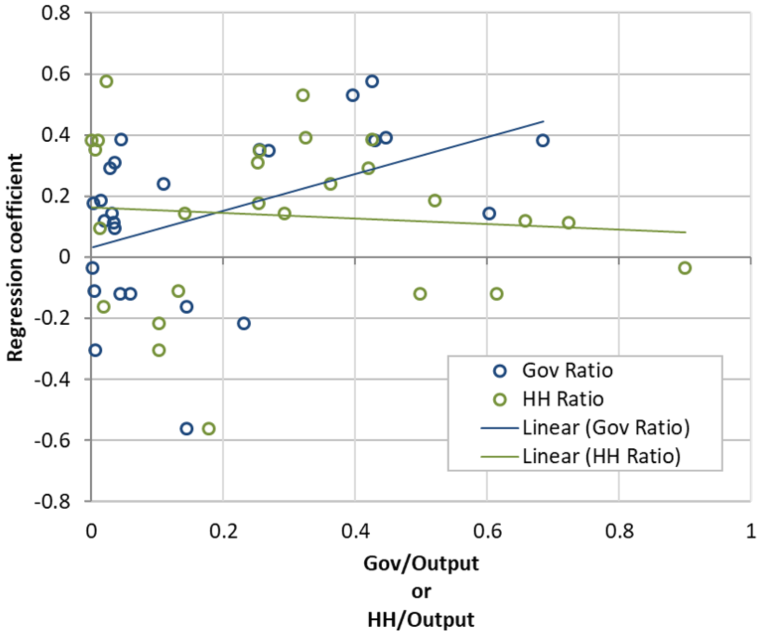
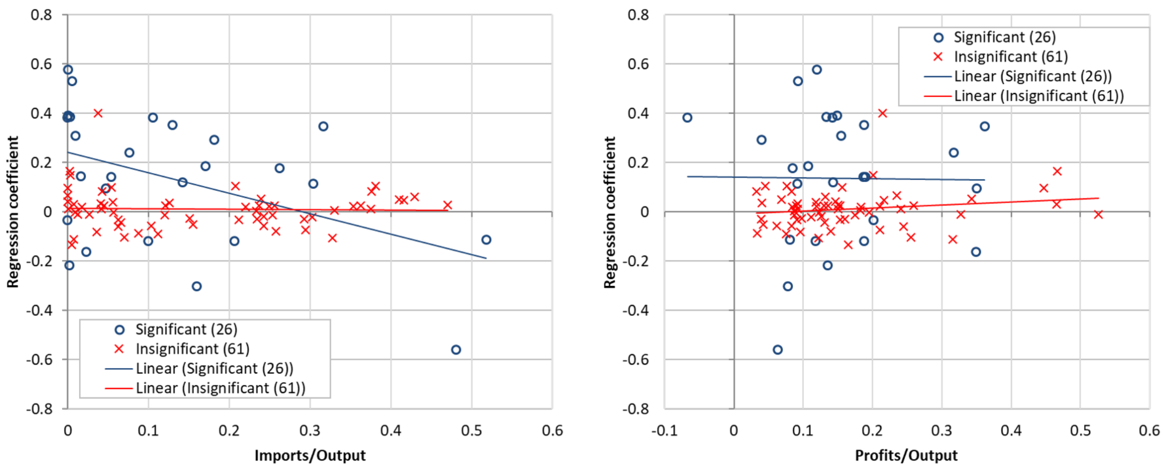


Figure 3.16: Industry output elasticity to government demand plotted against imports and profits ratio



As mentioned earlier, the disaggregation of the data into two- and three-digit SIC codes makes it possible to examine a point raised in section 2 (figure 3.1) of this paper, in that industries can be at different stages of employment, so government demand would have an impact on prices instead of output. Using an experimental industry-level deflator for data made available by the ONS[52], I estimate the baseline model (equation 3.5) by replacing industry output as the dependent variable with industry-level deflator, and regressing this against government demand. Matching the industries in the IO to those provided in the deflator table yields 81 industries, and I estimate the model for these industries. Results for all industries are presented in table 3.11, with figure 3.17 providing a visual representation of the estimated elasticities plotted against corresponding t-statistics. The results show that government demand has a statistically significant impact on the prices of 41 industries, 39 of these are positive to varying degrees, but the impact on the other 40 industries is statistically insignificant from zero. The statistically significant results with 95% confidence interval are presented in figure 3.18. For the majority of these industries, the results can range between -0.2 and 0.5, although some industries respond beyond this range. The results also suggest a slight negative relationship between the size of estimated elasticity and government demand/import ratio, as shown in figure 3.19, especially for imports. It is worth noting that the estimated elasticity size for some industries is quite sensitive to the base year used to produce real-term government spending. For example, the elasticity for SIC 35.1 as shown in table 3.11 is 1.05 using 2015 as the base year; however, experimenting with base year of 2012 reduces the elasticity to 0.69. This sensitivity suggests the results presented here should be seen as an indicator that industry prices do respond to government demand, so less should be made of the actual size of the impact. Capturing price impact is important as it means that government demand doesn't just have upstream effects on industries supplying an industry receiving government demand, but there are also downstream effects given that industry output price increases have a knock-on effect on other industries using such output as inputs.

These results on their own don't shed any light on the point raised in section 3.2 (figure 3.1),so next I combine the elasticities estimated for industry output and prices. Figure 3.20 shows the 49 industries with either statistically significant output or price response to government demand; for each of these, output elasticity is plotted against corresponding price elasticity. What figure 3.20 highlights is that government demand has an impact on both the output and price level of 15 industries, so the third scenario is depicted in figure 3.1. Government demand has an impact on the output of eight industries without affecting their price, so the first scenario is captured in figure 3.1, and 26 industries only experience price increase as a result of government demand; the second scenario is presented in figure 3.1. Overall, what the results suggest is that the simple argument presented in figure 3.1 is a very valid one, further highlighting the need to consider the heterogeneity of industry response to government demand when discussing the impact of government spending.

A final question the results allow us to tackle relates to the approach of grouping industries into buckets of intermediate or final goods/service-producing industries: do industries in these buckets respond in a similar way to government demand? Figure 3.21 shows the result of

[52] https://www.ons.gov.uk/economy/inflationandpriceindices/adhocs/006718industryleveldeflatorsexperimentaluk1997to2015.

Figure 3.17: Industry price elasticity to government demand plotted against t-statistics

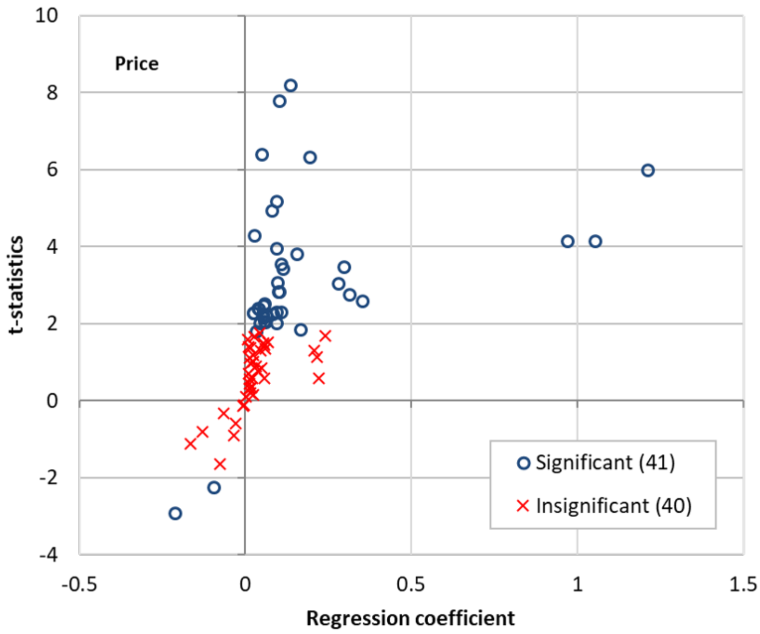
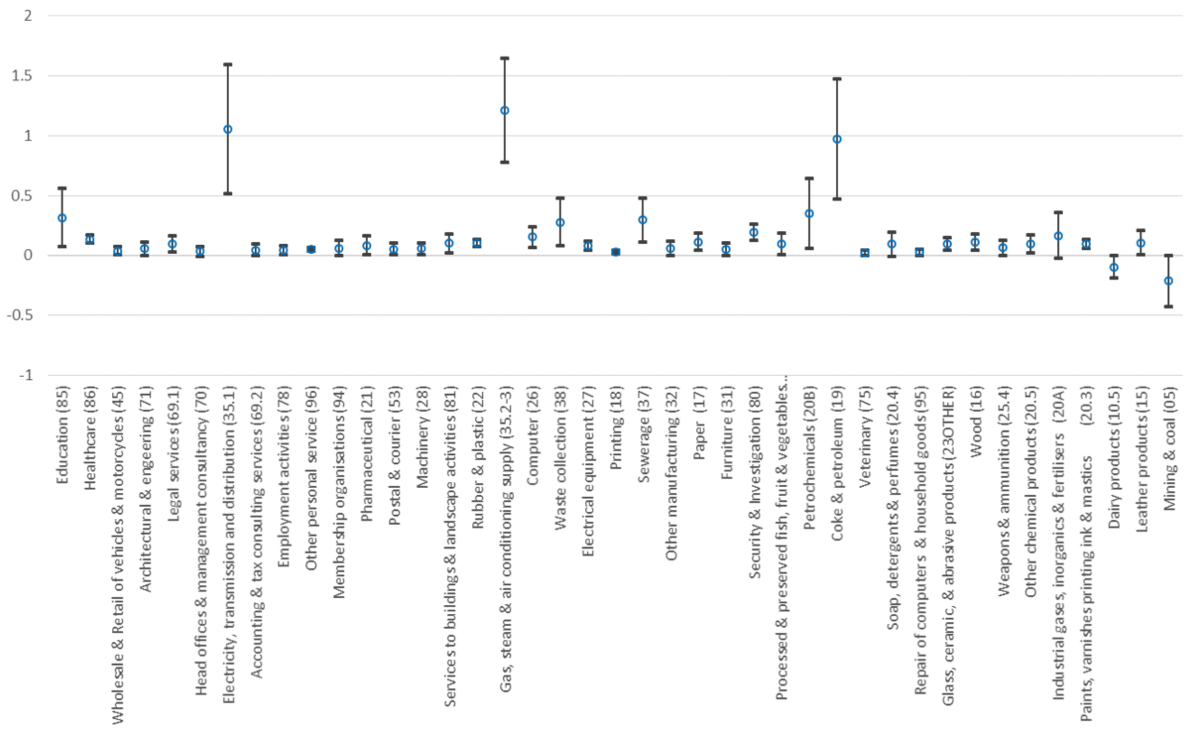


Figure 3.18: Industry price elasticity to government demand (disaggregated results)



Notes: The chart shows the estimated elasticities with 95% confidence intervals. It shows only statistically significant estimates at the 1%, 5%, and 10% level. The letters and numbers in the parentheses are standard industry classification codes.

Figure 3.19: Industry price elasticity to government demand plotted against government and imports ratio

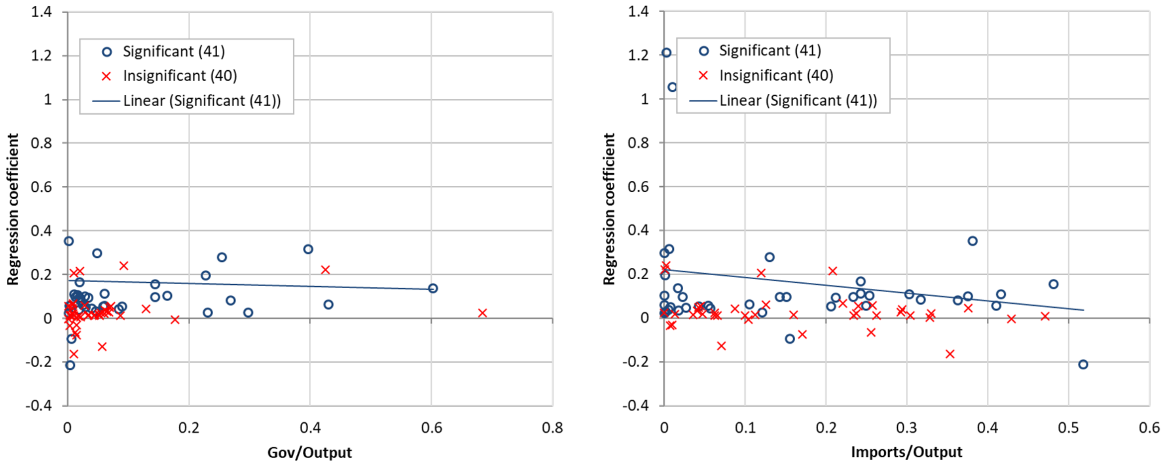
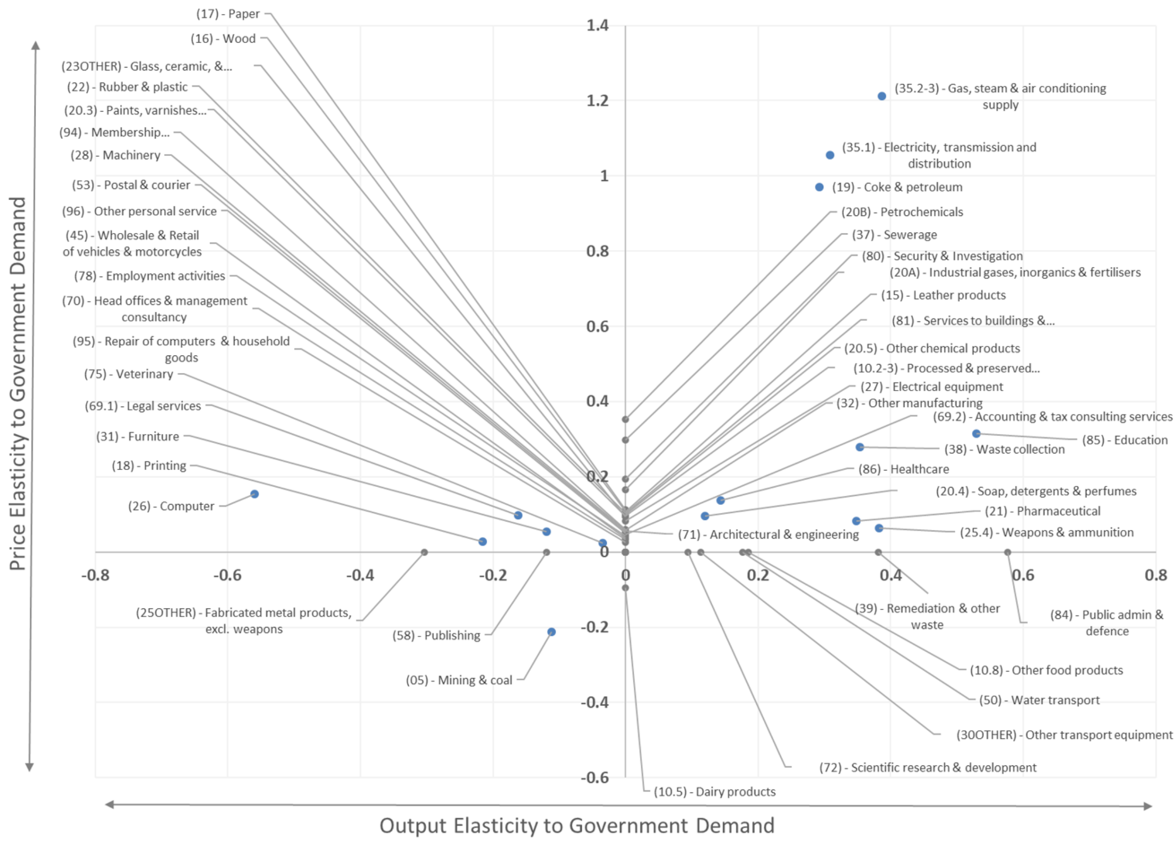
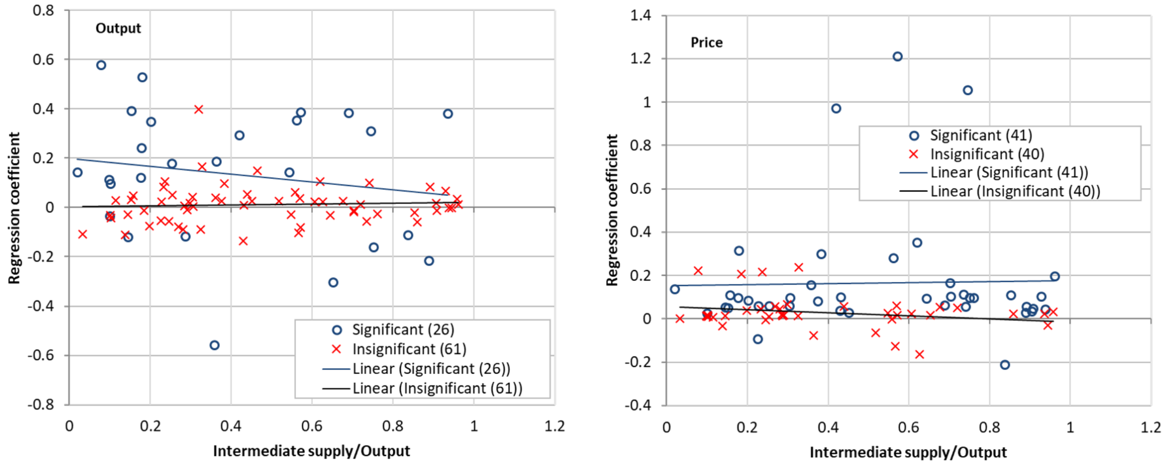


Figure 3.20: Industry output elasticity plotted against price elasticity



Note: The figure shows the 49 industries with statistically significant output or price response to government demand; for each of these, output elasticity is plotted against corresponding price elasticity.

Figure 3.21: Industry output elasticity to government demand plotted against intermediate consumption ratio



plotting the estimated elasticities to the ratio of intermediate goods to output. First, the left plot shows the intermediate consumption ratio against output elasticity and it suggests that there is no emerging pattern between industries that produce mainly for intermediate consumption compared to those that produce for final consumption. The responses to government demand of industries in both buckets are comparable, with a slight downward slope suggesting the impact of government demand is smaller in industries where outputs are used mainly for intermediate inputs by other industries. Turning our attention to price response as shown in the right plot presents similar results: industries in both buckets share comparable responses to government demand, so it is not the case that final goods/service-producing industries are more likely to increase or decrease prices compared to intermediate goods/service-producing industries.

The aim of this section was twofold: first, to present the heterogeneous output effects of government demand and examine if results from further disaggregation match those of the previous section; and second, to examine how this heterogeneity extends to prices. What the results show is that even with further disaggregation, the impact of government demand on both output and prices is heterogeneous across industries. However, it is not possible to generalise that government demand crossing a particular threshold would result in a statistically significant positive or negative effect. Nonetheless, there is generally a positive relationship between the ratio of government demand to output and the size of the impact government demand has on industry output, though this relationship is not repeated for prices. Similarly, the results also point to a negative relationship between the import ratio and the size of the estimated elasticity.

As discussed in the introduction of this chapter, the lack of government spending data at industry level is a possible explanation for why there has been few contributions in this strand of the fiscal literature. Unfortunately, the very few observations used in this chapter mean some caution should be applied when interpreting the results, especially when the implications of these results are discussed in section *3.6.* One way to be more confident in the estimated elasticities is by constructing a panel dataset to estimate the effects of government demand using a larger number of observations; this is done next, focusing only on output.

3.5.3 Industry output elasticity to government demand: a panel approach

In this section, I present a panel estimation, grouping the 87 industries into a panel to increase the number of observations and improve the robustness of results discussed thus far. The baseline model is:

$$y_{i,t} = \sum_{j=1}^{p} \alpha_{1ij} y_{i,t-1} + \sum_{j=0}^{p} \alpha_{2ij} g_{i,t-1} + \mu_i + \varepsilon_{i,t} \quad (3.8)$$

Where the number of industries $i = 1, 2, ..., N$, the number of periods $t = 1, 2, ..., T$, y is industry output, g captures government spending, μ_i is group-specific effects and ε is the unobserved error term. Equation 3.8 is an autoregressive distributed lag (ARDL(p,p)) model that can be re-parameterised into an error correction model (ECM) of form:

$$y_{i,t} = \alpha_i(y_{i,t-1} - \beta_{2i} g_{i,t-1}) + \sum_{l=0}^{p-1} \delta_{1il} \triangle y_{i,t-l} + \sum_{l=0}^{p-1} \delta_{2il} \triangle g_{i,t-l} + \mu_i + \varepsilon_{i,t} \quad (3.9)$$

The model captures both the short-run and long-run relationship between government spending and industry output. It suggests that changes in government spending have an impact in the short run (δ_2) and in the long run (β_2). While it is possible to estimate equation 3.9 with a Dynamic Fixed Effects (DFE) estimator, results from section 3.5.2 suggest this would be an inappropriate estimation approach because the DFE imposes homogeneity on estimated coefficients, allowing only the intercepts to differ across industries. So in addition to DFE estimators, equation 3.9is estimated by means of the Mean Group (MG) estimator proposed by Pesaran and Smith (1995) and the Pooled Mean Group (PMG) estimator proposed by Pesaran et al. (1997, 1999). These estimators relax the imposed homogeneity to varying degrees. With the MG estimator, the intercepts, long-run and short-run coefficients, and error variances are all allowed to differ across industries. The PMG estimator allows the short-run coefficients, intercepts and error variance to differ across industries, but imposes homogeneity on the long-run coefficients, as is the case with DFE. As a robustness check, Chudik and Pesaran's (2015) Dynamic Common Correlated Effects (DCCE) estimator is also implemented as it allows for the inclusion of lagged values of the dependent variable. Before the analysis, a unit root test is carried out to test for the order of integration between government spending and industry output. The Im–Pesaran–Shin (IPS, 2003), Levin, Lin & Chu Test (LLC, 2002), unit root tests and the Hadri (2000) stationarity tests are employed, with the results presented in table 3.15.Both the LLC and IPS results suggest both output and government demand series contain unit root, meaning the series are nonstationary; this nonstationarity is further confirmed by Hadri test results[53]. An important issue with ARDL models is the selection of lag structure. The limited amount of observations available for each industry suggests imposing a lag structure of one lag; however, although not presented, standard information criterion (IC) was used to select model lag length. I estimate the model for each industry individually, varying the lag length, then using the Schwarz IC and Akaike IC to decide on appropriate lag structure. For both information criteria, the suggested lag length was one, so I estimate an ARDL (1,1) model. In instances where both information criteria differ, the Schwarz IC lag suggestion was used. I discuss the results of the estimation next.

Results of the estimation are presented in table 3.14. Motivated by the results in section *3.5.2*, I estimate equation 3.9 for three samples; the first sample is a panel of all 87 industries, the second sample is made up of industries with significant output response to government demand based on results in section 3.5.2 (25 industries), and the third sample is made up of industries with only positive significant output response to government demand (18 industries). Results presented in table 3.14 show this split is necessary given that many industries don't seem to respond to government demand. Grouping all industries would provide an inaccurate picture of the impact of government demand and the results presented in this section confirm this. Table 3.14 shows the results from the three samples: the first panel shows estimates for the first sample, the second panel for the second sample, and the third panel shows estimates using the third sample. For each sample, I estimate DFE, MG, PMG, DCCEMG, and DCCEPMG, presenting long-run, short-run and error correction coefficients[54]. As expressed earlier, while both the MG and PMG estimators allow for the relaxation of the restrictive homogeneous assumption, a necessary condition for the consistency and validity of individual industry estimates is to have a sufficiently large time-series dimension of the data, which is not the case with the data used in this paper, so I focus on the averages.

Using a Hausman test, results from each estimator are compared. The p-value of the Hausman tests presented in table 3.14 suggests we cannot reject the null hypothesis that the estimated coefficients are the same across estimators (MG tested against DFE, and PMG tested against DFE), but given the results presented in section *3.3.1* that show that industries respond heterogeneously to government demand, the MG and PMG estimators are preferred, so I next discriminate between MG and PMG. The Hausman test between MG and PMG again suggests

[53]It is worth noting that the Hadri test result suggests nonstationarity for government spending; however, due to the results of the IPS and LLC tests showing the differenced series to contains a unit root I take both output and government spending to be I(1), so integrated to the of order one.

[54]For the DCCE estimators, I test for cross-sectional correlation between the residuals, using the Cross-Sectional Dependence (CD) test proposed by Pesaran (2004). The CD results show that for the entire sample there is serial correlation across industries, which is not a surprise given what is captured in figure 3.2, which shows how interconnected these industries are. The result for the subsample gives a different picture because for sample two, which includes all industries that respond to government demand, then the CD results suggest there is no serial correlation across these sets of industries. However, by only focusing on industries that respond positively to government demand (sample three), then serial correlation returns, although this is not the case for the PMG estimation, so the serial correlation disappears when government spending is pooled.

the estimated coefficient is the same for sample two and three, while the MG group estimator is preferred for the entire sample. I choose the MG estimator as it is less restrictive than PMG.

Focusing first on the results for samples two and three, what table 3.14 shows is that government demand has an impact on industry output, but more importantly output response is not one for one to government demand; based on the preferred MG estimator, the long-run output elasticity to government demand on average is between 0.83 and 0.94, with short-run elasticity effectively zero. Based on the PMG estimators, the long-run elasticity is between 0.55 and 0.98, with short-run elasticity between 0.14 and 0.16. Interestingly, when the entire sample is considered, the only estimator to return a significant long-run estimate is the MG estimator, with estimated long-run elasticity half those estimated for the smaller samples. Although these results obviously mask the heterogeneity across industries, they suggest that the true impact of government spending is necessarily dampened when we group all industries together; however, if we take into account this heterogeneity when grouping industries, then a truer picture of the impact of government demand emerges. By splitting the sample into subsamples to reflect the results from section *3.5.2*, what this section also confirms is that the simple regression utilised in section *3.5.2* is not a bad approximation of the different impacts government demand has on industry output. The question then becomes why so many industries don't respond to government demand, a question that was briefly explored in section *3.5.2* and deserves future research attention.

Next, I explore the government spending multiplier implications of the estimated elasticities presented in this and the previous section.

3.6 Government spending output multiplier implications

The goal of this section is to show that if some industries do not respond to government demand, then it is necessarily the case that the output multiplier would be smaller compared to the case where all industries respond to government demand, especially if they respond one for one. To examine the implications of the estimated elasticities, I rely on a simple I-O model. In the I-O model, industry output is a linear function of its consumption of input and final demand from households, government, capital investments, and exports. Industry output is defined as:

$$\mathbf{x} = A\mathbf{x} + \mathbf{d}$$

where $\mathbf{x}$ is the S×1 output vector, A is the inter-industry input-output matrix defined above (technical coefficient), and $\mathbf{d}$ is the S×1 column vector of final demand. Some basic algebra allows us to present industry production as a function of final demand and the matrix of technical coefficients:

$$\mathbf{x} = (1 - A)^{-1}\mathbf{d}$$

Where $(1 - A)^{-1}$ is the Leontief inverse, and can be represented by$L$. This set-up allows us to examine the output effect of a change in government spending across industries:

$$\triangle \mathbf{x} = L\triangle \mathbf{d}$$

What the model above leaves out is the possibility that an industry might choose to increase production not by the full amount of an increase in government demand, but by a fraction, choosing instead to sell less to other customers to satisfy government demand. As the estimated elasticities suggests, industries don't necessarily respond one-for-one to government demand, thus the argument is $\triangle \mathbf{d} \neq \triangle \mathbf{g}$, but $\triangle \mathbf{d} = \boldsymbol{\psi} {*} \triangle \boldsymbol{g}$, where $\boldsymbol{\psi}$ is a 1 x S vector of industry output elasticity to government demand. The resulting $\boldsymbol{\psi} {*} \triangle \boldsymbol{g}$ is a 1 x S vector, but this is transposed into S x 1 vector. So the model becomes:

$$\triangle \mathbf{x} = L([\psi * \triangle \mathbf{g}]^{\mathrm{T}})$$

The above shows that the output multiplier is dependent on three elements; *the structure of production, government spending, and the elasticity of industry output to government demand.* It suggests the multiplier can be high or low due to any one of these three elements. A challenge with the model presented above is that we need an IO table that accounts for imports in the inter-industry relationship; the yearly IO tables fail to do this so we have to rely on the IOAT that tends to be produced every five years. However, this throws up another challenge because the IOAT[55] needs to be based on the same standard industry classification as the yearly IO tables (or allows for the construction of the same). This challenge means we are left with IOAT tables from 2010, 2013 and 2014, and on further investigation, only the 2010 table lends itself to the analysis in this section[56]. This is a minor setback because while we would ideally want a yearly IOAT that allows us to calculate yearly multipliers taking into account the production structure for that year, estimating multipliers for just 2010 still allows examination of the implications of estimated elasticities.

As results from section *3.5.2* show, it was not possible to estimate elasticity for all industries due to lack of data, and many of the estimated elasticities were not statistically different from zero. Thus, it is not possible to calculate a single multiplier that uses only estimated elasticities for all industries. For this reason, multipliers are estimated for three scenarios:

Scenario one: Set all elasticity equal one, so industry respond one for one to government demand.

Scenario two: Set all elasticity equal to the average elasticities calculated based on MG estimators (*0.487*, *0.830*, and *0.944*).

Scenario three: Set elasticity equal to individually estimated elasticities using simple regression in section *3.5.2* (table 3.11), use average elasticity for industries

[55] Every edition of the IOAT tends to have minor or major changes that affect the number of industries in the tables and the inter-industry relationship structure.

[56] The yearly government intermediate consumption series was constructed based on the 2010 industry structure; both the 2013 and 2014 IOAT combined SIC 64–69.1 for the NPISH sector, making it impossible to match it to the industry level for 2010.

without estimated elasticities (*0.487*), and a value of zero for industries with statistically insignificant estimates[57].

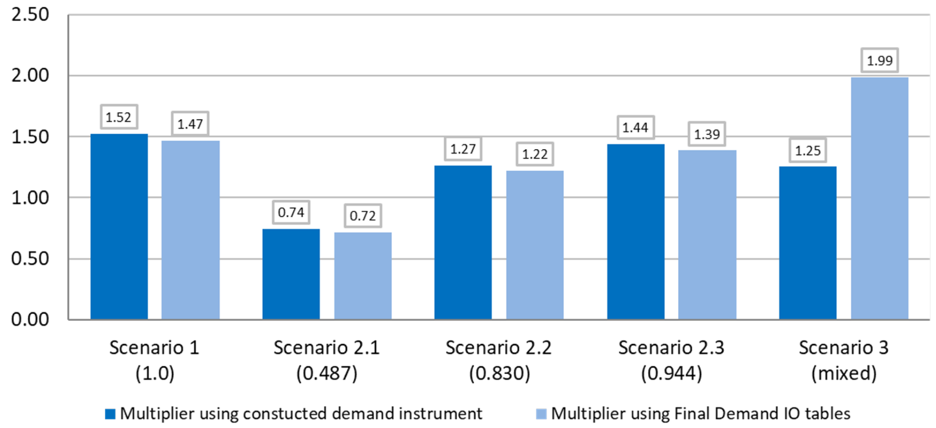
For each scenario, I calculate two multipliers using the long-run elasticity: the first is based on the final demand of the constructed government demand series, and the second is based on the final demand as presented in the final demand column of the IO tables. The main multipliers of interest are those estimated using the constructed government demand series of this chapter because they reflect a truer representation of disaggregated government spending than what is in final demand column figures from the I-O tables. Nonetheless, the final demand column figures are used to make sure the general conclusion of this section is not affected by series choice.

Figure 3.22 presents the estimated multipliers from the scenarios and what it confirms is that the estimated impact of government spending is necessarily dampened when we group all industries together, which is captured in scenario 2.1. Using the estimated average elasticity of 0.487 for the entire sample, so including all industries, the estimated multiplier is below one, an estimate that is in line with previous empirical evidence for the UK. But as shown in results presented in section *3.5.2* and *3.5.3*, including all industries when estimating average elasticities necessarily reduces the size of the estimated elasticities because many industries don't respond to government demand. Consequently, a possible reason behind empirical evidence of an aggregate output multiplier of below one is simply because government spending has a muted effect at the disaggregated level, which is ultimately translated into aggregate data. As mentioned earlier, the reasons behind this muted effect offer future research avenues, one of which is the threshold argument.

If we now assume that this muted impact is unmuted and government demand has an impact on all industries of the economy (negative and positive), then the average elasticity from scenario 2.2 allows us to assess the implication of this because it is the average elasticity of the 25 industries with significant output response. In this scenario, we can see that even though industries don't respond one for one to government demand, the estimated multiplier is above one. Obviously it is best if the impact of government demand is strictly positive given that if we use the average elasticity of the 18 industries that responded positively to government demand (scenario 2.3), then the output multiplier is necessarily higher. Thus, even with this simple model, what the estimated output multipliers show is that disaggregated impact has important implications for aggregate impact. Aggregate effects would be larger if government demand has the desired effect on industries.

[57] Sectors without estimated elasticities make up a very small amount of government spending and assigning elasticities to these sectors have non-noticeable effects on the estimated multipliers. Out of the 17 industries without estimated elasticities, 8 of them received no government demand for the whole sample period, whilst the remaining 9 received demand only in some periods.

Figure 3.22: Government spending output multiplier estimates using IO model



Notes: The figure shows the estimated cumulative multiplier for each scenario using a simple input-output model. (.) shows the elasticity assumption in each scenario, scenario 3 uses multiple elasticities, hence 'mixed'. The estimates are based on the 2010 IO tables for the UK and government spending for the year, so it is essentially the multiplier for 2010. The lack of yearly IO analytical tables means it is not possible to estimate for other years; nonetheless, for the purpose of this chapter this is less of an issue.

3.7 Conclusion

In this chapter I have attempted to: first, document the heterogeneous effects of government demand across industries; and second, assess the output multiplier implications of this heterogeneity using a simple input-output model. The main challenge with this sort of investigation, which can help explain the limited contributions to this strand of the fiscal literature, is the availability or lack of disaggregated government spending data. To overcome this, I took advantage of data from the UK's IO accounts for the period 1997 to 2015, constructing new industry-specific government demand with this data. Using this new measure, results from this chapter confirm heterogeneity in the response of industries to government demand, with this heterogeneity correlated to imports and the proportion of industry output consumed by the government. In addition, industries do not necessarily respond one for one to government demand, which has implications for any output multiplier effects.

Using the estimated elasticities, a simple input-output model was used to estimate output multipliers, with cumulative multipliers ranging between 0.74 and 1.44; what the result shows is that the impact of government spending is necessarily dampened when the average elasticity of all industries is used, but if we take into account industry heterogeneity and use the average elasticity of only industries that respond to government demand, then a better picture of the impact of government demand emerges. The natural question then becomes why most industries don't respond to government demand. This question was briefly explored and deserves future research attention because a possible explanation for empirical evidence of an aggregate output multiplier below one is simply because government spending has a muted effect at the disaggregated level, which is ultimately translated into aggregate data used in empirical studies.

Results from the estimated elasticity suggest that while it is possible to generalise that government demand needs to make up at least 10% of industry output to trigger a response from an industry, the uniqueness of each industry means we have to be careful with such generalisations. This is because some industries received more than 10% of their demand from the government yet their output responses were not statistically different from zero. In addition, some industries that received less than the 10% threshold responded significantly to government demand. However, it is noteworthy that 92% of the insignificant estimated elasticities are for industries receiving less than 10% of their output demand from the government, so it is difficult to simply discard the threshold argument. Thus, if taken that government demand needs to make up at least 10% of industry output to have a significant response, and if as data used in the chapter suggests that on average this 10% level is not achieved across industries, then it should be less of a surprise that taken together the empirical output effect reported for the UK tends to be below unity. The size of the multiplier is linked not only to household response, but also to how firms within industries respond to any increase in government demand. If these firms are not increasing production, all else being equal, then it means they are not demanding either additional labour or inputs from other firms, which also has an impact on the labour demands of these firms. Put simply, the multiplier process is muted if industries don't respond to government demand by increasing production. Thus, the story of the *government spending multiplier is one that not only needs to take into account the input-output linkages, but also the initial responses of industries.* For the UK, it seems the government is not spending enough to initiate a response from most industries.

While understanding the aggregate effects of government spending is very useful for policy makers, results presented in this chapter suggest that to achieve the largest aggregate effects, policy makers might be better served looking at what is happening at the disaggregated level. If government spending policy is not having the desired first round effects, which happens at the disaggregated level, then any aggregate effects will be necessarily dampened.

Appendix: Summary Statistics and Tables of Results

Table 3.3: Input-output tables for industries

ONS SIC Code	Industry Sector Description	Classification	Ave. Gov Spending share (in %) **	Ratio of Gov Demand in output
1	Products of agriculture, hunting and related services	ND	0.0001	0.0013
2	Products of forestry, logging and related services	ND	0.0000	0.0022
3	Fish and other fishing products; aquaculture products; support services to fishing	ND	0.0000	0.0000
5	Coal and lignite	ND	0.0000	0.0043
06 & 07	Crude Petroleum And Natural Gas & Metal Ores	ND	0.0000	0.0001
8	Other mining and quarrying products	ND	0.0000	0.0012
9	Mining support services	ND	0.0000	0.0000
10.1	Preserved meat and meat products	ND	0.0016	0.0198
10.2-3	Processed and preserved fish, crustaceans, molluscs, fruit and vegetables	ND	0.0008	0.0130
10.4	Vegetable and animal oils and fats	ND	0.0001	0.0098
10.5	Dairy products	ND	0.0004	0.0064
10.6	Grain mill products, starches and starch products	ND	0.0002	0.0081
10.7	Bakery and farinaceous products	ND	0.0004	0.0106
10.8	Other food products	ND	0.0013	0.0142
10.9	Prepared animal feeds	ND	0.0000	0.0006
11.01-6 & 12	Alcoholic beverages & Tobacco products	ND	0.0000	0.0000
11.07	Soft drinks	ND	0.0003	0.0100
13	Textiles	D	0.0007	0.0095
14	Wearing apparel	D	0.0024	0.0143
15	Leather and related products	D	0.0007	0.0169
16	Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials	D	0.0004	0.0110
17	Paper and paper products	ND	0.0057	0.0608
18	Printing and recording services	ND	0.0086	0.2314
19	Coke and refined petroleum products	ND	0.0068	0.0286
20.3	Paints, varnishes and similar coatings, printing ink and mastics	ND	0.0007	0.0342
20.4	Soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	ND	0.0016	0.0201
20.5	Other chemical products	ND	0.0010	0.0284
20A	Industrial gases, inorganics and fertilisers (all inorganic chemicals) - 20.11/13/15	ND	0.0005	0.0196
20B	Petrochemicals - 20.14/16/17/60	ND	0.0002	0.0021
20C	Dyestuffs, agro-chemicals - 20.12/20	D	0.0002	0.0126
21	Basic pharmaceutical products and pharmaceutical preparations	ND	0.0416	0.2691
22	Rubber and plastic products	D	0.0018	0.0169
23.5-6	Manufacture of cement, lime, plaster and articles of concrete, cement and plaster	D	0.0019	0.0652
23OTHER	Glass, refractory, clay, other porcelain and ceramic, stone and abrasive products - 23.1-4/7-9	D	0.0010	0.0193
24.1-3	Basic iron and steel	D	0.0000	0.0000
24.4-5	Other basic metals and casting	D	0.0000	0.0001
25.4	Weapons and ammunition	D	0.0059	0.4301
25OTHER	Fabricated metal products, excl. machinery and equipment and weapons & ammunition - 25.1-3/25.5-9	D	0.0007	0.0049
26	Computer, electronic and optical products	D	0.0487	0.1442
27	Electrical equipment	D	0.0026	0.0214
28	Machinery and equipment n.e.c.	D	0.0008	0.0044
29	Motor vehicles, trailers and semi-trailers	D	0.0027	0.0079
30.1	Ships and boats	D	0.0015	0.0865
30.3	Air and spacecraft and related machinery	D	0.0022	0.0215
30OTHER	Other transport equipment - 30.2/4/9	D	0.0006	0.0337
31	Furniture	D	0.0037	0.0581
32	Other manufactured goods	D	0.0005	0.0031
33.15	Repair and maintenance of ships and boats	ND	0.0000	0.0028
33.16	Repair and maintenance of aircraft and spacecraft	ND	0.0000	0.0006
33OTHER	Rest of repair; Installation - 33.11-14/17/19/20	ND	0.0000	0.0006
35.1	Electricity, transmission and distribution	ND	0.0057	0.0348
35.2-3	Gas; distribution of gaseous fuels through mains; steam and air conditioning supply	ND	0.0037	0.0441

Notes: D = Durable goods; ND = Non-Durable goods; S = Services. *Italics* are industries that don't supply goods or services to the government, or those that don't supply each year in our sample period.

Table 3.4: Input-output tables for industries continued...

ONS SIC Code	Industry Sector Description	Classification	Ave. Gov Spending share (in %) **	Ratio of Gov Demand in output
36	Natural water; water treatment and supply services	ND	0.0018	0.0927
37	Sewerage services; sewage sludge	ND	0.0010	0.0488
38	Waste collection, treatment and disposal services; materials recovery services	ND	0.0171	0.2545
39	Remediation services and other waste management services	ND	0.0009	0.6844
41, 42 & 43	Construction	ND	0.0204	0.0260
45	Wholesale and retail trade and repair services of motor vehicles and motorcycles	S	0.0018	0.0187
46	Wholesale trade services, except of motor vehicles and motorcycles	S	0.0000	0.0000
47	Retail trade services, except of motor vehicles and motorcycles	S	0.0000	0.0000
49.1-2	Rail transport services	S	0.0034	0.1293
49.3-5	Land transport services and transport services via pipelines, excluding rail transport	S	0.0111	0.0692
50	Water transport services	S	0.0002	0.0034
51	Air transport services	S	0.0009	0.0095
52	Warehousing and support services for transportation	S	0.0011	0.0089
53	Postal and courier services	S	0.0053	0.0897
55	Accommodation services	S	0.0032	0.0276
56	Food and beverage serving services	S	0.0053	0.0185
58	Publishing services	S	0.0041	0.0439
59 & 60	Motion Picture, Video & TV Programme Production, Sound Recording & Music Publishing Activities & Programming And Broadcasting Activities	S	0.0096	0.1086
61	Telecommunications services	S	0.0094	0.0572
62	Computer programming, consultancy and related services	S	0.0094	0.0453
63	Information services	S	0.0000	0.0015
64	Financial services, except insurance and pension funding	S	0.0121	0.0301
65.1-2 & 65.3	Insurance and reinsurance, except compulsory social security & Pension funding	S	0.0048	0.0236
66	Services auxiliary to financial services and insurance services	S	0.0001	0.0012
68.1-2	Real estate services, excluding on a fee or contract basis and imputed rent	S	0.0132	0.0513
68.2IMP	Owner-Occupiers' Housing Services	S	0.0000	0.0000
68.3	Real estate activities on a fee or contract basis	S	0.0001	0.0038
69.1	Legal services	S	0.0131	0.1445
69.2	Accounting, bookkeeping and auditing services; tax consulting services	S	0.0018	0.0395
70	Services of head offices; management consulting services	S	0.0053	0.0469
71	Architectural and engineering services; technical testing and analysis services	S	0.0079	0.0608
72	Scientific research and development services	S	0.0036	0.0347
73	Advertising and market research services	S	0.0053	0.0553
74	Other professional, scientific and technical services	S	0.0049	0.0686
75	Veterinary services	S	0.0000	0.0021
77	Rental and leasing services	S	0.0072	0.0715
78	Employment services	S	0.0095	0.0842
79	Travel agency, tour operator and other reservation services and related services	S	0.0008	0.0151
80	Security and investigation services	S	0.0044	0.2279
81	Services to buildings and landscape	S	0.0074	0.1640
82	Office administrative, office support and other business support services	S	0.0088	0.0601
84	Public administration and defence services; compulsory social security services	S	0.1863	0.4246
85	Education services	S	0.1420	0.3965
86	Human health services	S	0.2065	0.6025
87 & 88	Residential Care & Social Work Activities	S	0.0693	0.4463
90	Creative, arts and entertainment services	S	0.0023	0.0610
91	Libraries, archives, museums and other cultural services	S	0.0050	0.1775
92	Gambling and betting services	S	0.0000	0.0000
93	Sports services and amusement and recreation services	S	0.0023	0.0527
94	Services furnished by membership organisations	S	0.0013	0.0250
95	Repair services of computers and personal and household goods	S	0.0051	0.2977
96	Other personal services	S	0.0020	0.0296
97	Services of households as employers of domestic personnel	S	0.0000	0.0000

Notes: D = Durable goods; ND = Non-Durable goods; S = Services. *Italics* are industries that don't supply goods or services to the government, or those that don't supply each year in our sample period.

Appendix C3: summary statistics and results

Table 3.5: Industry classification, SIC codes and government demand

ONS Code	Industry Sector Description	Industry SIC Codes	Ave. Gov Spending share (in %) **	Ratio of Gov Demand in output
A	Agriculture, Forestry & Fishing	01-03	0.0002	0.0012
B	Mining & Quarrying	04-09	0.0001	0.0005
C1	Food Products, Beverages and Tobacco	10-12	0.0052	0.0082
C2	Textiles, Leather & Clothing	13-15	0.0038	0.0133
C3	**Chemicals & Man-made Fibres**	20-21	0.0458	0.1058
C4	Basic Metals & Metal Products	24-25	0.0067	0.0230
C5	Engineering & Allied Industries	26-30;33	0.0592	0.0495
C6	Other Manufacturing	16-19;22-23;31-32	0.0304	0.0374
D & E	**Electricity, Gas & Water Supply**	35-39	0.0303	0.0848
F	Construction	41-43*	0.0204	0.0260
G46*	Wholesale Trade	46	0.0000	0.0000
G45 & G47	Retail Trade & Repairs	45-47	0.0018	0.0185
H	**Transport & Storage**	49-53	0.0219	0.0425
I	Accommodation & Food Service Activities	55-56	0.0085	0.0211
J	Information & Communication	58-63	0.0326	0.0557
K	Financial & Insurance Activities	64-66	0.0171	0.0237
L	Real Estate Activities	68	0.0133	0.0156
M	Professional, Scientific & Technical Activities	69-75	0.0420	0.0633
N	Administrative & Support Service Activities	77-82	0.0382	0.0793
O	**Public Administration**	84	0.1865	0.4246
P	**Education**	85	0.1421	0.3965
Q	**Health & Social Work**	86-88	0.2761	0.5533
R	**Arts, Entertainment & Recreation**	90-93	0.0095	0.0603
S	Other Service Activities	96-96	0.0084	0.0607

Notes: G46*: Industry sector does not supply goods or services to the government ***Italics and bold*** are industry sectors that supply final demand goods and services to the government ** This figure shows for each pound the government spends, how much each industry sector receives. This proportion is the avearge across the sample period.

Table 3.6: Numbers of industries with government intermediate consumption demand

	Government Service Industries											
Date	38	49.3-5	52	59 & 60	84	85	86	87 & 88	90	91	93	Total
1997	39	-	-	46	91	70	66	53	15	32	46	92
1998	38	-	-	46	91	71	66	56	15	32	49	92
1999	37	-	-	46	90	71	66	56	15	32	46	92
2000	39	-	-	46	91	69	66	54	15	32	46	92
2001	40	-	-	46	91	71	66	54	15	32	46	91
2002	41	-	-	46	92	71	66	56	15	32	46	91
2003	41	-	-	46	92	70	66	56	15	32	49	90
2004	41	-	59	46	92	70	64	57	15	32	49	95
2005	41	-	60	46	87	66	64	48	15	32	48	94
2006	41	-	57	46	88	67	64	53	15	32	48	94
2007	41	1	57	45	87	67	64	52	15	32	48	94
2008	41	1	57	45	87	68	64	53	15	32	48	93
2009	41	1	57	45	88	68	64	53	15	32	48	93
2010	41	1	57	45	87	68	64	53	15	32	48	93
2011	41	1	58	45	87	68	64	53	15	32	48	93
2012	41	1	57	46	87	68	64	53	15	32	48	94
2013	41	1	59	46	87	68	69	53	15	32	48	94
2014	41	1	59	46	87	68	69	53	15	32	48	94
2015	41	1	59	46	87	68	69	53	15	32	48	94

Notes: Table shows the number of industries the government service industries make intermediate purchases from. See table 2.2 for description of each government service industry code.

Table 3.7: Reduced-form regression of industry output on government demand: direct and indirect demand

Industry Sector	Ratio of Gov Demand in output	Output Response	
		Direct Demand	Indirect Demand
Agriculture, Forestry & Fishing	0.0012	0.035	0.150***
		(0.067)	(0.025)
Mining & Quarrying	0.0005	-0.231***	0.753*
		(0.076)	(0.382)
Food Products, Beverages and Tobacco	0.0082	0.018	0.037
		(0.050)	(0.030)
Textiles, Leather & Clothing	0.0133	0.008	0.000
		(0.096)	(0.064)
Chemicals & Man-made Fibres	0.1058	0.247***	0.287***
		(0.049)	(0.061)
Basic Metals & Metal Products	0.0230	0.101***	0.147**
		(0.027)	(0.056)
Engineering & Allied Industries	0.0495	-0.087	-0.078
		(0.089)	(0.063)
Other Manufacturing	0.0374	0.127*	0.224***
		(0.061)	(0.053)
Electricity, Gas & Water Supply	0.0848	0.194***	0.218**
		(0.060)	(0.077)
Construction	0.0260	0.150	0.105
		(0.196)	(0.169)
Retail Trade & Repairs	0.0185	-0.130	0.073
		(0.089)	(0.161)
Transport & Storage	0.0425	0.049	0.013
		(0.033)	(0.049)
Accommodation & Food Service Activities	0.0211	-0.065	-0.067
		(0.047)	(0.073)
Information & Communication	0.0557	-0.107	0.016
		(0.090)	(0.066)
Financial & Insurance Activities	0.0237	0.201**	0.510***
		(0.093)	(0.169)
Real Estate Activities	0.0156	-0.054**	-0.121***
		(0.019)	(0.033)
Professional, Scientific & Technical Activities	0.0633	-0.041	-0.147
		(0.083)	(0.134)
Administrative & Support Service Activities	0.0793	-0.003	-0.043
		(0.053)	(0.106)
Public Administration	0.4246	0.577**	0.014
		(0.250)	(0.190)
Education	0.3965	0.530***	0.678***
		(0.155)	(0.097)
Health & Social Work	0.5533	0.149***	0.191**
		(0.050)	(0.088)
Arts, Entertainment & Recreation	0.0603	-0.091	0.025
		(0.057)	(0.162)
Other Service Activities	0.0607	-0.033*	-0.100**
		(0.018)	(0.046)

Notes: table shows output response to direct or indirect government demand. Specification is $y_t = \alpha + \beta y_{t-1} + \gamma g_t + \varepsilon_t$, Where y_t is the variable of interest such as industry output, g captures government spending, ε_t is the unobserved error term. Estimated for the period 1997–2015. Standard errors in parentheses ***indicates significance at 1%, ** at 5% and * at 10% level. ***Italics and bold*** are industry sectors that supply final demand goods and services to the government.

Table 3.8: Reduced-form regression of industry output on government demand with controls

			Controls		
Industry Sector	Ratio of Gov Demand in output	Baseline	GDP	Bank Rate	10 year yield
Agriculture, Forestry & Fishing	0.0012	0.035	-0.069**	-0.031	0.000
		(0.067)	(0.031)	(0.036)	(0.049)
Mining & Quarrying	0.0005	-0.231***	-0.316**	-0.228**	-0.229***
		(0.076)	(0.140)	(0.082)	(0.077)
Food Products, Beverages and Tobacco	0.0082	0.018	0.031	-0.011	0.014
		(0.050)	(0.059)	(0.033)	(0.040)
Textiles, Leather & Clothing	0.0133	0.008	-0.062	-0.093	-0.032
		(0.096)	(0.133)	(0.087)	(0.088)
Chemicals & Man-made Fibres	0.1058	0.247***	0.219***	0.262***	0.260***
		(0.049)	(0.058)	(0.055)	(0.047)
Basic Metals & Metal Products	0.0230	0.101***	-0.042	0.196***	0.094
		(0.027)	(0.108)	(0.046)	(0.066)
Engineering & Allied Industries	0.0495	-0.087	-0.330	-0.151*	-0.278***
		(0.089)	(0.230)	(0.083)	(0.093)
Other Manufacturing	0.0374	0.127*	0.023	0.127**	0.154***
		(0.061)	(0.121)	(0.059)	(0.051)
Electricity, Gas & Water Supply	0.0848	0.194***	0.177	0.198***	0.202***
		(0.060)	(0.121)	(0.053)	(0.065)
Construction	0.0260	0.150	0.047	0.218	0.140
		(0.196)	(0.142)	(0.279)	(0.197)
Retail Trade & Repairs	0.0185	-0.130	-0.170*	-0.175**	-0.147
		(0.089)	(0.095)	(0.073)	(0.091)
Transport & Storage	0.0425	0.049	-0.066	0.129	-0.010
		(0.033)	(0.095)	(0.081)	(0.036)
Accommodation & Food Service Activities	0.0211	-0.065	-0.169***	-0.086**	-0.084**
		(0.047)	(0.034)	(0.040)	(0.035)
Information & Communication	0.0557	-0.107	-0.040	-0.101	-0.062
		(0.090)	(0.084)	(0.090)	(0.103)
Financial & Insurance Activities	0.0237	0.201**	0.159	0.193**	0.222**
		(0.093)	(0.092)	(0.082)	(0.093)
Real Estate Activities	0.0156	-0.054**	-0.072***	-0.059***	-0.022
		(0.019)	(0.018)	(0.016)	(0.022)
Professional, Scientific & Technical Activities	0.0633	-0.041	-0.041	-0.058	-0.012
		(0.083)	(0.039)	(0.086)	(0.071)
Administrative & Support Service Activities	0.0793	-0.003	-0.097**	-0.006	0.025
		(0.053)	(0.037)	(0.053)	(0.043)
Public Administration	0.4246	0.577**	0.609**	0.554*	0.588**
		(0.250)	(0.230)	(0.261)	(0.203)
Education	0.3965	0.530***	0.536***	0.512**	0.456**
		(0.155)	(0.172)	(0.174)	(0.168)
Health & Social Work	0.5533	0.149***	0.133	0.185***	0.236***
		(0.050)	(0.086)	(0.056)	(0.042)
Arts, Entertainment & Recreation	0.0603	-0.091	-0.113**	-0.085	0.018
		(0.057)	(0.039)	(0.075)	(0.083)
Other Service Activities	0.0607	-0.033*	-0.033	-0.029	-0.015
		(0.018)	(0.020)	(0.024)	(0.034)

Notes: table shows output response to direct government demand. Specification is $y_t = \alpha + \beta y_{t-1} + \gamma g_t + \phi X + \varepsilon_t$, Where y_t is the variable of interest such as industry output, g captures government spending, X captures control variables that are included one at a time, ε_t is the unobserved error term. Estimated for the period 1997–2015. Standard errors in parentheses ***indicates significance at 1%, ** at 5% and * at 10% level. ***Italics and bold*** are industry sectors that supply final demand goods and services to the government.

Table 3.9: Reduced-form regression of industry output, gva and household consumption on government demand: direct demand

		Direct Demand Effects		
Industry Sector	Ratio of Gov Demand in output	Output	GVA	HH Consumption
Agriculture, Forestry & Fishing	0.0012	0.035	0.044	-0.087***
		(0.067)	(0.109)	(0.011)
Mining & Quarrying	0.0005	-0.231***	-0.020	0.438***
		(0.076)	(0.084)	(0.092)
Food Products, Beverages and Tobacco	0.0082	0.018	-0.134	0.062
		(0.050)	(0.190)	(0.037)
Textiles, Leather & Clothing	0.0133	0.008	-0.530	-0.081
		(0.096)	(0.821)	(0.147)
Chemicals & Man-made Fibres	0.1058	0.247***	-0.072*	0.043**
		(0.049)	(0.039)	(0.018)
Basic Metals & Metal Products	0.0230	0.101***	-0.093	-0.041
		(0.027)	(0.153)	(0.052)
Engineering & Allied Industries	0.0495	-0.087	-0.177	-0.021
		(0.089)	(0.208)	(0.067)
Other Manufacturing	0.0374	0.127*	-0.225***	0.058
		(0.061)	(0.075)	(0.095)
Electricity, Gas & Water Supply	0.0848	0.194***	0.191*	0.335***
		(0.060)	(0.101)	(0.076)
Construction	0.0260	0.150	0.092	0.515**
		(0.196)	(0.103)	(0.234)
Retail Trade & Repairs	0.0185	-0.130	0.013	-0.066
		(0.089)	(0.047)	(0.079)
Transport & Storage	0.0425	0.049	0.045	0.003
		(0.033)	(0.041)	(0.065)
Accommodation & Food Service Activities	0.0211	-0.065	-0.090	-0.042
		(0.047)	(0.067)	(0.043)
Information & Communication	0.0557	-0.107	-0.139	0.052
		(0.090)	(0.118)	(0.158)
Financial & Insurance Activities	0.0237	0.201**	0.342***	0.138
		(0.093)	(0.081)	(0.114)
Real Estate Activities	0.0156	-0.054**	0.019	-0.050**
		(0.019)	(0.030)	(0.017)
Professional, Scientific & Technical Activities	0.0633	-0.041	-0.121	-0.018
		(0.083)	(0.101)	(0.059)
Administrative & Support Service Activities	0.0793	-0.003	-0.052	-0.063
		(0.053)	(0.057)	(0.124)
Public Administration	0.4246	0.577**	0.586***	0.520
		(0.250)	(0.116)	(0.452)
Education	0.3965	0.530***	0.368**	0.390***
		(0.155)	(0.128)	(0.124)
Health & Social Work	0.5533	0.149***	0.450***	-0.009
		(0.050)	(0.092)	(0.108)
Arts, Entertainment & Recreation	0.0603	-0.091	-0.137	-0.058
		(0.057)	(0.091)	(0.049)
Other Service Activities	0.0607	-0.033*	0.022	-0.035
		(0.018)	(0.054)	(0.033)

Notes: See notes for table 3.7. Standard errors in parentheses ***indicates significance at 1%, ** at 5% and * at 10% level. ***Italics and bold*** are industry sectors that supply final demand goods and services to the government.

Table 3.10: Reduced-form regression of industry output, gva and household consumption on government demand: indirect demand

Industry Sector	Ratio of Gov Demand in output	Indirect Demand Effects		
		Output	GVA	HH Consumption
Agriculture, Forestry & Fishing	0.0012	0.150***	-0.184	0.071
		(0.025)	(0.133)	(0.062)
Mining & Quarrying	0.0005	0.753*	0.008	-0.877***
		(0.382)	(0.329)	(0.281)
Food Products, Beverage and Tobacco	0.0082	0.037	-0.149**	-0.015
		(0.030)	(0.062)	(0.028)
Textiles, Leather & Clothing	0.0133	0.000	-0.140	-0.158
		(0.064)	(0.535)	(0.150)
Chemicals & Man-made Fibres	0.1058	0.287***	-0.087	0.063**
		(0.061)	(0.058)	(0.025)
Basic Metals & Metal Products	0.0230	0.147**	-0.259	-0.048
		(0.056)	(0.276)	(0.091)
Engineering & Allied Industries	0.0495	-0.078	-0.250	-0.045
		(0.063)	(0.237)	(0.057)
Other Manufacturing	0.0374	0.224***	-0.309**	0.140*
		(0.053)	(0.107)	(0.073)
Electricity, Gas & Water Supply	0.0848	0.218**	0.263*	0.389***
		(0.077)	(0.131)	(0.083)
Construction	0.0260	0.105	0.046	0.484
		(0.169)	(0.084)	(0.368)
Retail Trade & Repairs	0.0185	0.073	0.109	-0.001
		(0.161)	(0.140)	(0.232)
Transport & Storage	0.0425	0.013	0.000	-0.067
		(0.049)	(0.079)	(0.078)
Accommodation & Food Service Activities	0.0211	-0.067	-0.111	-0.035
		(0.073)	(0.126)	(0.063)
Information & Communication	0.0557	0.016	0.061	-0.138
		(0.066)	(0.149)	(0.083)
Financial & Insurance Activities	0.0237	0.510***	0.647***	-0.054
		(0.169)	(0.198)	(0.103)
Real Estate Activities	0.0156	-0.121***	0.043	-0.115***
		(0.033)	(0.055)	(0.029)
Professional, Scientific & Technical Activities	0.0633	-0.147	-0.218	0.037
		(0.134)	(0.158)	(0.093)
Administrative & Support Service Activities	0.0793	-0.043	-0.105	-0.088
		(0.106)	(0.126)	(0.194)
Public Administration	0.4246	0.014	0.358**	0.582**
		(0.190)	(0.123)	(0.199)
Education	0.3965	0.678***	0.445***	0.469***
		(0.097)	(0.112)	(0.123)
Health & Social Work	0.5533	0.191**	0.468**	-0.038
		(0.088)	(0.193)	(0.153)
Arts, Entertainment & Recreation	0.0603	0.025	0.216	0.172
		(0.162)	(0.325)	(0.187)
Other Service Activities	0.0607	-0.100**	0.043	-0.052
		(0.046)	(0.138)	(0.107)

Notes: See notes for table 3.7. Standard errors in parentheses ***indicates significance at 1%, ** at 5% and * at 10% level. ***Italics and bold*** are industry sectors that supply final demand goods and services to the government.

Table 3.11: Reduced-form regression of industry variables on government demand: direct demand (disaggregated)

			Direct Effects				
Industry SIC Code	Classification	Ratio of Gov Demand in output	Output	GVA	HH	Price	Long-run Elasticity♯
1	ND	0.0013	0.052	-0.232*	-0.057**	0.056	0.4326
			(0.059)	(0.130)	(0.023)	(0.095)	
2	ND						
3	ND						
5	ND	0.0043	-0.112*	0.057*	0.369***	-0.212**	-0.2126*
			(0.059)	(0.029)	(0.063)	(0.073)	
06 & 07	ND	0.0001	-0.114	0.025*			
			(0.063)	(0.011)			
8	ND	0.0012	0.062	0.029	-0.034	-0.003	0.2275
			(0.070)	(0.061)	(0.060)	(0.026)	
9	ND						
10.1	ND	0.0198	0.106	-0.402	0.045	0.216	1.9273
			(0.125)	(0.292)	(0.057)	(0.190)	
10.2-3	ND	0.0130	0.005	-0.186	-0.008	0.096**	-0.3276
			(0.037)	(0.141)	(0.053)	(0.042)	
10.4	ND	0.0098	0.024	-0.124	-0.076	-0.164	0.0636
			(0.071)	(0.233)	(0.096)	(0.144)	
10.5	ND	0.0064	-0.052	0.037	-0.026	-0.094**	-0.5030
			(0.032)	(0.186)	(0.024)	(0.042)	
10.6	ND	0.0081	0.037	-0.134	0.029	0.061	0.0624
			(0.023)	(0.113)	(0.025)	(0.046)	
10.7	ND	0.0106	-0.090	-0.447*	-0.008	0.014	0.6582
			(0.065)	(0.246)	(0.031)	(0.045)	
10.8	ND	0.0142	0.186***	-0.504	0.185***	-0.076	1.2380***
			(0.052)	(0.339)	(0.039)	(0.046)	
10.9	ND						
11.01-6 & 12	ND						
11.07	ND	0.0100	-0.013	0.388	-0.046	0.206	-0.1827
			(0.115)	(0.373)	(0.128)	(0.157)	
13	D	0.0095	0.019	-0.258	0.005	0.067	0.0991
			(0.067)	(0.233)	(0.066)	(0.044)	
14	D	0.0143	-0.107	0.087	-0.168	0.002	1.0107
			(0.096)	(0.244)	(0.102)	(0.022)	
15	D	0.0169	0.048	0.436	0.003	0.108**	-0.3857
			(0.068)	(0.475)	(0.145)	(0.047)	
16	D	0.0110	-0.021	0.295	-0.003	0.110***	-0.0494
			(0.111)	(0.266)	(0.165)	(0.031)	
17	ND	0.0608	-0.056	-0.091	-0.042	0.113***	-0.2182
			(0.041)	(0.239)	(0.070)	(0.033)	
18	ND	0.2314	-0.216*	-0.030	-0.530***	0.028***	-0.7130*
			(0.112)	(0.157)	(0.144)	(0.007)	
19	ND	0.0286	0.293**	0.023	0.180*	0.971***	0.8175**
			(0.101)	(0.207)	(0.087)	(0.235)	
20.3	ND	0.0342	-0.027	0.096	-0.252*	0.095***	-0.0379
			(0.025)	(0.198)	(0.129)	(0.018)	
20.4	ND	0.0201	0.120*	-0.076	0.073	0.096*	0.5912*
			(0.063)	(0.159)	(0.081)	(0.048)	
20.5	ND	0.0284	0.011	-0.198*	-0.095***	0.099**	0.0102
			(0.017)	(0.113)	(0.028)	(0.035)	
20A	ND	0.0196	-0.019	-0.192*	-0.243**	0.166*	-0.0259
			(0.036)	(0.094)	(0.107)	(0.090)	
20B	ND	0.0021	0.105	0.511**		0.352**	0.6223
			(0.087)	(0.229)		(0.137)	
20C	D	0.0126	0.026	0.522***	-0.022	-0.064	0.1325
			(0.073)	(0.170)	(0.199)	(0.187)	
21	ND	0.2691	0.348***	-0.200*	-0.212	0.083**	0.5822***
			(0.068)	(0.110)	(0.125)	(0.037)	
22	D	0.0169	-0.012	-0.150	-0.096**	0.103***	-0.0303
			(0.031)	(0.123)	(0.040)	(0.013)	
23.5-6	D	0.0652	0.034	0.197	-0.396	0.032	0.1044
			(0.149)	(0.288)	(0.326)	(0.036)	
23OTHER	D	0.0193	-0.033	0.168	-0.179**	0.095***	-0.0726
			(0.052)	(0.221)	(0.069)	(0.024)	
24.1-3	D						

Notes: See notes for table 3.7. D = Durable goods; ND = Non-Durable goods; S = Service. See tables 3.3 and 3.4 for Industry SIC Code description. Standard errors in parentheses ***indicates significance at 1%, ** at 5% and * at 10% level. ***Italics and bold*** are industry sectors that supply final demand goods and services to the government. Industries that did not supply goods or services for each in the sample period were excluded. ♯ Long-run elasticity captures industry output elasticity to government demand calculated as $\frac{\gamma}{1-\beta}$.

Table 3.12: Reduced-form regression of industry variables on government demand: direct demand (disaggregated), continued...

Industry SIC Code	Classification	Ratio of Gov Demand in output	Direct Effects: Output	GVA	HH	Price	Long-run Elasticity♯
24.4-5	D						
25.4	D	0.4301	0.382***	-0.150*	0.030	0.063**	0.8292***
			(0.112)	(0.074)	(0.139)	(0.029)	
25OTHER	D	0.0049	-0.303**	0.473*	-0.207	0.016	-0.9268**
			(0.124)	(0.231)	(0.171)	(0.081)	
26	D	0.1442	-0.560**	-0.755	-0.297***	0.155***	-1.1382**
			(0.256)	(0.489)	(0.046)	(0.041)	
27	D	0.0214	0.027	-0.136	-0.018	0.082***	0.2163
			(0.048)	(0.131)	(0.045)	(0.017)	
28	D	0.0044	0.051	-0.093	-0.066	0.058**	0.0952
			(0.060)	(0.088)	(0.065)	(0.023)	
29	D	0.0079	0.082	-0.058	-0.053	0.045	0.2534
			(0.082)	(0.158)	(0.092)	(0.035)	
30.1	D	0.0865	-0.030	0.076	0.050	0.013	-0.7876
			(0.115)	(0.085)	(0.112)	(0.023)	
30.3	D	0.0215	0.028	-0.022	0.011	0.007	0.1733
			(0.022)	(0.021)	(0.023)	(0.005)	
30OTHER	D	0.0337	0.114**	-0.295	0.000	0.013	0.1670**
			(0.041)	(0.179)	(0.031)	(0.041)	
31	D	0.0581	-0.119*	0.102	-0.174	0.054**	-0.6747*
			(0.064)	(0.373)	(0.118)	(0.024)	
32	D	0.0031	0.023	0.247	-0.087	0.058*	0.1399
			(0.096)	(0.257)	(0.103)	(0.028)	
33.15	ND						
33.16	ND						
33OTHER	ND						
35.1	ND	0.0348	0.309***	-0.252*	0.744***	1.055***	1.4029***
			(0.064)	(0.129)	(0.129)	(0.254)	
35.2-3	ND	0.0441	0.387***	-0.194**	0.358***	1.212***	1.0539***
			(0.053)	(0.070)	(0.101)	(0.202)	
36	ND	0.0927	0.165	-0.573	0.153	0.239	1.5612
			(0.139)	(0.580)	(0.172)	(0.142)	
37	ND	0.0488	0.096	-0.209*	0.234***	0.297***	0.2471
			(0.060)	(0.105)	(0.048)	(0.086)	
38	ND	0.2545	0.353***	-0.029	0.487**	0.280***	0.5957***
			(0.110)	(0.168)	(0.209)	(0.092)	
39	ND	0.6844	0.382**	-0.199*		0.024	0.3817**
			(0.141)	(0.095)		(0.156)	
41, 42 & 43	ND	0.0260	0.150	-0.079	0.515**	0.000	0.4659
			(0.196)	(0.160)	(0.234)	(0.000)	
45	S	0.0187	-0.134	-0.135	-0.066	0.038**	0.9200
			(0.089)	(0.093)	(0.079)	(0.016)	
46	S	0.0000					
47	S	0.0000					
49.1-2	S	0.1293	-0.088	-0.001	-0.001	0.044	3.2519
			(0.098)	(0.187)	(0.069)	(0.025)	
49.3-5	S	0.0692	0.011	-0.294**	0.030	0.050	0.0260
			(0.022)	(0.119)	(0.054)	(0.059)	
50	S	0.0034	0.177***	-0.038	0.027	0.012	0.4906***
			(0.057)	(0.046)	(0.046)	(0.027)	
51	S	0.0095	0.005	-0.050	-0.004	0.020	0.0229
			(0.043)	(0.087)	(0.059)	(0.034)	
52	S						
53	S	0.0897	0.084	0.025	-0.146	0.055**	0.4999
			(0.070)	(0.201)	(0.117)	(0.022)	
55	S	0.0276	-0.079	-0.066	-0.075	0.059	2.1338
			(0.061)	(0.112)	(0.092)	(0.041)	
56	S	0.0185	-0.042	-0.108	-0.028	0.011	-2.1225
			(0.034)	(0.085)	(0.034)	(0.008)	
58	S	0.0439	-0.119***	-0.029	-0.103*	0.013	-0.9350***
			(0.026)	(0.161)	(0.050)	(0.012)	
59 & 60	S	0.1086	0.242**	0.549	0.269***		0.9944**
			(0.085)	(0.326)	(0.090)		

Notes: See notes for table 3.7. D = Durable goods; ND = Non-Durable goods; S = Service. See tables 3.3 and 3.4 for Industry SIC Code description. Standard errors in parentheses ***indicates significance at 1%, ** at 5% and * at 10% level. ***Italics and bold*** are industry sectors that supply final demand goods and services to the government. Industries that did not supply goods or services for each in the sample period were excluded ♯ Long-run elasticity captures industry output elasticity to government demand calculated as $\frac{\gamma}{1-\beta}$.

Table 3.13: Reduced-form regression of industry variables on government demand: direct demand (disaggregated), continued...

Industry SIC Code	Classification	Ratio of Gov Demand in output	Direct Effects: Output	GVA	HH	Price	Long-run Elasticity♯
61	S	0.0572	-0.104	0.051	0.123	-0.128	-0.7101
			(0.092)	(0.232)	(0.186)	(0.156)	
62	S	0.0453	-0.080	-0.017	0.492	0.016	-0.7736
			(0.117)	(0.133)	(0.284)	(0.017)	
63	S						
64	S	0.0301	0.143**	0.141	-0.037		0.4856**
			(0.059)	(0.165)	(0.121)		
65.1-2 & 65.3	S	0.0236	0.400	0.145	0.056		2.0605
			(0.232)	(0.125)	(0.095)		
66	S	0.0012	0.039	0.234	0.248		0.2861
			(0.077)	(0.230)	(0.214)		
68.1-2	S	0.0513	-0.010	-0.111	0.034*	0.018	0.6431
			(0.030)	(0.101)	(0.019)	(0.053)	
68.2IMP	S						
68.3	S	0.0038	-0.111	0.297*	-0.229	-0.033	-0.8911
			(0.096)	(0.153)	(0.153)	(0.037)	
69.1	S	0.1445	-0.162*	-0.159	-0.319	0.097***	7.3445*
			(0.084)	(0.132)	(0.382)	(0.032)	
69.2	S	0.0395	-0.011	-0.099	-0.180**	0.046*	-0.1208
			(0.060)	(0.091)	(0.070)	(0.023)	
70	S	0.0469	0.019	0.009	0.000	0.034*	0.1554
			(0.095)	(0.174)	(0.098)	(0.019)	
71	S	0.0608	0.099	-0.159	0.250*	0.057**	0.3555
			(0.149)	(0.100)	(0.122)	(0.026)	
72	S	0.0347	0.094***	-0.096**	0.202*	0.017	0.2384***
			(0.031)	(0.040)	(0.104)	(0.012)	
73	S	0.0553	-0.059	0.094	-0.244	0.024	-0.2472
			(0.056)	(0.217)	(0.218)	(0.020)	
74	S	0.0686	-0.028	-0.086	-0.150	0.027	-0.8247
			(0.043)	(0.071)	(0.091)	(0.017)	
75	S	0.0021	-0.035*	0.178	-0.010	0.024**	-2.3107*
			(0.016)	(0.104)	(0.024)	(0.011)	
77	S	0.0715	0.025	-0.157	-0.226	0.055	0.1040
			(0.050)	(0.139)	(0.149)	(0.037)	
78	S	0.0842	-0.002	-0.080	-0.183	0.043**	-0.0090
			(0.038)	(0.049)	(0.157)	(0.018)	
79	S	0.0151	-0.001	-0.053	-0.054	-0.030	-0.0036
			(0.070)	(0.126)	(0.137)	(0.051)	
80	S	0.2279	0.011	-0.099	0.069	0.195***	0.0419
			(0.050)	(0.095)	(0.075)	(0.031)	
81	S	0.1640	0.068	-0.204	0.499**	0.103**	0.9692
			(0.042)	(0.130)	(0.212)	(0.037)	
82	S	0.0601	0.024	-0.035	0.268	0.023	0.1509
			(0.067)	(0.107)	(0.246)	(0.022)	
84	S	0.4246	0.577**	-0.133	0.520	0.222	2.1683**
			(0.250)	(0.615)	(0.452)	(0.387)	
85	S	0.3965	0.530***	-0.181	0.390***	0.315**	0.9594***
			(0.155)	(0.164)	(0.124)	(0.114)	
86	S	0.6025	0.143***	-0.181	0.028	0.137***	0.9749***
			(0.034)	(0.133)	(0.082)	(0.017)	
87 & 88	S	0.4463	0.391*	-0.221	0.341	0.000	0.8509*
			(0.196)	(0.140)	(0.202)	(0.000)	
90	S	0.0610	-0.074	0.652	0.072	0.039	-2.9724
			(0.124)	(0.415)	(0.083)	(0.051)	
91	S	0.1775	-0.057	0.401	-0.110	-0.006	-0.2139
			(0.148)	(0.299)	(0.063)	(0.047)	
92	S						
93	S	0.0527	-0.033	0.227	-0.075	0.011	-0.1234
			(0.044)	(0.219)	(0.055)	(0.016)	
94	S	0.0250	0.042	0.299	-0.126**	0.060*	0.4832
			(0.030)	(0.244)	(0.045)	(0.030)	
95	S	0.2977	0.025	0.026	0.018	0.027**	0.2088
			(0.049)	(0.131)	(0.046)	(0.012)	
96	S	0.0296	0.031	-0.136	0.089**	0.050***	0.1597
			(0.063)	(0.112)	(0.032)	(0.008)	
97	S						

Notes: See notes for table 3.7. D = Durable goods; ND = Non-Durable goods; S = Service. See tables 3.3 and 3.4 for Industry SIC Code description. Standard errors in parentheses ***indicates significance at 1%, ** at 5% and * at 10% level. ***Italics and bold*** are industry sectors that supply final demand goods and services to the government. ***Italics and bold*** are industry sectors that supply final demand goods and services to the government. Industries that did not supply goods or services for each in the sample period were excluded ♯ Long-run elasticity captures industry output elasticity to government demand calculated as $\frac{\gamma}{1-\beta}$.

Table 3.14: Output effects of government demand: ARDL(1,1) Model

		DFE	DFE	MG	PMG	DCCEMG	DCCEPMG
All							
	Long-Run	0.113	0.044	0.487***	0.006	1.271	0.143
		(0.077)	(0.086)	(0.189)	(0.013)	(0.844)	(1.967)
	Error-correction term	-0.134***	-0.159***	-0.253***	-0.179***	-0.157***	-0.125
		(0.015)	(0.020)	(0.026)	(0.022)	(0.033)	(1.685)
	Short-Run	0.007	0.018**	0.000	0.056**	0.018	0.049**
		(0.008)	(0.008)	(0.021)	(0.023)	(0.026)	(0.021)
	No of Observations	1566	1566	1566	1566	1566	1566
	No Industries	87	87	87	87	87	87
	Year dummies	No	Yes				
	Hauseman MG vs DFE	0.9887	0.9890				
	Hauseman PMG vs DFE	0.9423	0.9831				
	Hauseman MG vs PMG			0.0338			
	CD stat					3.300	12.64
	p-value					0.001	0.000
Sample 1							
	Long-Run	0.154	0.042	0.830**	0.547***	1.321	-0.092
		(0.200)	(0.155)	(0.390)	(0.031)	(0.962)	(1.971)
	Error-correction term	-0.117***	-0.146***	-0.357***	-0.176***	-0.345***	-0.046
		(0.021)	(0.046)	(0.049)	(0.052)	(0.062)	(1.832)
	Short-Run	0.007	0.015	0.029	0.074	0.051	0.162***
		(0.041)	(0.039)	(0.060)	(0.069)	(0.051)	(0.046)
	No of Observations	450	450	450	450	450	450
	No Industries	25	25	25	25	25	25
	Year dummies	No	Yes	No	No	No	
	Hauseman MG vs DFE	0.9866	0.9883				
	Hauseman PMG vs DFE	0.8748	0.8792				
	Hauseman MG vs PMG			0.5790			
	CD stat					-0.54	-1.27
	p-value					0.5908	0.2026
Sample 2							
	Long-Run	0.520***	0.301**	0.944***	0.982***	0.737***	0.645
		(0.129)	(0.140)	(0.187)	(0.026)	(0.235)	(1.270)
	Error-correction term	-0.178***	-0.247***	-0.391***	-0.211***	-0.348***	-0.170
		(0.054)	(0.083)	(0.059)	(0.042)	(0.061)	(0.926)
	Short-Run	0.074***	0.072***	-0.006	0.114**	0.082	0.144***
		(0.025)	(0.024)	(0.069)	(0.046)	(0.072)	(0.037)
	No of Observations	324	324	324	324	324	324
	No Industries	18	18	18	18	18	18
	Year dummies	No	Yes				
	Hauseman MG vs DFE	0.9917	0.9910				
	Hauseman PMG vs DFE	0.9135	0.986				
	Hauseman MG vs PMG			0.8789			
	CD stat					-2.21	-1.33
	p-value					0.027	0.1823

Notes: The MG estimates are unweighted averages of elasticities from each industry regression. A weighted average would be appropriate if we wanted to interpret the result as aggregate elasticities. Standard errors in parentheses ***indicates significance at 1%, ** at 5% and * at 10% level.

Table 3.15: Unit root and stationary test

Variable		IPS	LLC	Hadri
Output				
	Level	0.000	0.000	0.000
	Difference	0.000	0.000	0.001
Gov Spending				
	Level	0.000	0.000	0.0000
	Difference	0.000	0.000	0.1286

Notes: The figures in the table present the p-values of each tests. H0: IPS/LLC - All panels contain unit root; Hadri - All panels are stationary.

Table 3.16: Chapter three: description of variables and sources

Variable	Description	Sources
Government final consumption expenditure (P3)	Expenditure, including imputed expenditure, incurred by general government on both individual consumption goods and services and collective consumption of services. (OECD SNA)	ESA 2010 tables, Office of National Statistics (ONS)
Government Intermediate consumption (P2)	The goods and services consumed during the accounting period in the production process.	ESA 2010 tables, ONS
Household Ratio (HH)	Import ratio is defined as household consumption divided by total output	Input-Output tables (IO), ONS
Import Ratio	Import ratio is defined as industry import divided by total output	IO, ONS
Profit Ratio	Profit ratio is defined as industry profit divided by total output	IO, ONS
Industry Output	The measure of total output produced by an industry	IO, ONS
Industry GVA	The measure of the value of goods and services produced by an industry	IO, ONS
Industry Profits	The measure of profits made by an industry	IO, ONS
Industry Imports	The amount of goods and services imported by an industry	IO, ONS
Industry Intermediate Supply	The amount of intermediate goods and services consumed by an industry in the production process	IO, ONS
Industry Intermediate Consumption	The amount of intermediate goods and services supplied by an industry	IO, ONS
GDP	Gross domestic product (GDP) captures the measure of the total value of all final goods and services produced	ONS
Bank Rate	This is the Bank of England base rate. Annual average observation.	Bank of England
Ten-year/medium-term government bond yields	Yield on 10-year/medium-term British Government Securities. Annual average observation.	Bank of England
GDP Deflator	The measure of price levels for all final goods and services	ONS
Industry Level Deflators (GVA Deflator)	The measure of price levels for goods and services produced by an industry	ONS

Chapter 4

The Impact of Government Expenditure on Employment and Wages: Evidence from Firm-level Data for the UK

4.1 Introduction

> '*The principle objective of fiscal policy according to Keynes was to solve "the real problem, fundamental yet essentially simple... [namely] to provide employment for everyone'*
>
> P.R. Tcherneva (2011)

Tcherneva (2011) argues that Keynes 'believed that the unemployment problem should be solved speedily and directly by one primary method—direct job creation through public works'. However, if it is the case as she also stated that 'the goal of modern fiscal policy has largely been confined to stabilizing incomes, consumption, and investment, whereas employment stabilization is left to be determined as a byproduct of these policies' (p. 2), the question that naturally arises is if employment is indeed affected by these policies[1]. Studies that attempt to understand the effect that changes in government spending have on employment and wages tend to present results that are mixed, but an important point that has emerged from the literature is the importance of distinguishing between the wage and non-wage components of government spending given that both components operate via different channels. This chapter makes an

[1]While this paper doesn't discuss the two strands of functional finance which argue that fiscal policy should be used to achieve full employment through aggregate demand management or direct job creation (see Tcherneva, 2008), it sheds some light on the impact aggregate demand management can have on employment.

empirical contribution to the literature by focusing on the non-wage component of government consumption expenditure.

The empirical fiscal literature has certainly enjoyed renewed interest and seen a significant increase in the amount of contributions, a renewed interest which can be traced to the financial crisis of 2008[2]. Nonetheless, this increase in contribution hasn't been translated to all strands of the literature. Using firm-level data, this chapter investigates the impact government expenditure has on employment and wages, distinguishing between the manufacturing and service sector, and in addition, how the impact varies depending on the size of firms. It provides micro-level evidence for the UK on a key transmission mechanism through which government expenditure impacts the economy: the labour market. The data used is novel and captures central government procurement of goods and services excluding the government's wage bill, representing on average about 27% of yearly total government procurement expenditure between 2010 and 2015 (see figure 4.1).

The chapter contributes to a few strands of the fiscal policy literature. First, it contributes to the strand that focuses on the impact of government spending on employment and wages (e.g. Pappa, 2009a). Second, it contributes to a strand that argues that the impact is dependent on the sector in which the fiscal shock occurs, distinguishing between manufacturing and services (e.g. Monacelli and Perotti, 2008; Wesselbaum; 2015). Third, it contributes to a strand that has seen few contributions due to a lack of data in that the size of the fiscal shock matters. Fourth, it contributes to a strand of the literature that makes use of firm-level data to provide micro- and macro-level evidence (e.g. Boehm, 2016; Hebous and Zimmermann, 2016). The final contribution is how the impact varies by size of firms, i.e. how do small firms react to government expenditure compared to large firms.

Firm-level micro data offers some flexibility that macro data doesn't in that it allows us to explore firm characteristics and its implications on the impact of government spending. One can take firm-level analysis one step deeper into the strand of the literature that argues that the characteristics of a country have a role to play in the impact of government spending (e.g. Ilzetzki et al., 2010; Batini et al., 2014). But rather than focusing on aggregate characteristics, useful information in firm-level characteristics can be exploited to provide a richer understanding of the transmission mechanism of government spending. Could it be the case that the impact of government expenditure depends on how such expenditure is distributed across firms of different sizes, so would results be different in countries where such expenditure is mainly distributed between large firms compared to those where expenditure is distributed more evenly? While the data used here is only for the UK, comparisons can potentially be made with other studies once similar data becomes available for other economies.

The lack of literature on the impact of government spending using the firm level is not a surprise given the challenge of matching firm-level data across different sources. Even after

[2]See chapter two of this thesis.

matching firms across different data sources, the quality of the data is not always ideal, and as shown in this chapter, imposed data quality assurance criteria mean we lose a significant number of firms from our sample set. However, sacrificing sample size for quality is deemed necessary to be confident in the sets of results presented. Nonetheless, this data challenge hasn't deterred the few papers that have used micro-level government spending data, such as Hebous and Zimmermann (2016). They used US procurement data to investigate the impact of government spending on investments of financially constrained and non-constrained firms, presenting evidence which suggests that increases in government purchases have a positive effect on firms' capital investments, with stronger effects reported for constrained firms[3].

Following the example of Hebous and Zimmermann (2016), it is worth stating that the result presented in this chapter is not about the effect of let's say building a new train tunnel on the economy, but rather it captures the effect of government spending on the 'firms that build the tunnel'. So it captures the direct reaction of firms exposed to government demand shocks, which is just one element of the fiscal multiplier. The remainder of the chapter is organised as follows. Section two provides a brief review of the empirical literature. Section three describes the dataset, with section four providing important summary statistics for government procurement spending and the other variables used in the analysis. Section five describes the empirical approach used. Section six discusses the results, and section seven concludes.

4.2 A brief review of the empirical literature

In this section, I provide a brief review of empirical evidence regarding the effects of government spending on employment and wages. As explained earlier, results tend to be mixed, but recent contributions have made attempts to distinguish between different components of government spending and in doing so reveal important insights. A short theoretical overview is provided first.

While it might appear that there is consensus in the theoretical literature on the impact an increase in government spending has on employment in that it is generally positive, closer inspection of the mechanisms at play within the leading theories reveals differences that have implications on the impact the government has on real wages.

I use this with caution, but for Keynesians and post-Keynesians, the impact of an increase in government spending on employment is positive, but the impact on wages is not as clear cut as

[3]It is worth noting that although government procurement data is used, this paper differs from the public procurement literature where the debate tends to centre around the procurement process/strategy followed by a government or the differences between public and private procurement, and the implications of these differences (for a brief introduction see Telgen et al., 2007). Nonetheless, within the literature, Telgen et al. (2007) recognised a seven-stage framework of public procurement, presenting the sixth stage as public procurement being used for broader government policy objectives, with job creation and employment a policy area. Thus, results from this paper can be of use to public procurement researchers, but it should also be noted that these results although comparable as discussed in section 6 are different from those discussed in Erridge (2007, p. 1,034), where contractors were 'required to include with their bid an Employment Plan for utilizing those registered unemployed for at least 3 months in work on the contract, failure to do so resulting in rejection of the bid'.

one would expect[4]. The difference lies in the assumption on changes in nominal wages and price level, which are affected by assumptions about the aggregate supply curve. As Palley (2013) showed using a simple IS-LM model, a post-Keynesian economy is one where the AS schedule is horizontal[5], so both price and nominal wage level don't increase as a result of an increase in government spending, and as a result real wages remain unchanged. However, a neo-Keynesian model has an upward-sloping AS curve, which means any shift in the *aggregate demand* curve affects price level which then affects real wages, so an increase in price level with a fixed nominal wage results in a reduction in real wages.

The wealth effect dominance in both the standard neoclassical[6] and NK models means if Ricardian equivalence holds, then positive government spending induces a negative wealth effect on households as forward-looking agents with perfect foresight anticipate higher taxes in the future. This negative wealth effect causes a reduction in consumption; with the assumption of leisure being a normal good and the separable utility of consumption and leisure, the reduction in consumption leads to an increase in hours worked by agents. It is the reaction of firms to this increase in hours supplied by households that shapes the theoretical prediction on the effects of government spending on wages. In a neoclassical model setting, there is no mechanism to shift the labour demand curve leftward to counter the increase in labour supply induced by the negative wealth effect, which results in real wages decreasing (e.g. Baxter and King, 1993). However, a NK model with nominal rigidities and monopolistic competition provides the framework to achieve the shift in the demand curve. As with the neoclassical model, a negative wealth effect puts downwards pressure on consumption, raising labour supply. However, since prices are sticky in a NK setting, profit-maximising monopolistic firms would take advantage of the marginal product of labour by increasing the supply of output through the employment of more labour as long as the price of goods exceeds the marginal cost of producing. This increase in demand for labour shifts the labour curve leftwards, raising the real wage rate (e.g. Devereux et al., 1996). The natural question to ask is if current empirical evidence differs from these theoretical predictions.

The crisis certainly spurred not only many new contributions to the empirical literature, but also many review papers such as those by Ramey (2011b) and Auerbach et al. (2010). Not only did these contributions confirm the lack of consensus, but they also show that the empirical literature is shaped by the identification of fiscal shocks (see Perotti, 2007; Ramey, 2011a, 2016). Furthermore, the contributions tend to be primarily focused on the output effects of government spending, with labour market effects arguably treated as a by-product. As expressed by Hristov (2012), 'the fascination with the size of the multiplier is related to the predictive power of this simple metric regarding how fast the economy may grow following fiscal stimulus actions and

[4]The simple Keynesian model does not provide an exact transmission mechanism that occurs in the labour market following an increase in government spending.

[5]Based on firms following Kaleckian pricing behaviour, set prices as mark-up over normal average cost and meet all demand at that price (Palley, 2013).

[6]I follow Fontana (2009) in labelling this group of real business cycle models as Neoclassical models.

whether some form of direct crowding out may be taking place... Multipliers as a metric are not very eloquent on the consequences for overall welfare. That is, whether output increases caused by activist fiscal policy are desirable or not needs to be evaluated by other means.' These other means include macroeconomic variables such as wages and employment. Encouragingly, some studies such as the contributions of Pappa (2009a) and Bénétrix (2012) set their primary goal on understanding the impact government spending has on employment and real wages, even more so the contributions to the local multiplier literature that are motivated by the question of job creation.

Table 4.1 presents a small sample of commonly cited papers on the effects of government spending shocks on employment and wages, and unsurprisingly, it captures the lack of consensus mentioned earlier. Contributions such as those by Fatas and Mihov (2001) and Burnside et al. (2004) suggest that private employment reacts positively to an increase in government spending, a result consistent with other papers focused on countries and alternative empirical approaches. However, there are examples where negative impacts are reported; Lane and Perotti (2003) presented results which suggest negative effects, with the cost or labour market channel[7] presented as an explanation for their results. What the table highlights is that most studies in the literature tend to find evidence that support the narrative that an increase in government purchases lowers unemployment. Nonetheless, Ramey (2012) provided results which suggest that while it is true that overall employment increases, it is actually government employment that increases, not private employment . The lack of consensus could perhaps also be explained by the results of Bruckner and Pappa (2012)[8], who found that although higher government expenditure increases employment, it can also increase the unemployment rate[9] due to the higher participation rate caused by an increase in labour supply[10]. So it could be the case that studies that report negative or no statistically significant effect on employment are not accounting for the increase in labour participation rate, and in doing so are understating the impact government spending has on employment.

Although local multipliers are not directly comparable with aggregate multipliers[11], with Du-

[7]The channel argues that an increase in the wage bill component of government spending increases wages in the private sector, and in doing so reduces profits given the rise in labour cost, which leads to a decrease in private investments and employment. While this channel is generally seen to generate a negative response, Tagkalakis (2013) presented results which show that the structure of the economy matters with how this channel operates, so for the Greek economy an increase in government wage bill actually resulted in a positive response in both output and employment, which is due to the importance of the government sector of the Greek economy. The result highlights a very important factor in how the channel operates in that the starting point of the size of the government sector matters, so if the sector makes up a large size of the economy, then it shouldn't come as a surprise that cutting the wage bill would have a proportional effect on the economy as it means a direct decline in domestic demand.

[8]They analysed ten OECD countries, presenting results that suggest that an increase in government spending had a positive effect on employment and wages.

[9]They were able to reproduce their empirical results using a standard NK model with matching friction, with additional inclusion of labour force participation choice and workers' heterogeneity.

[10]Using the evidence of Perotti (2004), who found different fiscal shock effects for pre-1980s and post-1980s samples, they provide some explanations for why their results differ from the results of Monacelli et al. (2010). See page 9 of their paper.

[11]See e.g. Clemens and Miran, 2012.

Table 4.1: Empirical evidence on the effects of an increase in government spending on real wages and employment

Study	Country	Employment	Wages
Alesina et al (2002)	18 OECD countries		+
Bénétrix (2012)	Panel of 11 EU countries		+
Bruckner and Pappa (2012)	10 OECD countries	+	
Burnside et al. (2004)	US	+	-
De Castro and De Cos (2008)	Spain	+	
Dupor (2016)	US	+	
Edelberg et al. (1999)	US		-
Fatas and Mihov (2001)	US	+	
Fishback and Kachanovskaya (2015)	US	=	
Gomes (2009)	US		+
Holden and Sparrman (2011)	20 OECD countries	+	
Lane and Perotti (2003)*	14 OECD countries	-	-
Lorusso and Pieroni (2017)	US (civilian spending)		+
	US (military spending)		-
Nakamura and Steinsson (2014)	US	+	
Pappa(2009a)	US	+	+
Pappa (2009b)	Canada	+	+
	EU Aggregate	+	+
	Japan	+	+
	UK	+	+
	US	+	+
Perotti (2007)	Canada	-	+
	UK	-	+
	US	+	+
Ramey (2011)	US		-
Tagkalakis (2006)	UK	-	
Tagkalakis (2013)	Greece	+	

Source: Author's, based on reported results from respective papers.
Notes: * The report effects although negative were estimated to be quite small and statistically insignificant from zero.

por (2016) highlighting that 'local multiplier estimates alone do not provide useful information about the aggregate effects of policy'[12], they provide valuable contributions on the employment impacts of government spending. Using state-level federal defence spending, Dupor (2016) reported positive employment effect at the state level[13]; however, his results suggested government spending has a limited ability in substantially increasing employment in the short run. But, as is the case with all defence spending multipliers, one needs to be mindful, as expressed by Barro and Redlick (2011), that it captures only the multiplier for defence expenditure, and thus, it is not a multiplier for total government spending. Nakamura and Steinsson (2014), using military procurement spending, also reported a positive multiplier effect on employment with multipliers ranging from 1.3 to 1.8. However, Fishback and Kachanovskaya (2015) found no significant impact of government spending on employment[14], thus highlighting the fact that the local multiplier literature is not immune to the lack of consensus that is present in the aggregate level. Nonetheless, the local multiplier literature seems to suggest that government spending doesn't impact employment negatively.

Turning our attention to wages, the results are also mixed as studies that use general government spending in standard fiscal VARs tend to report a rise in real wages as a result of an increase in government spending, but studies that use military spending including those identified via a narrative approach tend to report a decrease in real wages; this can be readily seen in the examples of Perotti (2007)[15] and Ramey (2011a). This pattern is further proven by Lorusso and Pieroni (2017): using quarterly data from 1960 to 2010 in a structural VAR setting for the US, they showed that government civilian spending had a positive effect on real wages, while military spending had a negative effect. For a panel data of 11 euro area member countries, Bénétrix (2012) reported an impact response of 0.95% for wages to shocks in government spending made up of purchases and investment[16]. When government spending is disaggregated, government purchase shocks increased wages by 1.04% on impact, while government investment shocks increased wages by 1.37%[17].

The need to account for the state of the economy when measuring the impact of government spending has been one strand of the literature that has received most attention since the crisis

[12]He argues for the need for spillover effects to be counted to get any meaningful information from local multipliers.

[13]Results are based on a four-year and ten-year cumulative horizon. At the four-year horizon, within-state military spending had a positive effect, while national military spending had a negative impact on state-level employment.

[14]Other papers such as Serrato and Wingender (2016), Chodorow-Reich et al. (2012), Wilson (2012) and Shoag (2013) tackle the question from a different angle by asking how much it costs to create a job, with results suggesting between $25,000 and $125,000 (Chodorow-Reich et al. and Wilson, respectively) of additional government spending to create a job.

[15]Perotti (2007) also explored the response of the business and manufacturing sector, showing that real product wage increases in both sectors, but more so in the manufacturing sector.

[16]He also reported a maximum of 1.18% in year two.

[17]The peak impact for government purchase was 1.4% and 1.66% for government investment. Disaggregating government purchase further into wage and non-wage elements, he reported results that suggested shocks to the wage component had a positive effect on private sector real wages, while shocks to the non-wage component produced negative effects although insignificant.

(e.g. Auerbach and Gorodnichenko, 2012a), but the focus tends to be on output effects with very few papers investigating employment or wage effects. One such paper was Holden and Sparrman (2011) who, for a panel of 20 OECD countries for the period 1960 to 2007, showed that not only does an increase in government purchases decrease unemployment, but the reduction is larger in bad times when the output gap is negative than in good times[18]. Distinguishing between government wage consumption, non-wage consumption and real investments, they found that an increase in investment and wage consumption has a stronger dampening effect on unemployment when the output gap is negative; however, when the state of the economy was not accounted for, both types of purchases had a negative effect on unemployment rate.

A point worth discussing and touched upon briefly in the last paragraph is the need to distinguish between different components of government consumption and the impact this has on reported results. The importance of distinguishing between different components of government spending is well argued by Gomes (2011) who presented that the differences[19] in the literature on the effect of fiscal shocks on real wages might not be due to methodological issues, but instead to the type of expenditure data considered. He expressed that 'increasing the wage of all employees by 1 percent is different from increasing employment by 1 percent and is different from increasing by the same amount goods bought from the private sector' (p. 19). Using a DSGE model for the US, he presented evidence that showed that an increase in public sector wages or employment increases wages in the private sector, but ; unsurprisingly, it increased public sector employment but 'crowded out' private sector employment. This evidence holds when public employment is distinguished between hiring and separation shocks; however, the overall effect on unemployment rate is due to the different level of crowding out from each type of shock to not outweigh the increase in public employment. Separation shock has a negative effect on unemployment, while a shock to hiring reduces unemployment. Shocks to government purchases increased employment, but decreased wages in the private sector, so it is the opposite of what was present with the public sector employment shock. Also, the response of unemployment to government purchase shock was small, hence as expressed by Gomes (2011), 'government purchases shocks have a small quantitative effect on unemployment but, as public sector employment or wage shocks strike directly in the labour market, they have a much stronger effect' (p.19). Extending his investigation further in a structural VAR setting (Gomes, 2009), he presented evidence that showed that a shock to both government wages and employment increased private sector wages[20], with wage shock having a stronger impact. Along this line of approach with a sign restriction VAR[21], Pappa (2009a) disaggregated US government spending into that of purchases, investment and employment, presenting evidence suggesting that increases in all three spending types had

[18] This result is also consistent with Nakamura and Steinsson (2014), who presented evidence suggesting that employment effects are higher when unemployment is high.

[19] Rotemberg and Woodford (1992) report increases in real wage, but Edelberg et al. Eichenbaum and Fisher(1999) and Ramey and Shapiro (1998) report a decrease.

[20] The reported negative effect on private hours was not statistically different from zero for the whole sample period, although it has become significant in recent decades.

[21] Consistent with neoclassical and neo-Keynesian theoretical predictions.

positive effect on real wages and employment. There was a stronger response of real wages to purchase shocks than the other two shocks. A 1% increase in government purchases pushes, on impact, real wages up by 2% and employment up 0.17%. Extending this to US state-level data, she showed that although the results are less persistent and different in magnitude, the overall positive state-level effect is similar to that of aggregate level; however, when individual state responses are examined, the result is mixed. Given a 1% increase in government purchases, the wage response across states ranged from -0.21% to 2.15%, while the employment response ranged from 0.01% to 2.27%. Nonetheless, the heterogeneity[22] in the responses was small once some outliers were excluded from the results, with median cross-sectional responses of 0.16% and 0.13% for wages and employment, respectively[23].

Interestingly, although both aforementioned papers focus on the US economy, they report mixed results in the sense that a stronger impact is reported for either government wages or purchases. The difference could be due to two factors. First, both papers use different VAR approaches, even though it is often presented that sign and structural VARs tend to deliver similar results. The second factor is the data and period covered: Gomes (2009) used data from 1950 to 2008, while the data used by Pappa (2009a) was from 1969 to 2001; Gomes used nominal wage series for his main results while Pappa used real wages, thus suggesting that the data and method used can significantly impact the direction of results.

Specifically for the country of focus in this chapter, the UK, Tagkalakis (2006) presented results which suggested that the 'cost or labour market' channel as defined by Alesina et al. (2002) and Lane and Perotti (2003) is present in the UK, with the negative response of private employment to government shock attributed to this channel. However, this channel does not come into play in this chapter given that our data captures the non-wage component element of government spending. Consequently, results obtained here would be compared to those obtained by Tagkalakis where non-wage government consumption had a positive and significant impact on employment.

All the papers discussed thus far have either used aggregate or state-level data, and perhaps due to data challenges, there have been very few papers that have attempted to investigate the direct employment impact of government spending, i.e. using firm-level data to understand what happens when the government purchases goods and services from firms. While attempts have been made to use micro-level data to understand private investment impact (e.g. Hebous and Zimmermann, 2016) and employment impact at sector level (e.g. focus on the construction sector by Saini and Silva, 2015), to my knowledge, no paper has mapped firm-level government spending data to employment and wage data across multiple industry sectors. This chapter aims to fill this gap and investigates how micro-level results compare to aggregate and state-level results. The data and sources are explained next.

[22]It is worth noting that employment response across states was very heterogeneous to government employment shocks.

[23]The responses of employment and real wages are positive in 39 of the 43 states.

4.3 Data description

To link firm-specific government expenditure to firm behaviour of employment and wages, a combination of two databases is used.

Firm-level financial accounts data was obtained from the FAME database compiled and organised by Bureau van Dijk (BvD). It contains information on companies registered at Companies House in the UK, providing comprehensive financial accounts of these companies. Given that regulation in the UK stipulates that only large firms report their financial accounts, the FAME database coverage of medium and small/micro firms is not as complete as one would want. Another limitation is that it includes the global accounts of companies, so global turnover and employee numbers are included, which could affect any analysis that is focused on looking at domestic impact of government spending. Nonetheless, given the comprehensive level of financial accounts it provides, it is widely seen as the standard in firm-level data for the UK. For the analysis here, the information obtained from the database includes turnover, number of employees, wages and salaries, total assets, standard industry classification, and region of the registered address of the firm. The fact that companies can report accounts either for the calendar year or fiscal year meant the sample was constructed to capture both. For example, companies accounts reported in December in 2015 are captured as 2015 accounts, and companies who reported in the end of March or early April[24] 2016 are captured as 2015 accounts.

The UK's Crown Commercial Service (CCS)[25] was the source of central government expenditure data. Access was granted to their database that contains accounts payable data of 17 central government departments and around 150 ALBs[26]. It provides detailed information on which suppliers the government buys from, how much was spent and the date. While the majority of the supplier details are available, some are redacted for sensitivity reasons. The data goes back to fiscal year 2009/2010, but only data from 2010/2011 onwards is used based on CCS's advice about the quality of the 2009/2010 data. With this advice, the sample period spans from 2010 to 2015, so six years' worth of data. The years of available data of government expenditure dictate the restrictions of our analysis to companies that meet the filtering criteria explained below. The first step was to match the suppliers in the CCS database to their respective company registration number (CRN); however, the manual approach of the process meant a cut-off criterion had to be imposed. Specifically, the data was restricted to capture suppliers that received at least £100k over the six-year sample period. The reason for this is that in the sample period the central government spent about £254.1bn purchasing goods or services with over 180,000 suppliers, with spending ranging from £800 to £3.5bn in a single year, and £800 to £19.2bn for the full sample period. Encouragingly, this restriction did not result in losing a large proportion

[24] The first four days of April.

[25] The analysis wouldn't have been possible without the CCS giving access under a confidentiality agreement to central government procurement data, so enormous gratitude is extended to the department for making this possible.

[26] Arm's-length bodies; these are organisations that deliver public services but are not ministerial.

of government expenditure, with about 98% of government expenditure captured, spread across almost 30,500 suppliers. Matching these suppliers to their CRN reduced the sample further to 11,495 suppliers, and matching them to the FAME database meant we lost more of them, retaining about 10,589 suppliers, capturing about 76% of government expenditure.

Once CRNs are matched to a firm in the FAME database, a sequence of restrictions was then imposed to ensure the quality and relevance of the data. Before the restrictions were applied, an initial step of name checking was carried out to ensure firm names as they appear in the CCS database are the same in FAME, or the differences could be explained by instances where 'LTD' is stored as 'Limited' in one database compared to the other, or if there was a record of name change. After this step, 10,176 suppliers are left. The remaining suppliers capture about 76% of government spending, indicating that this step didn't result in losing a significant amount of government spending from the sample. However, not all matched suppliers had industry codes; restricting the sample to those that have industry codes reduced the sample to 9,404 firms, capturing just over 72% of government spending. This provided a good sample set to perform a summary statistic of how this expenditure is split by industry sectors, but for the empirical estimation we need to impose additional restrictions, and in doing so we lose a significant number of suppliers from the sample set; this is explained next.

The limitation in the number of years of available government expenditure data meant the first step of compiling the empirical estimation sample was to restrict our sample to capture only firms that have supplied goods or services to the government and reported financial accounts continuously for six years to match the sample period of our government expenditure data. An initial step before applying this criterion was to filter out firms that hadn't reported their financial accounts for the period ending in calendar year 2015 or fiscal year 2015/2016. While it was possible to match 9,404 firms using the FAME database, not all firms report their financial accounts in a timely manner, with only 5,919 firms having financial accounts that can be matched to the period ending in calendar year 2015 or fiscal year 2015/2016. The requirement for six years of continuous financial accounts[27] reduces the sample size further to 2,077 firms, so only these firms have reported financial accounts for the sample period. Second, from these sets of firms, the next filter criteria captures only firms that supplied goods or services to the government continuously for six years. This filter returns a sample of 1,246 firms and highlights that the majority of firms drop out of the sample because of limited financial accounts. These criteria were driven by the empirical approach taken in this chapter and the log transformation of the data, which is explained further in section 4.4. Next, firms with a SIC code between 64110 and 66300 were excluded, because these are firms involved in financial and insurance activities, and excluding them reduces the sample size to 1,223 firms. Finally, the FAME database is company generated, so individual companies compile their reports before submitting to Companies House; these are then entered into databases by BvD, and as a result it is open to human error (e.g.

[27]This requires data for turnover, employee count, wages, fixed assets and total assets.

there are instances where employee count can jump from 20 to 200, with an unintentional extra zero). To reduce the impact this can have on the quality of our sample, following the example of Arellano and Bond (1986), a final filter was included to exclude companies where employee count, wages per employee or total assets jump by more than a factor of two from one year to the next. This filter removes instances where data might have been erroneously recorded. Due to restrictions, the number of firms left in our sample is 1,059. While the filter significantly reduces the size of our sample, the improvement to the quality of the sample set justifies the restrictions, with the firms captured representing about 33.3% of central government procurement expenditure for the period between 2010 and 2015.

4.3.1 Summary statistics

In this section, two sets of summary statistics are discussed. The first is based on the total number of matched companies, capturing over 9,000 firms, and in doing so helps capture a better picture of how government expenditure is split by industry, so it can be of use to other researchers interested in the procurement behaviour of the central government. The second set of summary statistics focuses on the firms that meet the filtering criteria explained above, so it represents the estimation sample.

Tables 4.2 and 4.3 show the summary statistics and how government procurement is split by industry sector for the larger sample set[28]. Encouragingly, the sample captures the characteristics of national accounts where services make up a significant amount of government procurement expenditure with about 64%, and manufacturing expenditure making up just over 10%[29]. This split is also captured in the number of firms from both sectors. The average amount received by firms per year in the sample is about £19.4m; however, the sample is highly skewed with the median value of £0.68m much lower than the mean. On average, manufacturing firms tend to receive higher spend from the government of about £25.2m compared to about £18.2m for firms in the service sector. The regional picture is also interesting given that tables 4.4 and 4.5 show that firms in London and South East (England) tend to enjoy more government expenditure, with a mean of £34.3m and £28m, respectively (substantially above the sample mean)[30]. Both regions also capture a significant proportion of government expenditure, with an average of 72% over the six-year period. This highlights an important point in that the data suggests central government spending is more highly concentrated regionally given that no two industry sectors account for over 50% of government spending. Nonetheless, it should be noted that it is possible the regional split is significantly influenced by the fact that businesses tend to register their

[28]Firms that had missing industry classification or had no region were excluded.

[29]Since our sample set only captures about 72% of government expenditure, which is £182bn, the industry split percentage uses this amount as the base. Put differently, the unmatched 28% of government expenditure is assumed to have similar distribution to the matched 72%.

[30]The sample mean for the industry and regional split are different given that firms without industry classifications were excluded from the industry sample, and firms with no region assigned to them were excluded from the regional sample, which meant the industry sample was made up of 9,404 firms, while the regional sample had 9,836 firms.

headquarters in London, so while the summary statistics indicate a concentration in London and South East (England), the actual place where the services or goods are produced might not necessarily be in these regions.

Turning our attention to the second sample set, the estimation sample, we are able to provide additional statistics for the accounting variables used in the analysis. First, as table 4.6 shows, the service sector makes up a majority of government expenditure with just over 59%, and manufacturing makes up just under 33%. While this split doesn't exactly mirror that of the larger sample, this is not a problem as it reflects the fact that many firms in the 'other' category have dropped off given that services still make up a significant amount of the sample. Also the regional concentration remains, as table 4.7 shows, with London and South East (England) capturing about 78% of government expenditure.

With the addition of our accounting variable, it becomes possible to split the estimation sample into size buckets of micro, small, medium and large, and in doing so reveal important characteristics of the sample[31]. Table 4.8 shows the split of government expenditure by firm size and what it shows is that on average large firms capture about 96% of total government expenditure. Unfortunately, this amount is not truly representative given that an audit carried out by the UK's National Audit Office (2016) presented that government procurement spending with small- to medium-sized companies (SMEs) was about 27% of total spending in 2014/2015[32]. Although the audit questions how this amount is calculated, even by correcting for a few percentages it is still higher than what is captured in the estimation sample used here. Nonetheless, it should be stressed that not capturing the national picture is not actually detrimental to the analysis because it offers a good opportunity to explore if how much the government spends with firms of certain sizes is important. For example, would it be the case that the impact, if any, of government spending on medium-sized firms in our sample would be much smaller than larger firms given that about 497 medium-sized firms have to split 3.3% of expenditure among themselves, while 413 large firms have 96% to share? As I show in the result section, this is quite important.

Finally, table 4.9 shows that the average amount received by firms per year in the estimation sample is about £13.3m. Again just as in the larger sample, the estimation sample is highly skewed, and firms in the manufacturing sector enjoy on average higher government expenditure of £18.1m compared to £11.8m for firms in the service sector. As can also be seen in table 4.9, the average firm in the sample has about 2,932 employees, which is heavily driven by few very large firms in the sample, and more so in the service sector, but when we look at split by firm size, the numbers are more representative[33]. The average wage is higher among micro

[31] I use the ONS's classification to categorise firms into sizes based on their employee count: micro [0–9]; Small [10–49]; Medium [50–249]; Large [250+].

[32] The UK Cabinet Office classifies all government suppliers as either SMEs or non-SMEs using Dun and Bradstreet, a private business which provides business information.

[33] The categorisation is based on firms' employee count in 2010. Given that firms are categorised into size based on their employee count in 2010, it is possible that firms that were small in 2010 grew to become medium-sized

and small firms compared to medium and large firms, with micro firms having an average wage just under £42k and large firms just under £37k. The average turnover for firms is as expected in that the average turnover for a large firm is £1bn, which is substantially higher than micro firms at £28.8m, a pattern that is repeated with total assets. The point made earlier about how 3.3% of government spending is split across medium-sized firms is well captured by the average government expenditure summary. The average medium-sized firm gets about £0.93m from government expenditure, which is substantially less than the £32.6m enjoyed by large firms, and also less than small firms at £1.1m, even though small firms in the sample capture just 1.1% of government spending. As mentioned earlier, these numbers have to be kept in mind when interpreting the estimation results later as they can shed some light on why some firms respond to government expenditure while others don't.

4.4 Empirical model

It is worth beginning this section with a summary presented by Fishback and Kachanovskaya (2015): 'despite the variety of theoretical models that generate income multipliers of government spending, their empirical estimation tends to be similar: reduced form models with a sparse set of correlates'. In the case of this chapter, these sets of correlates are shaped by heated debate on the appropriate analytical structure of the labour market; this won't be discussed here as the debates are ultimately shaped by different macroeconomic perspectives (see chapter one of this thesis). As discussed in chapter one and section 4.2 of this chapter, the empirical literature tends to investigate the impact of government spending on labour market variables in a VAR or single equation set-up. For example, Perotti (2007) used a seven variable set-up of government spending, tax, GDP, private consumption, private gross capital formulation, hours worked in the private sector, and product hourly compensation in the private sector. Specifically for the UK, Tagkalakis (2006) had a VAR set-up made up of government spending, taxes, GDP, a GDP deflator, employment in the private sector, average hours per work, real effective exchange rate and short-term nominal interest rate. Single equation examples were presented by Lane and Perotti (2003)[34], who used panel data of OECD countries to estimate a model of nine variables made up of employment, output, government spending, taxes, real product wage, the exchange rate, profitability, and dummy variables for oil shocks and exchange rate regimes. Using state-level data for the US, Fishback and Kachanovskaya (2015) estimated a single equation panel model that consisted of employment, government spending, a variable for weather, and fixed effect controls. What these examples show is that the chosen variables tend to be dependent on the aggregate or disaggregated approach of the investigation and more

firms by 2015, which can have an impact on the summary statistics. For example, one would expect the mean employee count for micro firms to be below ten, but as table 4.9 shows, the mean is actually ten, thus capturing the fact that some micro firms became small firms during the six-year period of our analysis.

[34]They do not account for the the fiscal variables in their model to be endogenous. Instead, they make the assumption that on average, changes in fiscal policy have an unanticipated component.

importantly the availability of data. This is also the case with this chapter, as the variables used are constrained by availability of data. The main difference between the aforementioned papers and this chapter is the disaggregated quality of data used. These papers tend to use aggregate or state-level data, while the data used in this chapter is at the firm level. This is an important difference as it means it is more plausible to assume our government spending measure is exogenous, and thus we do not need a VAR set-up to extract this. This quality influences the empirical method used in this chapter, and with this in mind the analytical structure taken is presented next.

The interest here is linking government expenditure to employment and wages. For simplicity, we take inspiration from the specification of Hamermesh (1976) and set our labour demand equation as[35]:

$$N = F(Q, W, X) \tag{4.1}$$

Where N = number of employees, Q = the sales or output of the firm, W = nominal wages, X = a vector of other control variables that may affect a firm's demand for labour. By disaggregating Q as those due to private and public demand we get:

$$N = F(Q^d, Q^g, W, X) \tag{4.2}$$

Where Q^d = private demand for firm output, and Q^g = government demand for firm output. To highlight how the debate at the aggregate level can influence the analytical structure, an alternative post-Keynesian model of employment as suggested by Atesoglu (1999)[36] is briefly discussed using the following equations:

$$Z = kWN \tag{4.3}$$

$$D = D' + D'' \tag{4.4}$$

$$D' = cWN \text{ and } D'' = A = G + I$$

Equation 4.3 is the aggregate supply function, equation 4.4 is the aggregate demand function. Z is aggregate supply (proceeds), k is the average mark-up[37], W is average wage, N is employment, D is aggregate demand, D' is demand that depends on current income, c is the

[35]See also Basu et al. (2005) who extended this simple model to firm-level employment behaviours.
[36]See also Weintraub (1981).
[37]The reciprocal of the wage share.

consumption coefficient linking consumer demand to income, and D" is autonomous expenditures independent of current income, A, is made up of government demand (G) and private sector investments (I), this is based on the assumption of a closed economy. Equation 4.3 & 4.4 allows us to solve for N at the equilibrium of $D = Z$, where:

$$N = \frac{1}{k - c} \frac{A}{W} \tag{4.5}$$

Following the example of Weintraub (1981) and assuming $k = 2$ and $a = 1$, then it is autonomous expenditures versus average wage that establishes employment[38]. There are a few points to note about this model. First, it is an aggregate-level model, meaning it is questionable how appropriate it would be for a more disaggregated-level analysis using firm data. Second, the data required to split out the government and investment component of each firm's demand is not available, thus additional assumptions would need to be made when taking the model to data. Finally, and still related to the disaggregation of data used in this chapter, the model in its current form doesn't allow for other control variables that may affect individual firm demand for labour. For these reasons, equation 4.2 is a preferred analytical structure given the structure of the data used in this chapter.

The preferred specification equation 4.2 can be specified in a loglinear form. In addition, a dynamic framework is introduced by including a lagged dependent variable, N, a one-year lagged, current and future term for private and government demand variables, and a one-year lagged and current term for the other variables in the model. While it is the case that the 'labor market reform that was pursued during the 1980s in the UK brought down the adjustment costs of labor input incurred by firms' (Tagkalakis, 2006), it is nonetheless the case that the estimated model should capture adjustment dynamics, hence the inclusion of the lagged endogenous variable in the model. However, to explore how capturing dynamic effects has an impact on our results, a static model is also estimated where the lagged endogenous variable is excluded. The specification for government spending is influenced by the wider empirical literature discussed in chapter one of this thesis, more specifically Nekarda and Ramey (2011), who include contemporaneous, lagged, and anticipated government expenditure in their industry-level analysis. This chapter can be seen as a further disaggregation compared to Nekarda and Ramey (2011) in that both studies are interested in the disaggregated effects of government spending: theirs is at the industry level, while this chapter is at the firm level. With these considerations, the baseline specification is:

$$\begin{aligned} y_{i,t} = \alpha y_{i,t-1} + \beta_1 q^p_{i,t-1} + \beta_2 q^p_{i,t} + \beta_3 q^p_{i,t+1} + \gamma_1 q^g_{i,t-1} + \gamma_2 q^g_{i,t} + \gamma_3 q^g_{i,t+1} \\ + \delta_1 w_{i,t-1} + \delta_2 w_{i,t} + \varphi_1 x_{i,t-1} + \varphi_2 x_{i,t} + \nu_i + \eta_t + \nu_t + \varepsilon_{i,t} \end{aligned} \tag{4.6}$$

[38] This assumption was based on Weintraub (1978) estimation of K = 1.85 and C = 1.04. These are obviously very old estimates and only are used to highlight the relationship between autonomous expenditures and average wage.

Where y is the variable of interest such as employment, q^p is a proxy for private demand, q^p captures government demand, w is wages per employee, x is the control variable which in our case is capacity utilisation, ν_i is the firm-specific fixed effect that captures firm heterogeneity not accounted for by the control variables, η_t is the year fixed effect and its inclusion allows us to control for aggregate shocks and aggregate policy such as changes in distortionary taxes and aggregate monetary policy, and $\varepsilon_{i,t}$ is the unobserved error term. Private demand is defined as turnover minus government spend. Government spending captures the amount spent on goods and services for each firm. Turnover captures total sale of goods and services for the year. Wages is defined as the average wage per employee, where the total wage bill is divided by total number of employees[39]. Capacity utilisation is defined as turnover divided by total assets. Total assets includes both fixed and current assets, including intangible assets. Given that our data captures about a quarter of total government expenditure, it is the case that for some firms, our defined private demand would capture other parts of government expenditure if a firm supplies goods and services to, for example, local governments whose expenditure is not captured in the data used for this study. All variables are in logarithm.

A major contribution to the literature since the financial crisis of 2008 is the need for model specifications to account for a monetary authority's stance when investigating the impact of fiscal policy, i.e. accounting for a central bank's adjustments to interest rates to counter fiscal actions. Ideally the model specification presented here should account for this and not rely on the time dummies; however, two reasons are presented to explain the lack of a direct monetary policy control variable. First, using an aggregate-level interest rate for firm-level data is not a true representation of how the control should be introduced into the model given that it is readily accepted that firms face different costs of borrowing, so using a single cost of borrowing for all firms in our sample would be inappropriate; moreover, the time dummy captures this. And given that our sample includes a range of firm types that are public, private, small, medium and large, there is no database that provides a possibility of matching each firm to their cost of borrowing[40]. In short, the time dummy does a good enough job for the lack of firm-level data. Second, and perhaps more important, is the period covered in our sample. Since the period is 2010/2011 to 2015/2016, we can use figure 4.2 which shows changes in the official bank base rate of the Bank of England to conclude that this period was one of an accommodating stance, meaning that no counteracting measure of increasing interest rates was taken by the bank to offset any benefit of fiscal action. In addition, this was a period that also saw the Bank of England implement a policy of quantitative and credit easing aimed at injecting liquidity into the banking system, in the hope that it would increase the supply of credit for business and boost domestic demand; see Haldane et al. (2016) and Lombardi et al. (2018) for good summaries.

[39]Dividing the total wage bill by the number of employees introduces an endogeneity problem, which will have an impact on the estimated coefficient of wages, so as part of the robustness check, the model is estimated again with the exclusion of the wage control variable. In addition, the exclusion of wages in the employment equation is motivated by arguments presented by Davidson (1983); this is discussed in section 4.5.6.

[40]This rests on the assumption that changes in base rates of the central bank are transmitted to firms.

The channel these policies take to affect the economy is hotly debated, but the literature tends to focus on, for example, the channel to bond yields (e.g. Krishnamurthy and Vissing-Jorgensen, 2011). While it would be ideal to capture this in the model, such data is not publicly available, and requires an assumption that quantitative easing did have an impact on the bond yields of the firms in this study. So, while there is no monetary policy control in the specified model, the consistent accommodating actions of the Bank of England for the period suggests that including the base rate as a control variable would not provide any additional insight[41] and the lack of firm-level data capturing the effects of quantitative easing means we rely on the time dummy. Nonetheless, the actions taken by the Bank of England during the sample period of this chapter suggest the result from the estimation here captures the effect of government spending when monetary policy is completely accommodating. Another control variable that is not included in the specified model pertains to the question of how the government funds its spending. Again, just as the case of a single interest rate, a single corporate tax rate is captured in the time dummy. Given that the government did not raise taxes during our sample period, we can interpret our results as debt financed.

The model is estimated for the entire sample, a subsample of firms in the manufacturing and service sectors, and for a subsample made up of small, medium and large firms. The model is estimated using fixed effects methods[42]. While the proposed empirical model estimation method doesn't directly deal with the main point of debate in the empirical fiscal literature in identifying exogenous shocks, the quality of our dataset means making an assumption that central governments don't change their spending behaviour due to the health of a single firm is not a controversial one[43]. Thus, not relying on a VAR and instead using a single equation estimation approach is appropriate.

Although using fixed effects methods helps with eliminating the firm-specific effects in the model, it is well documented that the use of fixed effects methods to estimate models which include LDV does not eliminate dynamic panel bias (Nickell, 1981; Bond, 2002). Essentially the estimates are biased downwards, with the case being serious especially for a panel with a short time dimension[44], which is the case with this study. For robustness, it is common to estimate the model presented in this paper using, for example, a differenced-GMM estimator often called AB estimators (Hansen, 1982; Holts-Eakin et al., 1998; Arellano and Bond, 1991). This estimator is able to deal with the endogeneity issue that arises with the inclusion of our LDV. In addition, the estimator deals with any endogeneity between the dependent and independent variables[45].

[41] While it is readily accepted that firms could face changing borrowing costs while the base rate remains unchanged, the model captures this in the fixed effect dummy.

[42] Although not reported, it is worth noting that each model was estimated using both fixed and random effects methods, with the Hausman test confirming that the fixed effect specification is appropriate.

[43] The argument here is that firm-level spending is a good source of exogenous variation in government spending.

[44] The bias approaches zero as T approaches infinity, with the bias in the order of 1/T.

[45] This quality is one of the reasons why it would be favoured over the bias correction least square dummy variable (LSDV) method proposed by Kiviet (1995) if the autoregressive parameter in the model was not near 1 as is the case here. In addition, LSDV works better with small datasets, which is not the case with the sample in this study.

However, given the characteristics of the dataset used in this paper, especially the presence of the unit root, which is discussed next, the GMM method is generally not appropriate so an alternative ML estimation approach is used.

Given that the sample data is for a fixed period and includes a large number of firms, the Harris–Tzavalis (HT, 1999) and Im–Pesaran–Shin (IPS, 2003) tests are used to test for the unit root; both tests are most suited to the dataset used. Table 4.34 presents the result and what it shows is that using either HT and IPS tests, employment is integrated to the order of 1, so we cannot reject the hypothesis that it contains a unit root. However, this is not the case with wages, so the result suggests we can reject the hypothesis that wages contain a unit root; this is also the case with government spending. Mixed results are returned for the measure of capacity utilisation and private demand, so we can reject the hypothesis for both using the HT test, but the IPS test suggests both variables contain a unit root. This mixed result is not an issue because we can conclude based on one of the tests coming back with results suggesting a unit root, and the case here is that results suggest a unit root for three out of the five variables; this has implications on the appropriate estimators to use for the robustness exercise and is discussed next.

While making the case for an alternative estimator, Allison et al. (2017, p1) argued that 'while the AB approach provides consistent estimators of the coefficients, there is evidence that the estimators are not fully efficient, have considerable small sample bias, and often perform poorly when the autoregressive parameter (the effect of a variable on itself at a later point in time) is near 1.0' (see Arellano and Bover, 1995; Blundell and Bond, 1998). The sample size is big enough to overcome the first of these issues, but the quality of the sample means we are not able to overcome the autoregressive paramet point, which is essentially highlighting cases of nonstationarity in the dependent variable, so the presence of unit root. Due to this, the maximum likelihood estimator as proposed by Moral-Benito (2013) is used for the robustness test. This method has been shown to be less biased and more efficient in cases of unit root.

4.5 Results

The sample of empirical evidence presented in table 4.1 for the UK suggests we can expect a positive effect on wages; however, the expected impact is not as clear cut when it comes to employment given that Pappa (2009b) presented results that suggest government spending has a positive effect on employment, whereas both Perotti (2007) and Tagkalakis (2006) reported negative impacts. If one wanted to rely on the theoretical literature for guidance, then the disagreement is reversed as shown in chapter one of this thesis, so while all macroeconomic perspectives considered in the chapter suggest a positive impact on employment, the prediction impact on wages is negative from a neoclassical perspective, positive from a NK perspective, while post-Keynesians predict no impact on wages (see table 1 in chapter one of this thesis). Results from this section would be compared against these theoretical predictions.

4.5.1 Baseline results

This section discusses the results from the model estimation. Results for the full sample are discussed first, then I discuss the impact firm size has on the report results, before finally discussing how the results vary by sectors. Tables 4.10 and 4.11 show the effect of government spending on employment; table 4.10 presents results for the static model, while table 4.11 captures results from the dynamic model estimation. Tables 4.12 and 4.13 show the effect of government spending on wages; table 4.12 shows results for the static model, while table 4.13 captures results from the dynamic model estimation. The low number of micro firms in the sample motivated the need to combine them with small firms, but to avoid micro firms diluting the results for small firms, I present two sets of results as shown in the tables. The focus here is on the main variable of interest which is government spending, so readers are left to explore the other variables independently.

Starting with the first column in table 4.10, the results indicate that contemporaneous, lagged and future government spending are all positive and statistically significant for employment, with contemporaneous spending having the largest effect: the size of this elasticity is 0.013. Once we consider the size of firms (columns 2–4), the impact is larger for micro and small firms in every instance of statistical significance, with future government spending having double the impact on small firms compared to medium-sized firms. For micro and small firms, lagged and future spending seems to be more important, for large firms contemporaneous and lagged spending appear to be more important, while all variations of government spending are important to medium-sized firms. These results change dramatically once we account for past employment as shown in table 4.11. The results again indicate that contemporaneous and future government spending are important for employment; however, the elasticity drops for both. More interesting is the fact that once we account for past employment, government spending doesn't seem to have an impact on micro and small firms, suggesting that our results are mainly driven by the impact on medium and large firms. But making this conclusion would be misleading, as section 4.5.3 shows once we split firms into manufacturing and service sectors.

Using results from table 4.11, a coefficient of 0.01 suggests that a 10% increase in government spending would increase employment by 0.1%. While this increase looks small, it is worth looking at the coefficient of private demand to examine if our data could explain this; focusing on the elasticity of 0.291 for contemporaneous private demand suggests a 10% increase in private demand would result in a 2.91% increase in employment, which many would argue seems small. The small elasticity for both private and government demand suggests intermediate consumption makes up a significant proportion of turnover for the firms in the sample set. Unfortunately, it is not possible to distinguish what proportion of intermediate consumption is assigned to government spending for each firm, hence turnover is used. While it would be possible to get a rough idea of GVA for each firm by adding wages to gross profit, inspecting the gross profit for each firm in the sample set revealed patterns that suggested issues with the data as in some cases GVA was over 100% of turnover. Also, not all firms have gross profit data available. For this reason, it was not possible to convincingly exclude intermediate consumption from turnover, thus the results should be seen as an exercise in how the impact of government spending differs across sectors and firms. An attempt is made to convert the elasticity in table 4.11 into jobs and cost per jobs[46], and unsurprisingly, the cost per job is quite high, further making the case to see these elasticities as an indicator of how the impact varies across sectors and firm size. Next I discuss the results for wages.

4.5.2 Is the size of government demand important?

The empirical literature tends to assume that the effects of a government spend of £1 are the same as when it spends £100, and this section tests if this assumption holds. To test whether the response of employment and wages differ by how much government spends, I create three dummy variables to capture instances where government demand makes up on average at least 10%, 20%, and 30% of a firm's total demand, so government expenditure/total turnover. As figure 4.3 shows, very few firms in our sample have government demand that is at least 10% of their turnover; for the sample, government procurement expenditure makes up at least 30% of total turnover for 33 firms, 20% for 59 firms, and 10% for 143 firms (111 firms in the service sector and 26 firms in the manufacturing sector)[47].

Due to the difficulty of interpreting the dummy variables with all variations of government spending in the model, the model is estimated separately for contemporaneous, lagged and anticipated government spending; the results are reported in table 4.15, with only the variable of interested government spending reported as there were no material changes in the signs and magnitude of the other variables. Again, results are reported for the static and dynamic model.

Starting with employment, what is very striking from the results in table 4.15 is just how much bigger the impact of contemporaneous government spending is on employment when gov-

[46] As the summary statistics in table 4.9 show, the sample is highly skewed so it is not straightforward to translate percentage increase into employee count, but a very rough attempt is made that many might find contentious. If we take the mean employment (2,932) and government spending (£13.31m) for the entire sample, then an elasticity of 0.01 presented in table 4.11 suggests a 10% increase in government spending would result in about three new jobs, which most would argue to be very small given that a 10% increase equates to £1.33m expenditure, meaning each job costing about £0.45m. This number seems high but is argued to be realistic when compared to those presented by Erridge (2007) for the Northern Ireland public procurement policy 'Unemployment pilot project', where 15 contracts ranging from £0.7m to £8.5m were awarded to contractors that provided employment plans for utilising those registered unemployed as part of their bid, meaning it was a procurement policy directly aimed at creating jobs. With total contract value at £45.9m and 51 people employed as a result of the projects, it meant each job cost £0.9m; focusing on contracts that address the target group of the policy, this amount drops to £0.61m. The figures presented by Erridge (2007) and those estimated in this paper suggest that firms not only allocate government spending to creating new jobs, but they also use this money to sustain current employment levels. In addition to the point made earlier concerning intermediate consumption in turnover as a likely factor in the small estimated elasticities, it must be stressed that an elasticity of 0.01 only captures the first round of effects, and probably more important is the fact that it doesn't capture the jobs that are sustained as a result of government spending or jobs that are likely created/sustained in other firms due to intermediate consumption. In doing so, it is very likely that the £0.45m figure is on the high side, meaning the estimated impact of government spending is biased downwards.

[47] Five micro firms, 35 small, 60 medium, and 43 large firms.

ernment demand makes up at least 10% of total demand, with the impact five times larger. This result is also repeated with the dynamic model showing significant increase in impact once we account for government demand size. Although the results also show this to be even bigger as government demand makes up a higher proportion of total demand, the results for instances of 20% and 30% of government demand need to interpreted with caution due to the sample size being small and the large standard errors. The results are mixed for lagged government spending because the results from the static model show that accounting for the size of government demand has an effect on the size of the impact, but the dynamic model does not return statistically significant results. The results for future government spending seem to suggest that once firms get above a certain threshold of government demand, they don't anticipate as much. When government demand makes up at least 10%, the results are significantly larger in both models, again five times larger; however, this is not the case for the 20% and 30% instances. But as mentioned earlier, the low number of firms in the larger demand category could be having an impact on the results.

The results for wages are very interesting in that they mirror the general message thus far in that government spending has no impact on wages. However, it is very revealing that once we account for the size of government demand, the impact of government spending on wages becomes not only statistically significant in both the static and dynamic model, but the impact is also quite large, especially for contemporaneous spending, with an elasticity of around 0.020. This is a very revealing result as it points to the complexity of discussing the impact of government spending on wages; it is not enough to ask if the government is increasing spending, but also by how much.

4.5.3 Impact of government spending on the manufacturing and service sectors

In this section, results from a subsample of firms in the manufacturing and service sector are discussed; results are presented in tables 4.16 and 4.17 with only government spending reported as the variable of interest. The first section of each table presents results for the service sector, while the second section gives results for firms in the manufacturing sector. I discuss the employment and wage impact for firms in the service sectors first. Table 4.16 shows the employment impact of government spending in the service sector, and what the result indicates is that even after controlling for past employment, contemporaneous government spending has a positive employment impact on all but medium-sized firms[48], with medium-sized firms more forward-looking. The pattern observed in the baseline results is also repeated: in every instance of statistical significance, the reported impact on micro and small firms is larger. The impact of government spending on wages once we control for sector is again very revealing: in both the

[48]The results for medium-sized firms appear to be quite sensitive to the inclusion of past employment in our model. For the static model, all variations of government spending are positively statistically significant.

static and dynamic model, contemporaneous government spending has a positive impact on the wages of micro and small firms in the service sector. Results presented in table 4.17 show that the reported impact is practically identical with elasticity of about 0.018 in both models.

Turning our attention to the manufacturing sector, results in tables 4.16 and 4.17 show that government spending has no statistically significant impact on employment or wages[49]. This result leads to a very important conjecture, and it is that the baseline results and results after controlling for government demand size are driven mostly by the response of firms in the service sector[50], especially in the case of employment. This result, taken together with others discussed thus far, indicates that while it is the case that firm size and the magnitude of government demand are important, we also need to account for industry sector to get a richer picture of the labour market effects of government spending.

4.5.4 Defence and non-defence government spending

As mentioned earlier, the empirical fiscal literature is shaped by the identification of fiscal shocks and isolating shocks that are not driven by the business cycle. While a case was made for the exogenous quality of the data used in this study[51], I nonetheless take advantage of another quality of the data. The richness of the database CCS manages is that it classifies spending by department and type, with one of those defence spending.

In line with Ramey (2011a), Nakamura and Steinsson (2014), I restrict the government procurement data to firms that supply defence goods and services. This restriction results in a sample of 383 firms. I place another restriction on these sets of firms to capture firms that not only supply goods and services for defence purposes, but also for non-defence purposes, resulting in 239 firms. I place a final restriction on the set of 383 firms to capture firms for whom 99% of their supply is made of up defence goods and services, I label these firms as supplying only defence goods and services, resulting in 93 firms[52]. I estimate two models, one for the sample of firms that only supply defence goods and services (93 firms), and another model for firms that supply both defence and non-defence goods and services (239 firms). The second model offers an opportunity to investigate if different expenditure types have different effects on employment and wages: does defence spending have larger or smaller impacts compared to non-defence spending? (e.g. Lorusso and Pieroni, 2017).

Table 4.18 summarises the results for firms that supply only defence goods and services with

[49] However, as mentioned earlier, the few numbers of micro and small manufacturing firms in the sample could be having an impact on the results.

[50] This is similar in some ways to the results provided by Monacelli and Perotti (2008) who reported larger output impact on services compared to manufacturing after a positive shock to government consumption.

[51] In other words, it is unlikely that central governments use procurement as a policy reaction to the financial health of a firm.

[52] Readers should be aware that although there are 383 firms that supply defence goods and services to the government, the sample of 239 firms added to 93 firms does not equal 383. The reason for this is that within the 383 firms, there are 51 firms that did not supply defence goods for the six-year period, which means they drop off from the sample set used to investigate the differences between defence and non-defence expenditure.

only government spending reported as the variable of interest. The first section of the table presents employment impacts, while the second section captures wage impacts. Focusing on employment impacts first, what the result suggests is that contemporaneous, lagged and future government spending have no impact on the employment activities of these firms, with the results holding for both the static and dynamic model[53]. While accounting for sectors results in lagged government spending having a positive impact on manufacturing firms' employment, this result is not replicated in the dynamic model. Also, once size is accounted for, the results suggest large firms respond positively in the case of the static model; however, in both the static and dynamic models, the impact of future government spending on employment is negative for medium-sized firms, even though contemporaneous spending has a positive impact. Turning our attention to the impact on wages reveals very interesting results because it differs from results discussed so far in the chapter. The results suggest contemporaneous government spending has a significant impact on wages, with results similar in both the static and dynamic models. Controlling for sector does not change this result as wages in the service and manufacturing sectors increase, with service sector wages increasing more. However, controlling for size suggests large firms respond to contemporaneous spending while medium-sized firms respond to lagged spending. This seems to suggest that defence firms don't increase employment to meet government demand; instead, they increase wages, which is different from what has been discussed thus far in that employment increases while wages remain unchanged. Blackley (2014) provided evidence for the US arguing that public investment has a significant crowding in effect on private investment while military purchases have a significant crowding out effect, with military purchases providing very few complementarities to private products as one of the possible explanations behind this result. Thus, it is possible for the UK that an increase in government spending on defence goods has little effect on employment because the skills required in the defence sector are not as easily transferable from other sectors, i.e. there are few complementary skill sets.

There is a very rich defence literature that explores the impact of military spending on economic growth and other economic indicators such as unemployment[54], but these contributions tend not to be mentioned much in the short-run fiscal policy literature contributions such as Hall (2009) where the argued exogenous quality of military spending is exploited. One possible reason for this is the long-run effects focus of the defence literature. In addition, the reported impact of military spending tends to be mixed. Specifically for the UK, Tang et al. (2009) presented results that suggest military expenditure does not influence unemployment rate, a result which is consistent with earlier contributions by Dunne and Smith (1990); however, results provided by Zhong et al. (2015) suggest otherwise. Nonetheless, it is worth noting that the mixed results could be due to the sensitivity of the Granger causality test to model specifications since these

[53] The sample size means I only estimate the model for large and medium firms.

[54] Alptekin and Levine (2012) provide a good meta-analysis focusing on economic growth, Dunne (1996) and Dunne and Tian (2013) provide detailed surveys, while Dunne and Smith (2010) provide a good discussion on methodology.

studies have different specifications and approaches[55]. The country-specific nature of defence spending and unemployment, as indicated by the results of Tang et al. (2009), suggests that while the results presented in this chapter might be applicable to the UK, making a sweeping statement on the impact of defence spending on employment would be ill-advised, but it is encouraging that the results presented are consistent with those in the wider defence literature.

To further investigate the response of firms to defence spending, I estimate the impact of government spending on firms that supply both defence and non-defence goods and services. The aim here is to investigate if firms respond differently to both types of spending. The results are presented in table 4.19 (employment) and 4.20 (wages). The first section of each table shows the estimated response of firms to non-defence demands from the government, while the second section shows how these same sets of firms respond to defence demand. The table presents results for the full sample of 239 firms; in addition, distinction is made between services, manufacturing, medium and large firms. For the full sample, the results suggest contemporaneous non-defence spending had a statistically significant positive impact on employment, while defence spending is not significantly different from zero. By controlling for sector, it becomes clear that this result is being driven by the response of firms in the service sector; however, the results from the dynamic model also suggest that manufacturing firms respond positively to lagged non-defence spending and future defence spending. Nonetheless, once we control for firm size, this positive impact of defence spending disappears as it seems large firms only respond positively to contemporaneous non-defence spending while medium-sized firms respond positively to lagged non-defence spending only. For the sample of 239 firms, defence spending makes up on average 43.3% of demand from the government, so it is not the case that these results are being driven by a significantly larger non-defence demand. The results of the impact of defence and non-defence spending on wages reflect those discussed in section 4.5.1, in that for the entire sample, both defence and non-defence spending have no impact on wages. However, by controlling for sector, the results seem to suggest that contemporaneous non-defence spending has a positive impact on service sector wages, while contemporaneous and future defence spending has a positive impact on manufacturing wages. Interestingly, when we control for firm size, only lagged non-defence spending has a positive impact and it is only on wages for medium-sized firms.

Motivated by results from this section, I re-estimate the baseline results to investigate if defence firms are a drag on the estimated impacts. I estimate two models; first, I estimate the model excluding from the sample the 94 firms that supplied only defence goods and service. I then estimate the model excluding all firms which had any defence expenditure, excluding 384 firms. Results are presented in table 4.21.

The first section of table 4.21 shows the impact of government spending for our entire sample after excluding certain types of government spending as explained below. The second and third sections show the same result but for firms in the service and manufacturing sectors. In each

[55] See Dunne and Smith (2010) for a discussion on this sensitivity.

section, the first three rows of results show the impact of government spending on employment, while the last three rows show the impact on wages. Similar to previous tables, I present results for both the static and dynamic versions of the model. In each section, column 1 is a condensed version of table 4.10, so it shows the impact of government spending using all firms in our sample set. Column 2 reports results for a sample specification that excludes firms that supply both defence and non-defence goods and services, thus excluding 383 firms. Column 3 reports results for sample specifications excluding firms that supply only defence goods and services, excluding 93 firms. Column 4 presents results from table 4.18, so it shows the impact of government spending on firms that only supply defence goods and services to the government.

The table makes it easy to compare the impact of including defence firms in our sample and ask if including these firms affects the magnitude of the reported results. Starting with employment, a pattern that emerges is that in each instance of statistically significant results, excluding firms that supply both defence and non-defence goods and services resulted in the reported impact being smaller. For example, in the static model results presented in the first row of the table, contemporaneous government spending had a positive impact with elasticity of 0.013 with the full sample of firms, but excluding firms that supplied both defence and non-defence goods and services decreases the elasticity to 0.010. This pattern is repeated with the dynamic model. Interestingly, by excluding firms that supplied only defence goods and services, the elasticity returns back to the full sample levels, thus suggesting that defence-only firms are a drag on the reported impact of government expenditure on employment. This pattern is continued when the sample is split to account for sectors.

The results for wages are not as consistent as the case of employment. As discussed earlier, results presented in tables 4.12 and 4.13suggest government expenditure has little impact on wages, with the reported impact driven by micro and small firms in the service sector. Taken together with results discussed in this section showing that government defence spending has a positive impact on wages, the fact that excluding defence firms from the sample leaves our results statistically insignificant is not a surprise. In addition, when we account for sectors and focus on firms in the service sector, results suggest that excluding defence firms from the sample reduces the reported impact, so it is the opposite of the results for employment. Again, this is not a surprise given the results presented in table 4.18, which indicates that defence-only firms tend to increase wages and not employment, so removing these firms from the sample set would have an impact on the estimated wage elasticities.

To conclude this section, the results presented here seem to suggest that the use of defence spending due to its argued exogenous quality to investigate the impact of government spending on employment might need to be reconsidered, especially in the case of the UK. This conclusion is driven by two results. First, defence spending had no statistically significant impact on the employment of firms that supply only defence goods and services; however, there was a positive impact when all government spending is considered, suggesting defence spending might not be an appropriate government spending instrument to capture employment elasticities that are not biased downwards. Second, the results presented for firms that supply both defence and non-defence goods showed that non-defence spending had a positive impact on employment, while defence spending had a statistically insignificant impact, highlighting the need for further investigation into what defence spending really captures, how it is different from non-defence spending, and how this ultimately translates into the impact we can expect it to have on the economy. The results for wages are too mixed to provide a concise conclusion on whether defence spending is a good instrument for exploring the impact of government spending on wages.

4.5.5 Medium-run effects of government spending

A major constraint with firm-/micro-level analysis as explained earlier is the lack of data. Even if the data is available, the number of years of available data tends to be very short, as is the case in this chapter. So while it is common in the fiscal literature to have a model specification that includes lags of variables, doing so as done in the baseline specification means a third of the data is being lost. To avoid this loss, a model is estimated where only current values of all variables are used, essentially presenting the long-run effect of government expenditure; the results are presented in table 4.22. While it is common to label the specification as capturing long-run effects, the data only covers six years, which means the results should be interpreted as medium-run effects. The table captures the different dimensions of how the full sample set could be split, meaning it shows firms of different sizes and operating in different sectors responding to government demand. The results confirm those discussed already in that the reported effects of government spending on employment are driven by firms in the service sector, further highlighting the need to account for sectors when discussing the impact of government spending. As expected, the reported elasticities are higher given that we are capturing the cumulative effect, with small and micro firms having the larger responses. However, as will be shown in section 4.5.6,the inclusion of LDV changes this result because the reported impact becomes statistically insignificant, suggesting that the results which account for sectors are more robust than firm size. The impact of considering the size of government demand as discussed in section 4.5.2 is captured in table 4.23, which shows a much larger effect because the impact of government spending is about seven times larger when government demand makes up at least 10% of total demand. This increases significantly when government demand makes up at least 30% of total demand. The reported medium-run effects of wages are also generally consistent with results discussed thus far. The medium-run effect of government spending for firms that only supply defence goods and services is also consistent with results discussed thus far for employment, as shown in table 4.24. However, the short-run positive impact reported for wages is not replicated in the medium run.

An important issue was raised in section 4.5.4 with the use of government defence spending within the literature, so it is also important to examine if the results obtained in the section hold when we focus on medium-run effects. The results are presented in table 4.25 and confirm some of the results from section 4.5.4. Just as with the static and dynamic model results in section 4.5.4, results in table 4.25 show that firms in the service sector don't respond to defence spending by hiring more workers or increasing wages; instead, they seem to only respond to non-defence spending. However, firms in the manufacturing sector seem to only respond to defence spending. The response of manufacturing firms to defence spending is much stronger in the medium run than those reported in section 4.5.4, which are short-run effects. Thus, while the use of defence spending as an instrument for short-run analysis might result in a downward bias in the reported impact of government spending, the use of it for medium-run analysis might avoid such pitfalls as long as sectoral distinctions are made. Given the results presented here, it seems for an economy such as the UK where the service sector makes up a significant proportion of the economy, the use of defence spending as an instrument in investigating the employment and wage impact of government spending will result in a downward bias of reported impact, that is if any impact is even captured. As shown in section 4.5.6 where the robustness of the results is discussed, once we normalise government spending by either total assets or turnover of firms, the reported elasticities double, further highlighting the need to use appropriate government spending instruments.

4.5.6 Robustness

Robustness to model specification

As explained earlier, the debate on the impact of government spending is shaped by different theoretical predictions. These differences extend to how the employment equation should be constructed, with the inclusion or exclusion of wages as an explanatory variable a source of the debate. While it is common to include a wage variable from a neoclassical and NK perspective, Davidson (1998) argues that from a post-Keynesian perspective, 'there is no aggregate demand for labour demand schedule with the real wage as the independent variable', an argument that was formulated in Davidson (1983)[56]. Although the aforementioned papers are based on aggregate-level analysis while the data used here is firm level, they motivate the re-specification of the baseline model to exclude wages from the employment equation. This not only allows me to present an alternative model of employment, but it also allows me to address the endogeneity issue introduced into the model with the inclusion of a wage per employee variable that is constructed using the dependent variable. Results are presented in table 4.26, which shows that the results are consistent with the general baseline results, and the difference in reported elasticity is negligible. This little difference in reported impacts means other robustness checks are carried out using the baseline model.

Next I tackle another major debate in the literature on the importance of anticipation on

[56] A similar argument is presented by Riach (1995).

the reported effects of government spending[57]. This debate influenced the construction of the baseline model to test if results obtained thus far will be significantly different when anticipation effect is not captured, i.e. future spending is excluded from the model. The results are presented in tables 4.27 and 4.28. Results from both tables show that while the reported elasticities for both employment and wages are slightly higher, the overall direction of the results doesn't change.

As shown by Hebous and Zimmermann (2016), an alternative approach with a firm-level dataset would be to normalise government spending. To test if the results would significantly change if normalised, the model is estimated with two alternative normalisations, first with total assets and the other with total turnover. Tables 4.29 and 4.30 present the results, both showing the results from the baseline model next to those estimated after normalising government spending. The results indicate that although the elasticity is slightly smaller, the general conclusions on the impact of contemporaneous government spending from the baseline model remains, but the reported positive impact on wages reported for the service sector becomes insignificant once normalised. Similarly, the reported effects of lagged and future government spending do not change. Interestingly, the size of the reported elasticities does not change significantly once government spending is normalised, thus indicating that the baseline model does a good job of accounting for size heterogeneity. However, this is not the case for firms that supply both defence and non-defence goods and services to the government, as tables 4.31 and 4.32 show. Both tables show that once we normalise government spending, the reported elasticity becomes twice the size of those estimated with the baseline model; nonetheless, the general conclusion of defence spending having little impact remains.

Table 4.33 shows the comparison of our medium-run baseline results to those obtained after normalising government spending, and what it shows is that the response of employment to government spending remains consistent across all variations of government spending, especially for the entire sample set and firms in the service sector. It is worth noting that the reported elasticity decreases slightly with the normalisation of government spending. The reported positive elasticity for the manufacturing sector becomes insignificant once government spending is normalised; however, controlling for firm size retains the baseline result. Similar patterns are observed for wages with two instances of significant results becoming insignificant after the normalisation of government spending. While it is the case that normalisation has little effect on the size of the reported elasticities, this is again not the case with firms that supply both defence and non-defence goods and services. As table 4.25 shows, the estimated elasticities become almost double the size of the baseline model estimates.

To conclude this section, the robustness exercise indicates that the baseline results are robust across alternative specifications. Although some of the reported elasticities increase in size, the general conclusion of the impact of government spending, defence and non-defence spending on

[57] See Ramey (2011a) and section 1.6 of chapter one of this thesis.

employment and wages holds. The next robustness exercise will test if the use of the alternative estimation method changes the reported results to see if dealing with endogeneity and nonstationarity through alternative estimators has an impact on the reported results.

Robustness to empirical approach

As explained earlier, while the use of a fixed effects method is able to deal with firm-specific effects, this method is unable to address dynamic panel bias that arises with the inclusion of LDV in our model (Nickell, 1981; Bond, 2002). The main question this section answers is if the estimated results are significantly affected once we tackle the downward bias. Alternative approaches have been proposed to address the downward bias, with the most popular being the AB approach, but as discussed in section 4.4 with results from table 4.34, the presence of unit root in the dataset means an alternative maximum likelihood estimation approach (ML), as proposed by Modal-Benito (2013), is preferred[58]. Modal-Benito (2013) not only showed the ML estimator to be asymptotically equivalent to the standard AB GMM estimators, but he also showed that the ML estimators are more efficient than the AB GMM estimators[59]. The recent development of a software package by Williams et al. (2016) means this ML approach is more easily implementable, as is the case with the popular AB estimators. Another advantage of the ML approach over the AB approach that is usually not discussed is how both approaches deal with fixed effects; the popular differenced-GMM, as the name suggests, deals with this by taking the first difference to eliminate these effects as they don't change over time. However, the ML approach does not discard these effects, so it is able to reflect firm-specific effects that we know are present. A limitation of this method and others is that it is unable to deal with the inclusion of expectation variables. Due to this, the robustness check model only includes contemporaneous values of the independent variables[60]. The results are discussed next.

Table 4.35 shows the results from the robustness check exercise. The table presents results from the fixed effects method next to the ML approach. Results using all firms in the dataset are discussed first, before moving on to other key subsamples discussed thus far. In each table, results from three estimations are presented: the first column always captures a static fixed effect model; the second is also a fixed effect approach but dynamic; the third presents results from the ML approach. The first model is a repeat of results presented in table 4.22. It is presented again to allow for comparison and highlight the importance of model specification as discussed below.

Results from table 4.35 show that the general conclusion thus far holds in that government

[58]It is worth noting that although not reported, results were obtained using the AB first difference approach. The reason they are not reported is that while it was possible to use the third lag of the dependent variable as instruments, the results obtained were in many cases implausible and the instruments were also weak, especially when the dataset was split to take into account sector and firm sizes.

[59]See Allison et al. (2017) for discussion on the limitations of both approaches.

[60]The fact that future values are excluded from the model means including lagged value is simply a distraction from the main purpose of the robustness check.

spending has an impact on employment and wages, with the service sector the main driver of this result. However, before moving on to results that account for size and type of government demand, it is worth discussing the importance of model specification. The reported results seem to be more sensitive to the inclusion of the LDVs than the estimation approach as some results become statistically insignificant with the inclusion of the LDV. For example, while the impact of government spending on employment remains positive for the entire sample and service sector, this impact becomes indistinguishable from zero in the manufacturing sector once we include the LDV. The same is true for small and micro firms. Nonetheless, given the aim of this section, we can generally conclude that the results presented thus far are robust to alternative empirical approaches, especially employment impacts, although the reported employment impact on large firms seems to be an exception to this. The reported impact on wages using the entire sample seems to be sensitive to the estimation approach, but closer inspection suggests this sensitivity is being driven by small firms.

The results presented in table 4.36 further highlight the importance of capturing the size of government demand; it shows the response of firms receiving 10%, 20% or 30% of their total turnover compared to those who receive below those thresholds. Results from all three estimations indicate that firms that receive at least 10% of their total turnover from the government respond significantly more, both in terms of employment and wages, confirming the results to be robust to both the inclusion of LDV and estimation approach.

Finally, table 4.37 presents results for firms that provide defence and non-defence goods and services to the government. Again, it shows that the results discussed thus far are robust to the estimation approach in that firms tend to respond more to non-defence spending through an increase in employment, which is driven by firms in the service sector. This robustness also extends to the reported impact on wages as manufacturing firms seem to only respond to defence spending by increasing wages and not employment.

To conclude, the results presented in this section seem to suggest that the results are robust to the estimation approach, especially in the case of employment and when we account for sectors. However, the robustness for firm size is mixed given the results reported for large firms. For wages, the results are generally robust, although the results for small firms again highlight the sensitivity of our results to the estimation approach when we account for firm size.

4.6 Conclusion

Using novel and rich data of central government procurement expenditure at firm level, this chapter presented micro-level evidence on the effects of government spending on employment and wages in the UK.

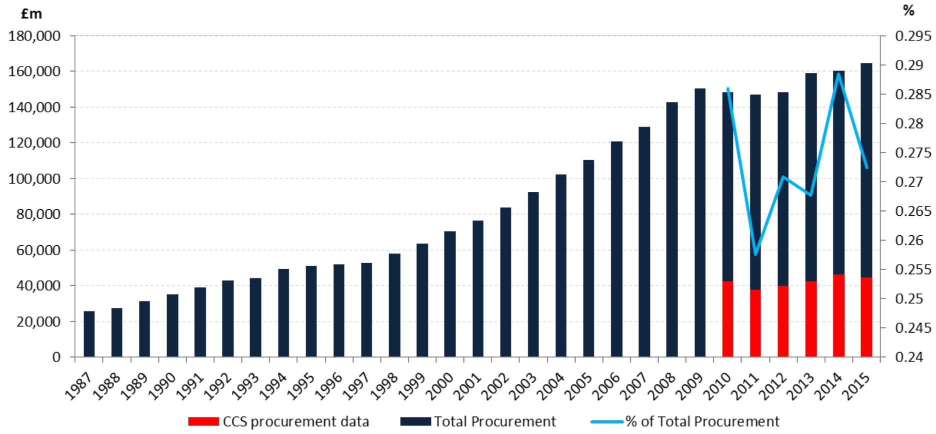
The empirical results presented here indicate that the impact of government spending on employment and wages varies not only by industry sector, but also by firm size. Once we account for the size of government demand, the impact of government spending on wages becomes significantly positive, especially for contemporaneous government spending. For employment, the impact of government spending is about five times larger when government demand makes up at least 10% of total demand. In addition, these results seem to be driven mostly by the response of firms in the service sector. Clearly, the results could be affected by our sample size of 1,059 firms. Nonetheless, these results shed new light on a key transmission mechanism of fiscal policy as they are robust to alternative model specifications and the estimation approach. The results presented in this chapter are consistent with the post-Keynesian perspective discussed in chapter one of this thesis: an increase in government spending is expected to have a positive impact on employment, with no impact on wages. However, what the theoretical models don't account for is the size of government demand, which as shown in this chapter seems to be important. Once we account for government demand size, the impact on wages becomes positive, a result consistent with NK models.

In addition, the results seem to suggest that the use of defence spending due to its argued exogenous quality to investigate the impact of government spending on employment might need to be reconsidered, especially in the case of the UK as it seems defence-only firms are a drag on the reported impact of government expenditure on employment. Further research is needed to understand why there is a difference in the impact of government defence and non-defence spending. The different responses of firms in the manufacturing and service sectors to defence spending indicate that we might be underestimating the impact of government spending when defence spending is used as a spending instrument for aggregate analysis, especially for a country such as the UK where the service sector makes up a significant portion of the economy.

While it is the case that firm size is an important factor, what the results suggest is that to get a richer picture of the labour market effects of government spending, it is more important to account for industry sector and the magnitude of government demand. The policy usefulness of aggregate-level evidence is not questioned here; however, due to results reported in this chapter, the view is that aggregate-level evidence will be even more powerful if complemented with industry-sector results. By revisiting the point made by Tcherneva (2011), that the goal of modern fiscal policy is confined to stabilising incomes, consumption and investment, which means the employment impact is a *by-product* of these policies, one can conclude that results presented in this chapter suggest that this *by-product* is indeed active, although not very active given the size of the estimated elasticity. Nonetheless, results presented suggest that not only is the size of government spending important, but what the government buys matters.

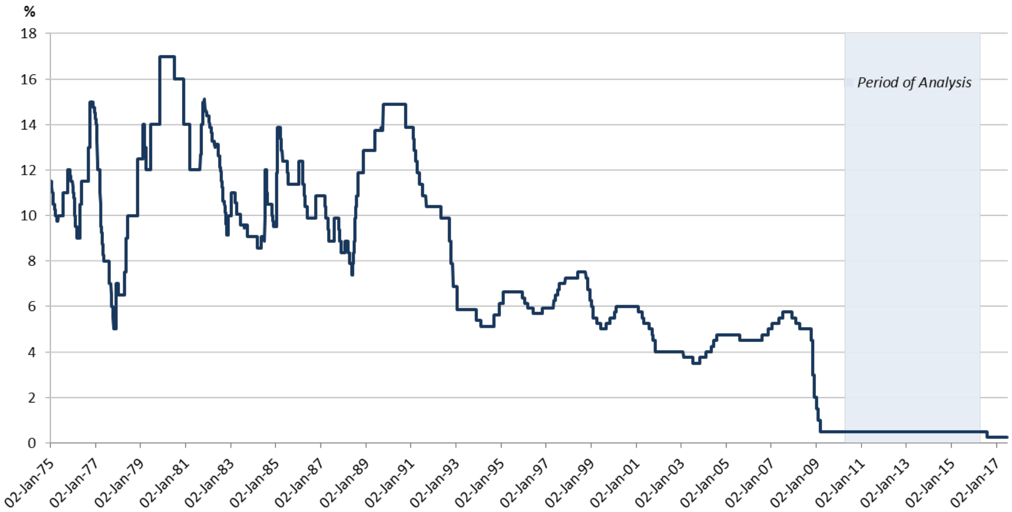
Appendix: Figures and tables of results

Figure 4.1: Proportion of central government procurement in total government procurement



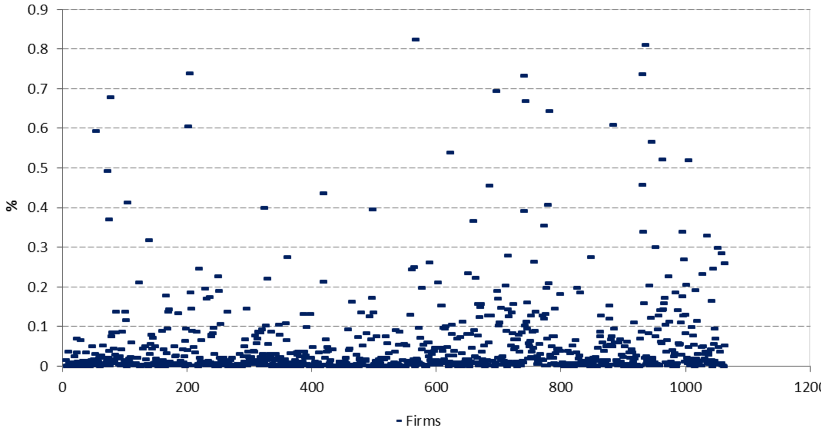
Source: Crown Commercial Service and ONS ESA Table published January 2017.

Figure 4.2: Bank of England official bank rate



Source: Bank of England.

Figure 4.3: Proportion of government demand in firm total demand



Note: Figure shows, for all firms in our sample, the proportion of government expenditure in total turnover.

Table 4.2: Summary statistics of government expenditure split by industry sector – large sample

	Central Government Procurement Statistics by Industry Sector					
Industry Sector	p25	Median	p75	Mean	Std	No. firms
Accommodation & Food Service Activities	0.167	0.359	0.908	14.93	83.805	111
Administrative & Support Service Activities	0.223	0.648	1.953	11.992	90.009	1,188
Agriculture, Forestry & Fishing	0.187	0.516	0.998	0.978	1.871	54
Arts, Entertainment & Recreation	0.157	0.453	1.002	0.771	0.892	72
Basic Metals & Metal Products	0.187	0.656	2.022	3.887	13.764	143
Chemicals & Man-made Fibres	0.373	0.894	2.779	4.889	12.282	80
Construction	0.271	0.872	2.67	23.103	158	702
Education	0.178	0.399	1.43	4.601	22.841	350
Electricity, Gas & Water Supply	0.192	0.713	2.26	7.644	34.162	97
Engineering & Allied Industries	0.215	0.629	1.981	46.413	772	655
Financial & Insurance Activities	0.409	1.375	4.596	40.115	177	137
Food Products, Beverages and Tobacco	0.255	0.408	0.822	2.647	6.375	19
Health & Social Work	0.294	0.997	3.631	9.201	40.61	422
Information & Communication	0.213	0.573	1.622	23.196	318	1,166
Mining & Quarrying	0.25	1.034	2.142	5.019	11.934	19
Other Manufacturing	0.195	0.507	1.258	6.467	48.065	407
Other Service Activities	0.215	0.508	1.332	18.191	151	369
Professional, Scientific & Technical Activities	0.261	0.802	2.35	15.806	141	2,015
Public Administration	0.41	2.64	20.89	312	1230	63
Real Estate Activities	0.307	0.903	3.1	30.108	183	275
Retail Trade & Repairs	0.208	0.551	1.379	6.592	47.81	228
Textiles, Leather & Clothing	0.21	0.706	2.505	3.666	10.529	55
Transport & Storage	0.194	0.607	1.943	13.926	68.191	331
Wholesale Trade	0.196	0.647	1.972	9.116	73.758	446
Manufacturing	0.209	0.614	1.807	25.188	536.757	1,359
Services	0.225	0.677	2.088	18.213	202.582	7,173
Total	0.225	0.682	2.075	19.351	273	9,404

Note: All amounts are expressed in millions of British pounds, except No. firms.

Appendix C4: Summary statistics and tables of results

Table 4.3: Government procurement expenditure percentage split by industry sector – large sample

	Central Government Procurement % split by Industry Sector							
Industry Sector	2010	2011	2012	2013	2014	2015	Total	No. firms
Accommodation & Food Service Activities	0.011	0.011	0.009	0.009	0.008	0.007	0.009	111
Administrative & Support Service Activities	0.067	0.065	0.076	0.087	0.087	0.085	0.078	1,188
Agriculture, Forestry & Fishing	0.000	0.000	0.000	0.000	0.000	0.000	0.000	54
Arts, Entertainment & Recreation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	72
Basic Metals & Metal Products	0.005	0.004	0.004	0.002	0.002	0.002	0.003	143
Chemicals & Man-made Fibres	0.004	0.002	0.001	0.002	0.002	0.002	0.002	80
Construction	0.092	0.084	0.082	0.091	0.092	0.092	0.089	702
Education	0.010	0.008	0.007	0.009	0.010	0.008	0.009	350
Electricity, Gas & Water Supply	0.003	0.003	0.004	0.005	0.005	0.005	0.004	97
Engineering & Allied Industries	0.158	0.182	0.176	0.167	0.158	0.163	0.167	655
Financial & Insurance Activities	0.028	0.032	0.028	0.029	0.032	0.032	0.030	137
Food Products, Beverages and Tobacco	0.001	0.000	0.000	0.000	0.000	0.000	0.000	19
Health & Social Work	0.015	0.012	0.014	0.012	0.036	0.036	0.021	422
Information & Communication	0.148	0.161	0.163	0.154	0.143	0.127	0.149	1,166
Mining & Quarrying	0.001	0.001	0.000	0.000	0.000	0.001	0.001	19
Other Manufacturing	0.019	0.018	0.013	0.015	0.012	0.011	0.014	407
Other Service Activities	0.083	0.028	0.025	0.026	0.030	0.029	0.037	369
Professional, Scientific & Technical Activities	0.143	0.153	0.169	0.191	0.189	0.200	0.175	2,015
Public Administration	0.106	0.116	0.115	0.104	0.103	0.105	0.108	63
Real Estate Activities	0.043	0.054	0.050	0.044	0.042	0.041	0.046	275
Retail Trade & Repairs	0.014	0.012	0.008	0.006	0.005	0.004	0.008	228
Textiles, Leather & Clothing	0.001	0.001	0.001	0.001	0.001	0.001	0.001	55
Transport & Storage	0.027	0.029	0.027	0.023	0.021	0.025	0.025	331
Wholesale Trade	0.023	0.023	0.024	0.022	0.021	0.022	0.022	446
Manufacturing	0.187	0.208	0.196	0.187	0.175	0.179	0.188	1,359
Services	0.718	0.704	0.717	0.717	0.728	0.722	0.718	7,173
Others	0.096	0.088	0.087	0.096	0.097	0.098	0.094	872

Notes: Table shows how government procurement expenditure is split across industries. For example, in 2010 about 16% of government procurement expenditure was spent on Engineering & Allied Industries.

Table 4.4: Summary statistics of government expenditure split by region – large sample

	Central Government Procurement Statistics by Region					
Region	p25	Median	p75	Mean	Std	No. firms
East Midlands (England)	0.213	0.547	1.594	5.585	35.056	509
East of England	0.201	0.659	2.116	21.075	189	975
London	0.284	0.85	3.098	34.333	455	2,377
North East (England)	0.199	0.648	2.104	6.03	38.783	219
North West (England)	0.215	0.645	1.61	6.003	62.135	883
Northern Ireland	0.235	0.878	2.724	6.282	16.791	67
Scotland	0.224	0.638	1.356	7.149	52.253	361
South East (England)	0.229	0.681	2.086	27.959	294	1,920
South West (England)	0.202	0.641	1.852	9.771	77.909	871
Wales	0.251	0.629	1.401	4.261	34.347	274
West Midlands (England)	0.208	0.697	1.802	8.76	79.938	754
Yorkshire and The Humber	0.209	0.56	1.68	6.436	39.306	626
Total	0.227	0.694	2.088	19.176	269	9,836

Note: All amounts are expressed in millions of British pounds, except No. firms.

Table 4.5: Government procurement expenditure percentage split by regions – large sample

	Central Government Procurement % split by Region							
Region	2010	2011	2012	2013	2014	2015	Total	No. firms
East Midlands (England)	0.017	0.014	0.013	0.014	0.016	0.015	0.015	509
East of England	0.105	0.111	0.108	0.112	0.108	0.098	0.109	975
London	0.399	0.441	0.444	0.442	0.448	0.487	0.433	2,377
North East (England)	0.01	0.007	0.004	0.006	0.007	0.007	0.007	219
North West (England)	0.064	0.017	0.019	0.02	0.024	0.018	0.028	883
Northern Ireland	0.001	0.002	0.002	0.002	0.003	0.004	0.002	67
Scotland	0.017	0.017	0.012	0.013	0.013	0.009	0.014	361
South East (England)	0.277	0.302	0.302	0.282	0.268	0.248	0.285	1,920
South West (England)	0.061	0.041	0.043	0.042	0.04	0.038	0.045	871
Wales	0.006	0.006	0.005	0.006	0.007	0.006	0.006	274
West Midlands (England)	0.028	0.03	0.029	0.035	0.041	0.043	0.035	754
Yorkshire and The Humber	0.015	0.013	0.019	0.025	0.026	0.026	0.021	626

Notes: Table shows how government procurement expenditure is split across the different regions of the UK. For example, in 2010 about 40% of government procurement expenditure went to firms registered as based in London.

Table 4.6: Government procurement expenditure percentage split by industry sector – estimation sample

	Central Government Procurement % split by Industry Sector							
Industry Sector	2010	2011	2012	2013	2014	2015	Total	No. firms
Accommodation & Food Service Activities	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10
Administrative & Support Service Activities	0.042	0.036	0.044	0.049	0.048	0.041	0.043	122
Agriculture, Forestry & Fishing	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4
Arts, Entertainment & Recreation	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7
Basic Metals & Metal Products	0.004	0.002	0.003	0.001	0.002	0.001	0.002	20
Chemicals & Man-made Fibres	0.008	0.004	0.003	0.003	0.003	0.003	0.004	28
Construction	0.089	0.074	0.068	0.070	0.077	0.087	0.078	60
Education	0.004	0.004	0.004	0.006	0.006	0.005	0.005	22
Electricity, Gas & Water Supply	0.002	0.002	0.002	0.002	0.002	0.002	0.002	21
Engineering & Allied Industries	0.277	0.311	0.298	0.301	0.302	0.306	0.299	130
Food Products, Beverages and Tobacco	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3
Health & Social Work	0.018	0.015	0.015	0.015	0.028	0.027	0.020	53
Information & Communication	0.137	0.152	0.160	0.156	0.141	0.108	0.142	116
Mining & Quarrying	0.002	0.001	0.000	0.000	0.000	0.000	0.001	6
Other Manufacturing	0.028	0.026	0.017	0.023	0.018	0.016	0.021	67
Other Service Activities	0.028	0.022	0.021	0.021	0.021	0.034	0.025	46
Professional, Scientific & Technical Activities	0.130	0.121	0.142	0.153	0.162	0.176	0.148	136
Public Administration	0.148	0.153	0.154	0.140	0.139	0.145	0.147	7
Real Estate Activities	0.005	0.007	0.009	0.012	0.010	0.010	0.009	20
Retail Trade & Repairs	0.027	0.020	0.012	0.006	0.004	0.003	0.012	39
Textiles, Leather & Clothing	0.000	0.000	0.000	0.000	0.000	0.000	0.000	7
Transport & Storage	0.041	0.040	0.037	0.031	0.030	0.027	0.034	63
Wholesale Trade	0.010	0.010	0.010	0.010	0.008	0.008	0.009	70
Manufacturing	0.318	0.343	0.321	0.328	0.324	0.327	0.327	255
Services	0.589	0.581	0.608	0.599	0.597	0.584	0.593	711
Others	0.093	0.077	0.070	0.073	0.079	0.089	0.080	93

Notes: Table shows how government procurement expenditure is split across industries. For example, in 2010 about 28% of government procurement expenditure was spent on Engineering & Allied Industries.

Table 4.7: Government procurement expenditure percentage split by regions – estimation sample

	Central Government Procurement % split by Region							
Region	2010	2011	2012	2013	2014	2015	Total	No. firms
East Midlands (England)	0.015	0.012	0.016	0.018	0.026	0.022	0.018	61
East of England	0.127	0.119	0.112	0.107	0.102	0.099	0.111	112
London	0.539	0.561	0.581	0.571	0.576	0.612	0.574	285
North East (England)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	19
North West (England)	0.004	0.004	0.004	0.006	0.005	0.005	0.005	57
Northern Ireland	0.002	0.002	0.003	0.003	0.003	0.005	0.003	9
Scotland	0.017	0.016	0.008	0.008	0.009	0.009	0.011	43
South East (England)	0.225	0.222	0.213	0.211	0.205	0.184	0.21	224
South West (England)	0.021	0.018	0.02	0.022	0.02	0.019	0.02	72
Wales	0.005	0.003	0.002	0.003	0.003	0.002	0.003	24
West Midlands (England)	0.037	0.037	0.037	0.043	0.041	0.038	0.039	75
Yorkshire and The Humber	0.008	0.005	0.005	0.005	0.006	0.006	0.006	59

Notes: Table shows how government procurement expenditure is split across the different regions of the UK. For example, in 2010 about 54% of government procurement expenditure went to firms registered as based in London.

Table 4.8: Government procurement expenditure percentage split by firm size – estimation sample

	Government Expenditure % split by Firm Size							
Size	2010	2011	2012	2013	2014	2015	Total	No. firms
Large	0.947	0.953	0.956	0.957	0.959	0.964	0.956	413
Medium	0.039	0.036	0.031	0.031	0.031	0.03	0.033	497
Small	0.014	0.011	0.013	0.012	0.01	0.006	0.011	140
Micro	0.000	0.000	0.000	0.000	0.000	0.000	0.000	9

Notes: Table shows how government procurement expenditure is split across different firm sizes. For example, in 2010 about 95% of government procurement expenditure went to large firms.

Table 4.9: Summary statistics for main variable – estimation sample

	Summary Statistics				
	p25	Median	p75	Mean	Std
*All Firms(1059)**					
GovSpend	0.10	0.28	1.34	13.31	119.00
Turnover	12.24	30.67	108.00	415.00	2,590.00
Wages	27,296.27	34,706.96	43,545.89	37,484.20	16,729.04
Total Assets	7.50	21.57	98.55	475.00	2,900.00
Employees	80.92	188.00	639.33	2,931.64	25,186.59
*Services(711)**					
GovSpend	0.10	0.29	1.32	11.75	76.02
Turnover	12.05	29.06	109.00	471.00	3,000.00
Wages	26,385.77	35,260.68	45,588.86	38,343.78	18,908.47
Total Assets	6.82	21.48	94.80	517.00	3,260.00
Employees	78.25	189.83	721.58	3,788.54	30,430.69
*Manufactuing(255)**					
GovSpend	0.09	0.21	0.85	18.05	205.00
Turnover	11.66	24.43	81.55	258.00	1,520.00
Wages	28,958.00	33,388.30	39,168.28	35,016.33	9,167.49
Total Assets	7.59	17.80	75.64	294.00	2,010.00
Employees	76.58	152.67	382.92	953.90	6,039.77
*Micro(9)**					
GovSpend	0.08	0.16	0.25	0.53	0.83
Turnover	0.63	0.93	12.28	28.89	63.58
Wages	24,322.86	34,938.41	44,366.27	41,848.10	23,128.82
Total Assets	0.64	0.98	13.30	9.85	13.82
Employees	6.00	9.17	10.50	9.78	5.69
*Small(140)**					
GovSpend	0.07	0.16	0.54	1.08	4.54
Turnover	2.59	7.28	12.18	31.98	219.21
Wages	27,798.18	36,461.69	48,128.35	40,110.08	17,582.08
Total Assets	1.99	4.48	6.80	24.76	165.38
Employees	23.96	36.75	44.13	35.51	14.67
*Medium(497)**					
GovSpend	0.08	0.20	0.69	0.93	2.83
Turnover	10.45	18.09	33.86	33.08	74.42
Wages	28,790.12	35,042.08	43,875.50	38,184.89	16,852.21
Total Assets	6.63	12.61	25.34	36.86	188.81
Employees	83.17	125.00	184.00	142.21	79.81
*Large(413)**					
GovSpend	0.15	0.75	4.85	32.63	189.00
Turnover	66.67	140.00	407.72	1,011.64	4,079.96
Wages	25,530.83	32,895.87	42,305.73	35,655.78	15,980.90
Total Assets	47.37	121.76	366.67	1,165.37	4,559.17
Employees	466.33	891.00	2,286.33	7,333.82	39,964.56

Notes: Statistics based on six-year average of each variable. Wages captures wages per employee. All amounts are expressed in millions of British pounds, except employee and wages per employee. * Captures number of firms in the sample.

Table 4.10: Reduced–form regression of employment on government spending, static model – full sample

	Dependent Variable: Employment				
Independent Variable	All	Small	Small+Micro	Medium	Large
$Govspend_t$	0.013***	0.009	0.012	0.009**	0.014***
	(0.003)	(0.011)	(0.011)	(0.003)	(0.004)
$Govspend_{t-1}$	0.010***	0.015*	0.013*	0.009***	0.008***
	(0.002)	(0.008)	(0.008)	(0.003)	(0.003)
$Govspend_{t+1}$	0.006**	0.014*	0.012*	0.007**	0.002
	(0.003)	(0.007)	(0.007)	(0.004)	(0.004)
$Wages_t$	-0.570***	-0.294**	-0.362***	-0.536***	-0.766***
	(0.068)	(0.117)	(0.111)	(0.075)	(0.174)
$Wages_{t-1}$	-0.103***	0.053	0.043	-0.151***	-0.159*
	(0.039)	(0.064)	(0.059)	(0.058)	(0.083)
$Capacity_t$	-0.008	-0.041	-0.043	0.014	0.002
	(0.041)	(0.046)	(0.044)	(0.054)	(0.035)
$Capacity_{t-1}$	-0.134***	-0.143***	-0.138***	-0.151***	-0.090***
	(0.031)	(0.043)	(0.042)	(0.048)	(0.024)
$Private-demand_t$	0.317***	0.217***	0.216***	0.311***	0.414***
	(0.046)	(0.045)	(0.043)	(0.060)	(0.056)
$Private-demand_{t-1}$	0.198***	0.294***	0.289***	0.184***	0.171***
	(0.025)	(0.062)	(0.056)	(0.032)	(0.037)
$Private-demand_{t+1}$	0.049	0.104**	0.123***	0.015	0.075**
	(0.030)	(0.044)	(0.037)	(0.037)	(0.035)
Observations	4236	560	596	1988	1652
No. Firms	1059	140	149	497	413
R-square	0.8309	0.2107	0.1567	0.3569	0.7949
F-test	38	6.36	7.12	21.93	18.93
P-value	0	0	0	0	0

Notes: Specification is $y_{i,t} = \beta_1 X_{i,t-1} + \beta_1 X_{i,t} + \gamma_1 g_{i,t-1} + \gamma_2 g_{i,t} + \gamma_3 g_{i,t+1} + \eta_t + \nu_i + \varepsilon_{i,t}$, Where y is the variable of interest such as employment, g captures government spending, X contains a vector of control variables, ν is the firm-specific fixed effect, and η is the year fixed effect. Estimated for the period 2010/2011 to 2015/2016. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level.

Table 4.11: Reduced–form regression of employment on government spending, dynamic model – full sample

	Dependent Variable: Employment				
Independent Variable	All	Small	Small+Micro	Medium	Large
$Employment_t$	0.450***	0.470***	0.450***	0.472***	0.423***
	(0.040)	(0.084)	(0.076)	(0.061)	(0.040)
$Govspend_t$	0.010***	0.004	0.006	0.008***	0.011***
	(0.002)	(0.008)	(0.008)	(0.003)	(0.003)
$Govspend_{t-1}$	0.002	0.002	0.001	0.004	0
	(0.002)	(0.007)	(0.007)	(0.003)	(0.003)
$Govspend_{t+1}$	0.004*	0.006	0.004	0.007**	0
	(0.002)	(0.006)	(0.006)	(0.003)	(0.004)
$Wages_t$	-0.562***	-0.361***	-0.413***	-0.529***	-0.718***
	(0.062)	(0.100)	(0.094)	(0.068)	(0.162)
$Wages_{t-1}$	0.147***	0.236***	0.239***	0.095**	0.160***
	(0.033)	(0.072)	(0.070)	(0.043)	(0.060)
$Capacity_t$	-0.007	-0.032	-0.061	0.011	0.004
	(0.037)	(0.042)	(0.042)	(0.047)	(0.031)
$Capacity_{t-1}$	-0.103***	-0.108***	-0.100***	-0.105***	-0.088***
	(0.020)	(0.033)	(0.035)	(0.027)	(0.028)
$Private-demand_t$	0.291***	0.171***	0.156***	0.300***	0.381***
	(0.045)	(0.039)	(0.042)	(0.058)	(0.062)
$Private-demand_{t-1}$	0.027	0.110***	0.128***	-0.005	-0.005
	(0.027)	(0.036)	(0.032)	(0.030)	(0.063)
$Private-demand_{t+1}$	0.044	0.061*	0.082***	0.019	0.064**
	(0.027)	(0.034)	(0.030)	(0.033)	(0.027)
Observations	4236	560	596	1988	1652
No. Firms	1059	140	149	497	413
R-square	0.957	0.5539	0.5139	0.7445	0.9293
F-test	79.26	15.31	15.65	55.12	42.27
P-value	0	0	0	0	0

Notes: Specification is $y_{i,t} = \alpha y_{i,t-1} + \beta_1 X_{i,t-1} + \beta_1 X_{i,t} + \gamma_1 g_{i,t-1} + \gamma_2 g_{i,t} + \gamma_3 g_{i,t+1} + \eta_t + \nu_i + \varepsilon_{i,t}$, Where y is the variable of interest such as employment, g captures government spending, X contains a vector of control variables, ν is the firm-specific fixed effect, and η is the year fixed effect. Estimated for the period 2010/2011 to 2015/2016. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level.

Table 4.12: Reduced–form regression of wages on government spending, static model – full sample

	Dependent Variable: Wages				
Independent Variable	All	Small	Small+Micro	Medium	Large
$Govspend_t$	0.002	0.009	0.009	0.003	0.001
	(0.002)	(0.007)	(0.007)	(0.002)	(0.003)
$Govspend_{t-1}$	0.001	0	0.001	0.004	0.001
	(0.002)	(0.006)	(0.006)	(0.002)	(0.002)
$Govspend_{t+1}$	-0.001	0.001	0.002	-0.001	-0.001
	(0.002)	(0.006)	(0.006)	(0.003)	(0.003)
$Wages_t$	-0.330***	-0.255***	-0.289***	-0.364***	-0.311***
	(0.029)	(0.071)	(0.066)	(0.051)	(0.032)
$Wages_{t-1}$	0.107***	0.152***	0.147***	0.135***	0.056**
	(0.020)	(0.051)	(0.045)	(0.027)	(0.027)
$Capacity_t$	-0.017	-0.048	-0.077**	-0.011	0.045**
	(0.015)	(0.032)	(0.030)	(0.022)	(0.020)
$Capacity_{t-1}$	-0.031***	-0.011	-0.004	-0.034**	-0.049***
	(0.011)	(0.029)	(0.027)	(0.016)	(0.017)
$Private-demand_t$	0.140***	0.144***	0.151***	0.130***	0.194***
	(0.020)	(0.039)	(0.034)	(0.033)	(0.031)
$Private-demand_{t-1}$	0.009	-0.049	-0.026	0.006	0.025
	(0.012)	(0.041)	(0.036)	(0.016)	(0.021)
$Private-demand_{t+1}$	0.009	0.029	0.031	-0.001	0.006
	(0.009)	(0.035)	(0.025)	(0.011)	(0.018)
Observations	4236	560	596	1988	1652
No. Firms	1059	140	149	497	413
R-square	0.2903	0.3595	0.346	0.2003	0.3553
F-test	28.76	4.83	6.29	11.49	21.9
P-value	0.00	0.00	0.00	0.00	0.00

Notes: See notes to table 4.10. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level.

Table 4.13: Reduced–form regression of wages on government spending, dynamic model – full sample

	Dependent Variable: Wages				
Independent Variable	All	Small	Small+Micro	Medium	Large
$Wages_{t-1}$	0.120***	0.148***	0.138***	0.091**	0.140***
	(0.028)	(0.047)	(0.046)	(0.041)	(0.053)
$Govspend_t$	0.003	0.008	0.008	0.003	0.001
	(0.002)	(0.007)	(0.007)	(0.002)	(0.002)
$Govspend_{t-1}$	0.001	-0.002	-0.001	0.003	0
	(0.002)	(0.006)	(0.006)	(0.002)	(0.002)
$Govspend_{t+1}$	-0.001	0	0.001	-0.001	-0.001
	(0.002)	(0.006)	(0.006)	(0.003)	(0.003)
$Employ_t$	-0.336***	-0.284***	-0.314***	-0.367***	-0.315***
	(0.029)	(0.071)	(0.065)	(0.051)	(0.032)
$Employ_{t-1}$	0.144***	0.201***	0.193***	0.165***	0.095***
	(0.022)	(0.054)	(0.048)	(0.031)	(0.028)
$Capacity_t$	-0.015	-0.043	-0.074**	-0.01	0.044**
	(0.015)	(0.031)	(0.030)	(0.022)	(0.020)
$Capacity_{t-1}$	-0.033***	-0.018	-0.008	-0.034**	-0.054***
	(0.011)	(0.029)	(0.026)	(0.016)	(0.017)
$Private-demand_t$	0.141***	0.145***	0.149***	0.132***	0.192***
	(0.021)	(0.037)	(0.033)	(0.034)	(0.032)
$Private-demand_{t-1}$	-0.007	-0.067*	-0.041	-0.007	0.003
	(0.013)	(0.039)	(0.035)	(0.017)	(0.022)
$Private-demand_{t+1}$	0.01	0.02	0.026	0.001	0.005
	(0.009)	(0.034)	(0.025)	(0.011)	(0.018)
Observations	4236	560	596	1988	1652
No. Firms	1059	140	149	497	413
R-square	0.5007	0.6308	0.5485	0.3908	0.5648
F-test	29.52	5.84	7.1	11.84	23.9
P-value	0.00	0.00	0.00	0.00	0.00

Notes: See notes to table 4.11. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level.

Table 4.14: Average government demand in firm total demand (%)

Sample	Government Demand	Firm Count
All	0.050	1059
Manufacturing	0.044	255
Service	0.054	711
Micro	0.133	9
Small	0.086	140
Medium	0.044	497
Large	0.042	413

Notes: Table shows the average amount of government demand in a firm's total turnover. This was calculated using the six-year sample period.

Table 4.15: Capturing the effects of the size of government demand

		Dependent Variable: Employment					
		Static			Dynamic		
		d10	d20	d30	d10	d20	d30
Contemporaneous							
	GovSpend	0.008***	0.013***	0.014***	0.007***	0.010***	0.010***
		(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
	Govspend x D	0.048***	0.075***	0.116**	0.032***	0.051***	0.088**
		(0.008)	(0.022)	(0.045)	(0.007)	(0.016)	(0.035)
Lagged							
	GovSpend	0.007***	0.009***	0.010***	0.002	0.003	0.003
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
	Govspend x D	0.034***	0.040***	0.110***	0.006	0.005	0.033
		(0.008)	(0.015)	(0.039)	(0.007)	(0.010)	(0.029)
Future							
	GovSpend	0.004	0.007***	0.007***	0.003	0.005**	0.005**
		(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)
	Govspend x D	0.025***	0	0.039	0.019**	0.003	0.041
		(0.009)	(0.017)	(0.036)	(0.007)	(0.016)	(0.032)

		Dependent Variable: Employment					
		Static			Dynamic		
		d10	d20	d30	d10	d20	d30
Contemporaneous							
	GovSpend	0.00	0.002	0.002	0.00	0.002	0.003
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
	Govspend x D	0.021***	0.027**	0.018	0.020***	0.026**	0.021
		(0.006)	(0.013)	(0.027)	(0.005)	(0.012)	(0.027)
Lagged							
	GovSpend	0.001	0.002	0.002	0	0.001	0.001
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
	Govspend x D	0.010*	0.004	-0.008	0.008	0.00	-0.008
		(0.005)	(0.008)	(0.029)	(0.005)	(0.008)	(0.026)
Future							
	GovSpend	-0.002	-0.001	-0.001	-0.002	-0.001	-0.001
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
	Govspend x D	0.008	0.007	-0.024	0.009	0.008	-0.024
		(0.008)	(0.015)	(0.037)	(0.008)	(0.016)	(0.034)

Notes: Specification is $y_{i,t} = \alpha y_{i,t-1} + \beta_1 X_{i,t-1} + \beta_1 X_{i,t} + \gamma g_{i,t} + \gamma g_{i,t} D_i + \eta_t + \nu_i + \varepsilon_{i,t}$, Where y is the variable of interest such as employment,g captures government spending, X contains a vector of control variables, ν is the firm-specific fixed effect, and η is the year fixed effect. D captures the dummy variable; this is interacted with the government spending. The model is estimated with three variation of government spending, $g_{i,t}$, $g_{i,t-1}$, and $g_{i,t+1}$. $d10$ captures instances where the dummy variable takes a value of 1 when the average government demand makes up at least 10% of a firm's total demand, so government expenditure/total turnover ≥10%. $d20$ captures instance of at least 20%, and $d30$ captures at least 30%. Government procurement expenditure makes up at least 30% of total turnover for 33 firms, 20% for 59 firms, and 10% of 143 firms (111 firms in the service sector and 26 firms in the manufacturing sector). All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms.*** indicates significance at 1%, ** at 5%, and * at 10% level.

Table 4.16: Reduced–form regression of employment on government spending – service and manufacturing sector

Employment		Static					Dynamic				
		All	Small	Small+Micro	Medium	Large	All	Small	Small+Micro	Medium	Large
Services											
	Contemporaneous	0.016***	0.026***	0.030***	0.008*	0.017***	0.013***	0.018**	0.021***	0.006	0.015***
		(0.003)	(0.009)	(0.009)	(0.005)	(0.004)	(0.003)	(0.007)	(0.007)	(0.004)	(0.004)
	Lagged	0.010***	0.01	0.008	0.010**	0.009***	0.002	-0.002	-0.004	0.003	0
		(0.003)	(0.007)	(0.007)	(0.004)	(0.004)	(0.002)	(0.007)	(0.007)	(0.004)	(0.003)
	Future	0.008**	0.013	0.011	0.013**	0.002	0.005**	0.006	0.004	0.011**	0
		(0.003)	(0.008)	(0.008)	(0.006)	(0.006)	(0.003)	(0.007)	(0.007)	(0.005)	(0.005)
	No. Obs.	2844	420	440	1276	1128	2844	420	440	1276	1128
Manufacturing											
	Contemporaneous	-0.001	-0.026		0.002	0.009	0	-0.015		0.006	0.002
		(0.006)	(0.028)		(0.005)	(0.006)	(0.005)	(0.019)		(0.005)	(0.005)
	Lagged	0.005	0.021		0.005	0.005	0.001	0.021		0.003	0.001
		(0.004)	(0.02)		(0.005)	(0.005)	(0.003)	(0.023)		(0.004)	(0.004)
	Future	0	0.018		-0.005	0.006	0.001	0.019		-0.002	0.003
		(0.005)	(0.02)		(0.005)	(0.012)	(0.004)	(0.014)		(0.004)	(0.011)
	No. Obs.	1020	116		572	332	1020	116		572	332

Notes: See notes to tables 4.10 and 4.11. The table presents results for a subsample of firms in the manufacturing and service sector, with only the variable of interested government spending reported. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level. Only the estimated coefficients of government spending are reported.

Table 4.17: Reduced–form regression of wages on government spending – service and manufacturing sector

Wages		Static					Dynamic				
		All	Small	Small+Micro	Medium	Large	All	Small	Small+Micro	Medium	Large
Services											
	Contemporaneous	0.004*	0.018**	0.018***	0.002	0.003	0.004**	0.018***	0.017***	0.003	0.003
		(0.002)	(0.007)	(0.007)	(0.003)	(0.003)	(0.002)	(0.007)	(0.006)	(0.003)	(0.003)
	Lagged	0.003	0.005	0.006	0.005	0	0.002	0.003	0.004	0.004	0
		(0.002)	(0.007)	(0.007)	(0.003)	(0.003)	(0.002)	(0.007)	(0.007)	(0.003)	(0.002)
	Future	0	0.004	0.005	0.002	-0.003	0.001	0.004	0.005	0.003	-0.003
		(0.002)	(0.007)	(0.007)	(0.003)	(0.003)	(0.002)	(0.007)	(0.007)	(0.003)	(0.003)
	No. Obs.	2844	420	440	1276	1128	2844	420	440	1276	1128
Manufacturing											
	Contemporaneous	-0.001	-0.026		0.002	0.009	0	-0.015		0.006	0.002
		(0.006)	(0.028)		(0.005)	(0.006)	(0.005)	(0.019)		(0.005)	(0.005)
	Lagged	0.005	0.021		0.005	0.005	0.001	0.021		0.003	0.001
		(0.004)	(0.02)		(0.005)	(0.005)	(0.003)	(0.023)		(0.004)	(0.004)
	Future	0	0.018		-0.005	0.006	0.001	0.019		-0.002	0.003
		(0.005)	(0.02)		(0.005)	(0.012)	(0.004)	(0.014)		(0.004)	(0.011)
	No. Obs.	1020	116		572	332	1020	116		572	332

Notes: See notes to tables 4.10 and 4.11. The table presents results for a subsample of firms in the manufacturing and service sector, with only the variable of interested government spending reported. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level. Only the estimated coefficients of government spending is reported.

Table 4.18: Reduced–form regression of the impact of government spending – defence only firms

		Static					Dynamic				
		All	Serv	Manu	Medium	Large	All	Serv	Manu	Medium	Large
Employment											
	Contemporaneous	0.005	0.007	0.006	0.01	0.042*	0.011	0.003	0.017	0.016*	0.015
		(-0.018)	(-0.019)	(-0.021)	(-0.011)	(-0.020)	(-0.011)	(-0.017)	(-0.013)	(-0.009)	(-0.024)
	Lagged	0.013	-0.001	0.026*	0.013	0.021	0.005	-0.012	0.015	0.005	0.002
		(-0.009)	(-0.016)	(-0.013)	(-0.007)	(-0.030)	(-0.008)	(-0.011)	(-0.013)	(-0.005)	(-0.025)
	Future	0.003	-0.021	0.004	-0.017**	0.046**	0.004	-0.008	0.006	-0.011*	0.024
		(-0.011)	(-0.018)	(-0.010)	(-0.007)	(-0.021)	(-0.009)	(-0.016)	(-0.009)	(-0.006)	(-0.026)
	No. Obs.	372	124	236	224	92	372	124	236	224	92
Wages											
	Contemporaneous	0.018***	0.036**	0.012*	0.009	0.043***	0.019***	0.031**	0.012*	0.009	0.043***
		(-0.007)	(-0.015)	(-0.007)	(-0.006)	(-0.011)	(-0.006)	(-0.015)	(-0.007)	(-0.006)	(-0.012)
	Lagged	0.004	0.002	0.005	0.011***	0.02	0.003	-0.001	0.005	0.011***	0.018
		(-0.005)	(-0.011)	(-0.006)	(-0.004)	(-0.013)	(-0.004)	(-0.010)	(-0.006)	(-0.004)	(-0.012)
	Future	0	-0.002	-0.005	-0.008	0.015	0	-0.006	-0.005	-0.008	0.015
		(-0.007)	(-0.017)	(-0.008)	(-0.006)	(-0.013)	(-0.007)	(-0.014)	(-0.008)	(-0.006)	(-0.013)
	No. Obs.	372	124	236	224	92	372	124	236	224	92

Notes: See notes to table 4.10and 4.11. The table presents results for a subsample of firms that supply only defence goods and services to the government (93 firms), with only the variable of interested government spending reported. All standard errors in parenthesss are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level. Only the estimated coefficients of government spending are reported.

Table 4.19: Reduced–form regression of employment on government spending – defence and non–defence firms

Employ		Static					Dynamic				
		All	Serv	Manu	Medium	Large	All	Serv	Manu	Medium	Large
Non-Defence											
	Contemporaneous	0.013***	0.014***	0.001	0.01	0.014***	0.010***	0.012***	0.003	0.012	0.008*
		(-0.004)	(-0.004)	(-0.010)	(-0.010)	(-0.005)	(-0.004)	(-0.004)	(-0.008)	(-0.008)	(-0.005)
	Lagged	0.013**	0.017**	0.012	0.026**	0.005	0.006	0.006	0.014*	0.019**	0.001
		(-0.006)	(-0.007)	(-0.008)	(-0.012)	(-0.006)	(-0.004)	(-0.005)	(-0.007)	(-0.008)	(-0.005)
	Future	-0.006	-0.011	0.007	-0.02	0.003	-0.005	-0.008	0.002	-0.014	0
		(-0.007)	(-0.010)	(-0.012)	(-0.015)	(-0.008)	(-0.006)	(-0.008)	(-0.011)	(-0.012)	(-0.006)
Defence											
	Contemporaneous	0.008	0.011	0.005	0.006	0.01	0.004	0.006	0.003	0	0.006
		(-0.006)	(-0.009)	(-0.005)	(-0.005)	(-0.009)	(-0.005)	(-0.006)	(-0.004)	(-0.004)	(-0.007)
	Lagged	0.003	0.003	0.009	0.007	-0.001	0.001	0.002	-0.002	0.005	-0.004
		(-0.005)	(-0.005)	(-0.015)	(-0.006)	(-0.005)	(-0.004)	(-0.004)	(-0.014)	(-0.006)	(-0.005)
	Future	0.002	0.001	0.012*	0.007	-0.004	0.001	-0.002	0.012*	0.005	-0.004
		(-0.004)	(-0.005)	(-0.006)	(-0.006)	(-0.005)	(-0.004)	(-0.005)	(-0.006)	(-0.006)	(-0.005)
	No. Obs.	956	644	220	320	584	956	644	220	320	584

Notes: The table presents results for a subsample of firms that supply both defence and non-defence goods and servcies to the government (293 firms). Specification is $y_{i,t} = \beta_1 X_{i,t-1} + \beta_2 X_{i,t} + \gamma_1 NDg_{i,t-1} + \gamma_2 NDg_{i,t} + \gamma_3 NDg_{i,t+1} + \gamma_4 Dg_{i,t-1} + \gamma_5 Dg_{i,t} + \gamma_6 Dg_{i,t+1} + \eta_t + \nu_i + \varepsilon_{i,t}$, Where y is the variable of interest such as employment, NDg captures non-defence government spending, Dg captures defence government spending, X contains a vector of control variables, ν is the firm-specific fixed effect, and η is the year fixed effect. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level. Only the estimated coefficients of government spending are reported.

Table 4.20: Reduced–form regression of wages on government spending – defence and non–defence firms

Wages		Static					Dynamic				
		All	Serv	Manu	Medium	Large	All	Serv	Manu	Medium	Large
Non-Defence											
	Contemporaneous	0.003	0.006*	-0.009	0.006	0.001	0.004	0.008**	-0.007	0.007	0.001
		(-0.003)	(-0.004)	(-0.005)	(-0.007)	(-0.004)	(-0.003)	(-0.004)	(-0.005)	(-0.007)	(-0.004)
	Lagged	0.003	0.004	0.002	0.015*	-0.002	0.002	0.002	0.002	0.014*	-0.002
		(-0.004)	(-0.004)	(-0.010)	(-0.009)	(-0.004)	(-0.004)	(-0.004)	(-0.010)	(-0.008)	(-0.004)
	Future	-0.006	-0.009	0	-0.018	0.002	-0.006	-0.007	-0.002	-0.017	0.002
		(-0.006)	(-0.008)	(-0.007)	(-0.012)	(-0.004)	(-0.005)	(-0.007)	(-0.007)	(-0.011)	(-0.004)
Defence											
	Contemporaneous	-0.001	-0.003	0.007**	-0.006	0.001	-0.001	-0.003	0.007*	-0.006	0.001
		(-0.003)	(-0.004)	(-0.004)	(-0.006)	(-0.003)	(-0.003)	(-0.004)	(-0.004)	(-0.006)	(-0.002)
	Lagged	0.001	0.002	0.007	0.002	-0.001	0.001	0.002	0.006	0.002	0
		(-0.003)	(-0.004)	(-0.011)	(-0.007)	(-0.003)	(-0.003)	(-0.003)	(-0.011)	(-0.007)	(-0.002)
	Future	0.002	0.002	0.009**	0.007	-0.001	0.002	0	0.009**	0.007	-0.002
		(-0.004)	(-0.006)	(-0.004)	(-0.008)	(-0.003)	(-0.004)	(-0.005)	(-0.004)	(-0.008)	(-0.003)
	No. Obs.	956	644	220	320	584	956	644	220	320	584

Notes: The table presents results for a subsample of firms that supply both defence and non-defence goods and servcies to the government (293 firms). Specification is $y_{i,t} = \beta_1 X_{i,t-1} + \beta_2 X_{i,t} + \gamma_1 NDg_{i,t-1} + \gamma_2 NDg_{i,t} + \gamma_3 NDg_{i,t+1} + \gamma_4 Dg_{i,t-1} + \gamma_5 Dg_{i,t} + \gamma_6 Dg_{i,t+1} + \eta_t + \nu_i + \varepsilon_{i,t}$, Where y is the variable of interest such as wages, NDg captures non-defence government spending, Dg captures defence government spending, X contains a vector of control variables, ν is the firm-specific fixed effect, and η is the year fixed effect. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level. Only the estimated coefficients of government spending are reported.

Table 4.21: Comparison of reduced–form regression results

	Static				Dynamic			
Full Sample	1	2	3	4	1	2	3	4
	Dependent Variable: Employment							
Contemporaneous	0.013***	0.010***	0.013***	0.005	0.010***	0.008***	0.010***	0.011
	(-0.003)	(-0.003)	(-0.003)	(-0.018)	(-0.002)	(-0.002)	(-0.002)	(-0.011)
Lagged	0.010***	0.007***	0.009***	0.013	0.002	0.002	0.002	0.005
	(-0.002)	(-0.002)	(-0.002)	(-0.009)	(-0.002)	(-0.002)	(-0.002)	(-0.008)
Future	0.006**	0.006**	0.007**	0.003	0.004*	0.004	0.004*	0.004
	(-0.003)	(-0.003)	(-0.003)	(-0.011)	(-0.002)	(-0.003)	(-0.002)	(-0.009)
	Dependent Variable: Wages							
Contemporaneous	0.002	0.001	0.002	0.018***	0.003	0.001	0.002	0.019***
	(-0.002)	(-0.002)	(-0.002)	(-0.007)	(-0.002)	(-0.002)	(-0.002)	(-0.006)
Lagged	0.001	0.001	0.001	0.004	0.001	0.001	0.001	0.003
	(-0.002)	(-0.002)	(-0.002)	(-0.005)	(-0.002)	(-0.002)	(-0.002)	(-0.004)
Future	-0.001	-0.002	-0.001	0.000	-0.001	-0.002	-0.001	0.000
	(-0.002)	(-0.002)	(-0.002)	(-0.007)	(-0.002)	(-0.002)	(-0.002)	(-0.007)
Service								
	Dependent Variable: Employment							
Contemporaneous	0.016***	0.014***	0.016***	0.007	0.013***	0.010***	0.013***	0.003
	(-0.003)	(-0.003)	(-0.003)	(-0.019)	(-0.003)	(-0.003)	(-0.003)	(-0.017)
Lagged	0.010***	0.008***	0.010***	-0.001	0.002	0.002	0.002	-0.012
	(-0.003)	(-0.003)	(-0.003)	(-0.016)	(-0.002)	(-0.003)	(-0.002)	(-0.011)
Future	0.008**	0.008**	0.008**	-0.021	0.005**	0.006**	0.005*	-0.008
	(-0.003)	(-0.003)	(-0.003)	(-0.018)	(-0.003)	(-0.003)	(-0.003)	(-0.016)
	Dependent Variable: Wages							
Contemporaneous	0.004*	0.003	0.003	0.036**	0.004**	0.003	0.003*	0.031**
	(-0.002)	(-0.002)	(-0.002)	(-0.015)	(-0.002)	(-0.002)	(-0.002)	(-0.015)
Lagged	0.003	0.003	0.003	0.002	0.002	0.002	0.002	-0.001
	(-0.002)	(-0.002)	(-0.002)	(-0.011)	(-0.002)	(-0.002)	(-0.002)	(-0.010)
Future	0.000	-0.002	0.000	-0.002	0.001	-0.002	0.001	-0.006
	(-0.002)	(-0.003)	(-0.002)	(-0.017)	(-0.002)	(-0.002)	(-0.002)	(-0.014)
Manufacturing								
	Dependent Variable: Employment							
Contemporaneous	-0.001	-0.006	-0.001	0.006	0	-0.006	-0.002	0.017
	(-0.006)	(-0.006)	(-0.005)	(-0.021)	(-0.005)	(-0.005)	(-0.004)	(-0.013)
Lagged	0.005	-0.001	0.002	0.026*	0.001	0.000	-0.001	0.015
	(-0.004)	(-0.005)	(-0.004)	(-0.013)	(-0.003)	(-0.004)	(-0.003)	(-0.013)
Future	0.000	0.001	0.001	0.004	0.001	0.002	0.002	0.006
	(-0.005)	(-0.007)	(-0.006)	(-0.010)	(-0.004)	(-0.005)	(-0.005)	(-0.009)
	Dependent Variable: Wages							
Contemporaneous	-0.001	-0.007	-0.003	0.012*	-0.001	-0.008	-0.003	0.012*
	(-0.005)	(-0.008)	(-0.005)	(-0.007)	(-0.005)	(-0.007)	(-0.005)	(-0.007)
Lagged	-0.002	-0.004	-0.004	0.005	-0.002	-0.003	-0.003	0.005
	(-0.003)	(-0.004)	(-0.004)	(-0.006)	(-0.003)	(-0.004)	(-0.004)	(-0.006)
Future	-0.003	0.001	-0.001	-0.005	-0.004	0.000	-0.002	-0.005
	(-0.004)	(-0.006)	(-0.005)	(-0.008)	(-0.004)	(-0.006)	(-0.005)	(-0.008)

Notes: In each section, column 1 is a condensed version of table 4.10, so it shows the impact of government spending using all firms in our sample set of 1059 firms. Column 2 reports results for a sample specification that excludes firms that supply both defence and non-defence goods and services, so excluding 383 firms. Column 3 reports results for sample specification excluding firms that supply only defence goods and services, excluding 93 firms. Column 4 presents results from table 4.18, so it shows the impact of government spending on firms that only supply defence goods and services to the government. See notes to table 4.10 and 4.11. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level.

Table 4.22: Medium–run effects of government spending – reduced–form regression of the impact of government spending

Dependent Variable:		Employment					Wages				
		All	Small	Small+Micro	Medium	Large	All	Small	Small+Micro	Medium	Large
GovSpend											
	Full Sample	0.019***	0.028***	0.031***	0.014***	0.018***	0.002	0.009	0.010*	0.002	-0.002
		(-0.003)	(-0.010)	(-0.010)	(-0.004)	(-0.004)	(-0.002)	(-0.006)	(-0.006)	(-0.002)	(-0.002)
	Services	0.021***	0.034***	0.036***	0.016***	0.019***	0.003*	0.011**	0.012**	0.004	-0.001
		(-0.003)	(-0.011)	(-0.012)	(-0.005)	(-0.005)	(-0.002)	(-0.006)	(-0.005)	(-0.003)	(-0.003)
	Manufacturing	0.009*	-0.004		0.006	0.015**	-0.001	-0.007		0.001	-0.002
		(-0.005)	(-0.025)		(-0.005)	(-0.006)	(-0.003)	(-0.015)		(-0.003)	(-0.007)

Notes: The table captures the different dimensions of how the full sample set could be split, meaning it shows firms of different sizes and operating in different sectors responding to government demand. Specification is $y_t = \beta X_{i,t} + \gamma g_{i,t} + \eta_t + \nu_i + \varepsilon_{i,t}$, Where y is the variable of interest such as employment, g captures government spending, X contains a vector of control variables, ν is the firm-specific fixed effect, and η is the year fixed effect. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level. There are no micro manufacturing firms. Only the estimated coefficients of government spending are reported.

Table 4.23: Medium–run effects of government spending – the impact of the size of government demand

	d10	d20	d30
Independent Variable	Dependent Variable: Employment		
Govspend	0.010***	0.016***	0.018***
	(-0.003)	(-0.003)	(-0.003)
Govspend x D	0.067***	0.091***	0.160***
	(-0.010)	(-0.020)	(-0.044)
	Dependent Variable: Wages		
Govspend	0.00	0.001	0.002
	(-0.002)	(-0.002)	(-0.002)
Govspend x D	0.017***	0.024**	-0.001
	(-0.005)	(-0.009)	(-0.024)

Notes: See notes to tables 4.15 and 4.22. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level.

Table 4.24: Medium–run effects of government spending – firms that supply only defence goods and services

	All	Services	Manufacturing	Medium	Large
Employment	0.007	-0.011	0.016	0.004	0.036
	(-0.011)	(-0.020)	(-0.012)	(-0.009)	(-0.031)
Wages	0.005	0.012	0.003	0.001	0.022
	(-0.006)	(-0.013)	(-0.006)	(-0.006)	(-0.014)

Notes: See Notes to table 4.22. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level.

Table 4.25: Medium–run effects of government spending – defence and non–defence government spending

	Baseline					Normalised by Total Assets				
	All	Services	Manu	Medium	Large	All	Services	Manu	Medium	Large
Employment										
Non-Defence	0.018***	0.024***	0.008	0.019*	0.018***	0.037***	0.049***	0.014	0.044*	0.033**
	(-0.006)	(-0.007)	(-0.010)	(-0.010)	(-0.007)	(-0.013)	(-0.016)	(-0.025)	(-0.025)	(-0.016)
Defence	0.010**	0.008	0.024**	0.01	0.008	0.016	0.01	0.052**	0.022	0.009
	(-0.005)	(-0.006)	(-0.009)	(-0.007)	(-0.007)	(-0.011)	(-0.014)	(-0.020)	(-0.016)	(-0.015)
Wages										
Non-Defence	0.004*	0.007**	-0.005	0.009*	0.00	0.007	0.015**	-0.014	0.020*	-0.002
	(-0.002)	(-0.003)	(-0.005)	(-0.005)	(-0.002)	(-0.005)	(-0.007)	(-0.012)	(-0.012)	(-0.005)
Defence	0.001	-0.002	0.011**	0.00	-0.001	0.00	-0.005	0.023**	0.001	-0.005
	(-0.002)	(-0.003)	(-0.004)	(-0.005)	(-0.003)	(-0.006)	(-0.007)	(-0.010)	(-0.011)	(-0.006)

Notes: Specification is $y_{i,t} = \beta_1 X_{i,t} + \gamma_1 NDg_{i,t} + \gamma_2 Dg_{i,t} + \eta_t + \nu_i + \varepsilon_{i,t}$, Where y is the variable of interest such as employment, NDg captures non-defence government spending, Dg captures defence government spending, X contains a vector of control variables, ν is the firm-specific fixed effect, and η is the year fixed effect. Baseline column results are estimated without normalising government spending, Total assets column are results estimated with government spending normalised by total assets. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level.

Table 4.26: Robustness – exclusion of wage variable from baseline specification

	Dependent Variable: Employment									
	Static					Dynamic				
Independent Variable	All	Small	Small+Micro	Medium	Large	All	Small	Small+Micro	Medium	Large
All										
Contemporaneous	0.014***	0.006	0.009	0.010**	0.017***	0.010***	0.002	0.005	0.008**	0.014***
	(-0.003)	(-0.011)	(-0.011)	(-0.004)	(-0.004)	(-0.002)	(-0.009)	(-0.009)	(-0.003)	(-0.003)
Lagged	0.010***	0.015*	0.013	0.008**	0.009**	0.002	0.006	0.005	0.003	0.000
	(-0.002)	(-0.008)	(-0.008)	(-0.003)	(-0.004)	(-0.002)	(-0.007)	(-0.007)	(-0.003)	(-0.003)
Future	0.008***	0.014*	0.012	0.010***	0.004	0.005**	0.007	0.005	0.009***	0.001
	(-0.003)	(-0.007)	(-0.007)	(-0.004)	(-0.005)	(-0.002)	(-0.007)	(-0.007)	(-0.003)	(-0.004)
Services										
Contemporaneous	(0.018***)	(0.020**)	(0.025**)	(0.009*)	(0.021***)	(0.013***)	(0.013)	(0.017*)	(0.006)	(0.017***)
	-0.003	-0.01	-0.01	-0.005	-0.004	-0.003	-0.009	-0.009	-0.005	-0.004
Lagged	(0.009***)	(0.009)	(0.006)	(0.007*)	(0.011**)	(0.001)	(0.000)	(-0.003)	(0.002)	(0.001)
	-0.003	-0.008	-0.008	-0.004	-0.005	-0.003	-0.007	-0.008	-0.004	-0.004
Future	(0.010***)	(0.013)	(0.009)	(0.015**)	(0.005)	(0.006**)	(0.006)	(0.002)	(0.012**)	(0.003)
	-0.004	-0.009	-0.009	-0.006	-0.006	-0.003	-0.007	-0.008	-0.005	-0.005
Manufacturing										
Contemporaneous	0	-0.026	-0.026	0.002	0.010*	0.001	-0.011	-0.011	0.005	0.002
	(-0.006)	(-0.028)	(-0.028)	(-0.006)	(-0.006)	(-0.005)	(-0.018)	(-0.018)	(-0.005)	(-0.005)
Lagged	0.006	0.02	0.02	0.003	0.006	0.002	0.027	0.027	0.002	0.000
	(-0.004)	(-0.018)	(-0.018)	(-0.005)	(-0.006)	(-0.004)	(-0.019)	(-0.019)	(-0.005)	(-0.004)
Future	0.001	0.019	0.019	-0.004	0.007	0.003	0.026*	0.026*	0	0.004
	(-0.005)	(-0.021)	(-0.021)	(-0.006)	(-0.014)	(-0.005)	(-0.013)	(-0.013)	(-0.004)	(-0.013)

Notes: See notes to tables 4.10 and 4.11, but the specification here excludes wages as a control variable. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level.

Table 4.27: Robustness – exclusion of future government spending from baseline specification – employment

	Dependent Variable: Employment									
	Static					Dynamic				
Independent Variable	All	Small	Small+Micro	Medium	Large	All	Small	Small+Micro	Medium	Large
All										
Contemporaneous	0.013***	0.011	0.014	0.010***	0.014***	0.010***	0.005	0.006	0.009***	0.011***
	(-0.003)	(-0.012)	(-0.012)	(-0.004)	(-0.004)	(-0.002)	(-0.008)	(-0.009)	(-0.003)	(-0.003)
Lagged	0.009***	0.013	0.011	0.009***	0.007**	0.002	0.001	0.001	0.003	0.000
	(-0.002)	(-0.008)	(-0.008)	(-0.003)	(-0.003)	(-0.002)	(-0.007)	(-0.007)	(-0.003)	(-0.003)
Services										
Contemporaneous	(0.017***)	(0.029***)	(0.032***)	(0.010**)	(0.017***)	(0.014***)	(0.019**)	(0.022***)	(0.008**)	(0.015***)
	-0.003	-0.01	-0.01	-0.005	-0.004	-0.003	-0.008	-0.008	-0.004	-0.004
Lagged	(0.010***)	(0.007)	(0.006)	(0.009**)	(0.009***)	(0.001)	(-0.003)	(-0.005)	(0.003)	(0.000)
	-0.003	-0.008	-0.007	-0.004	-0.004	-0.002	-0.007	-0.007	-0.004	-0.003
Manufacturing										
Contemporaneous	-0.001	-0.026	-0.026	0.003	0.01	0.000	-0.015	-0.015	0.006	0.002
	(-0.006)	(-0.028)	(-0.028)	(-0.005)	(-0.007)	(-0.005)	(-0.019)	(-0.019)	(-0.005)	(-0.006)
Lagged	0.005	0.017	0.017	0.006	0.004	0.001	0.017	0.017	0.003	0.001
	(-0.004)	(-0.021)	(-0.021)	(-0.005)	(-0.005)	(-0.003)	(-0.023)	(-0.023)	(-0.004)	(-0.005)

Notes: See notes to tables 4.10 and 4.11, but the specification here excludes wages as a control variable. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level.

Table 4.28: Robustness – exclusion of future government spending from baseline specification – wages

	Dependent Variable: Wages									
	Static					Dynamic				
Independent Variable	All	Small	Small+Micro	Medium	Large	All	Small	Small+Micro	Medium	Large
All										
Contemporaneous	0.002	0.01	0.009	0.002	0.001	0.003	0.008	0.008	0.003	0.001
	(-0.002)	(-0.007)	(-0.007)	(-0.002)	(-0.003)	(-0.002)	(-0.007)	(-0.007)	(-0.002)	(-0.003)
Lagged	0.002	0.000	0.000	0.004	0.001	0.001	-0.002	-0.001	0.003	0.001
	(-0.002)	(-0.006)	(-0.006)	(-0.002)	(-0.002)	(-0.002)	(-0.006)	(-0.005)	(-0.002)	(-0.002)
Services										
Contemporaneous	0.004*	0.018**	0.019***	0.002	0.002	0.004**	0.018***	0.018***	0.003	0.003
	(-0.002)	(-0.007)	(-0.007)	(-0.003)	(-0.003)	(-0.002)	(-0.007)	(-0.007)	(-0.003)	(-0.003)
Lagged	0.003	0.004	0.005	0.005	0.001	0.002	0.002	0.003	0.004	0.000
	(-0.002)	(-0.007)	(-0.007)	(-0.003)	(-0.002)	(-0.002)	(-0.007)	(-0.007)	(-0.003)	(-0.002)
Manufacturing										
Contemporaneous	-0.001	-0.011	-0.011	0.004	0.001	-0.001	-0.012	-0.012	0.004	0.001
	(-0.005)	(-0.019)	(-0.019)	(-0.003)	(-0.009)	(-0.005)	(-0.019)	(-0.019)	(-0.003)	(-0.008)
Lagged	-0.002	-0.033	-0.033	0.005	0.001	-0.002	-0.030	-0.03	0.004	0.002
	(-0.003)	(-0.021)	(-0.021)	(-0.004)	(-0.004)	(-0.003)	(-0.019)	(-0.019)	(-0.004)	(-0.003)

Notes: See notes to tables 4.10 and 4.11, but the specification here excludes future government spending. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level.

Table 4.29: Robustness – effect of normalising government spending from baseline specification – static model

	All			Service			Manufacturing		
	Baseline	TA	TU	Baseline	TA	TU	Baseline	TA	TU
Employment									
Contemporaneous	0.013***	0.011***	0.011***	0.016***	0.015***	0.015***	-0.001	-0.002	-0.002
	(-0.003)	(-0.003)	(-0.003)	(-0.003)	(-0.003)	(-0.003)	(-0.006)	(-0.006)	(-0.006)
Lagged	0.010***	0.009***	0.009***	0.010***	0.010***	0.010***	0.005	0.004	0.003
	(-0.002)	(-0.002)	(-0.002)	(-0.003)	(-0.003)	(-0.003)	(-0.004)	(-0.004)	(-0.004)
Future	0.006**	0.006**	0.007**	0.008**	0.007**	0.009**	0.000	0.002	0.001
	(-0.003)	(-0.002)	(-0.003)	(-0.003)	(-0.003)	(-0.003)	(-0.005)	(-0.005)	(-0.005)
Wages									
Contemporaneous	0.002	0.002	0.002	0.004*	0.003	0.003	-0.001	-0.001	-0.001
	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.005)	(-0.005)	(-0.005)
Lagged	0.001	0.002	0.002	0.003	0.003	0.003	-0.002	-0.002	-0.002
	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.003)	(-0.003)	(-0.003)
Future	-0.001	-0.001	-0.001	0.000	0.000	0.000	-0.003	-0.003	-0.003
	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.004)	(-0.004)	(-0.004)

Notes: See notes to tables 4.10. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level. Baseline column results are estimated without normalising government spending, TA column are results estimated with government spending normalised by total assets, while in the TU column, government spending is normalised by turnover.

Table 4.30: Robustness – effect of normalising government spending from baseline specification – dynamic model

	All			Service			Manufacturing		
	Baseline	TA	TU	Baseline	TA	TU	Baseline	TA	TU
Employment									
Contemporaneous	0.010***	0.009***	0.009***	0.013***	0.011***	0.011***	0.000	-0.001	-0.001
	(-0.002)	(-0.002)	(-0.002)	(-0.003)	(-0.003)	(-0.003)	(-0.005)	(-0.005)	(-0.005)
Lagged	0.002	0.003	0.003	0.002	0.002	0.002	0.001	0.002	0.001
	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.003)	(-0.003)	(-0.003)	(-0.003)	(-0.003)
Future	0.004*	0.004	0.004*	0.005**	0.005*	0.006**	0.001	0.002	0.001
	(-0.002)	(-0.002)	(-0.002)	(-0.003)	(-0.003)	(-0.003)	(-0.004)	(-0.004)	(-0.004)
Wages									
Contemporaneous	0.003	0.002	0.002	0.004**	0.003	0.003	-0.001	-0.001	-0.001
	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.005)	(-0.005)	(-0.005)
Lagged	0.001	0.001	0.001	0.002	0.002	0.002	-0.002	-0.002	-0.002
	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.003)	(-0.003)	(-0.003)
Future	-0.001	-0.001	-0.001	0.001	0.001	0.001	-0.004	-0.004	-0.003
	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.004)	(-0.004)	(-0.004)

Notes: See notes to table 4.11. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level. Baseline column results are estimated without normalising government spending, TA column are results estimated with government spending normalised by total assets, while in the TU column government spending is normalised by turnover.

Table 4.31: Robustness – effect of normalising government spending – defence and non–defence supplying firms – static model

	All			Service			Manufacturing		
	Baseline	TA	TU	Baseline	TA	TU	Baseline	TA	TU
Employment									
NonDef_Govspend									
Contemporaneous	0.013***	0.026**	0.026***	0.014***	0.028***	0.028***	0.001	-0.004	-0.003
	(-0.004)	(-0.010)	(-0.010)	(-0.004)	(-0.010)	(-0.010)	(-0.010)	(-0.024)	(-0.024)
Lagged	0.013**	0.030**	0.030**	0.017**	0.039**	0.039**	0.012	0.025	0.024
	(-0.006)	(-0.014)	(-0.014)	(-0.007)	(-0.017)	(-0.017)	(-0.008)	(-0.018)	(-0.019)
Future	-0.006	-0.015	-0.015	-0.011	-0.027	-0.026	0.007	0.019	0.015
	(-0.007)	(-0.016)	(-0.017)	(-0.010)	(-0.022)	(-0.023)	(-0.012)	(-0.028)	(-0.027)
Def_Govspend									
Contemporaneous	0.008	0.012	0.013	0.011	0.018	0.018	0.005	0.008	0.009
	(-0.006)	(-0.014)	(-0.014)	(-0.009)	(-0.020)	(-0.020)	(-0.005)	(-0.012)	(-0.011)
Lagged	0.003	0.006	0.006	0.003	0.005	0.005	0.009	0.020	0.018
	(-0.005)	(-0.012)	(-0.011)	(-0.005)	(-0.011)	(-0.011)	(-0.015)	(-0.036)	(-0.036)
Future	0.002	0.004	0.005	0.001	0.000	0.001	0.012*	0.031**	0.030**
	(-0.004)	(-0.009)	(-0.009)	(-0.005)	(-0.012)	(-0.012)	(-0.006)	(-0.015)	(-0.015)
Wages									
NonDef_Govspend									
Contemporaneous	0.003	0.005	0.004	0.006*	0.013	0.013	-0.009	-0.022	-0.023*
	(-0.003)	(-0.007)	(-0.007)	(-0.004)	(-0.008)	(-0.008)	(-0.005)	(-0.013)	(-0.013)
Lagged	0.003	0.008	0.008	0.004	0.011	0.011	0.002	0.004	0.004
	(-0.004)	(-0.009)	(-0.009)	(-0.004)	(-0.010)	(-0.010)	(-0.010)	(-0.024)	(-0.024)
Future	-0.006	-0.016	-0.014	-0.009	-0.023	-0.021	0.000	-0.003	0.001
	(-0.006)	(-0.012)	(-0.013)	(-0.008)	(-0.019)	(-0.019)	(-0.007)	(-0.016)	(-0.016)
Def_Govspend									
Contemporaneous	-0.001	-0.004	-0.004	-0.003	-0.009	-0.009	0.007**	0.015*	0.014*
	(-0.003)	(-0.007)	(-0.007)	(-0.004)	(-0.009)	(-0.009)	(-0.004)	(-0.009)	(-0.008)
Lagged	0.001	0.003	0.003	0.002	0.005	0.005	0.007	0.017	0.017
	(-0.003)	(-0.008)	(-0.008)	(-0.004)	(-0.008)	(-0.008)	(-0.011)	(-0.026)	(-0.025)
Future	0.002	0.004	0.005	0.002	0.003	0.004	0.009**	0.019*	0.022**
	(-0.004)	(-0.009)	(-0.009)	(-0.006)	(-0.013)	(-0.013)	(-0.004)	(-0.010)	(-0.010)

Notes: See notes to tables 4.19 and 4.20. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level. Baseline column results are estimated without normalising government spending, TA column are results estimated with government spending normalised by total assets, while in the TU column, government spending is normalised by turnover.

Table 4.32: Robustness – effect of normalising government spending – defence and non–defence supplying firms – dynamic model

	All			Service			Manufacturing		
	Baseline	TA	TU	Baseline	TA	TU	Baseline	TA	TU
Employment									
Non-Defence Govspend									
Contemporaneous	0.010***	0.019**	0.019**	0.012***	0.023**	0.023**	0.003	0.004	0.004
	(-0.004)	(-0.008)	(-0.008)	(-0.004)	(-0.009)	(-0.010)	(-0.008)	(-0.018)	(-0.019)
Lagged	0.006	0.016	0.016	0.006	0.016	0.016	0.014*	0.032*	0.031*
	(-0.004)	(-0.010)	(-0.010)	(-0.005)	(-0.012)	(-0.012)	(-0.007)	(-0.016)	(-0.016)
Future	-0.005	-0.014	-0.013	-0.008	-0.022	-0.021	0.002	0.008	0.005
	(-0.006)	(-0.013)	(-0.014)	(-0.008)	(-0.018)	(-0.019)	(-0.011)	(-0.024)	(-0.024)
Defence Govspend									
Contemporaneous	0.004	0.004	0.004	0.006	0.007	0.007	0.003	0.003	0.003
	(-0.005)	(-0.011)	(-0.011)	(-0.006)	(-0.015)	(-0.015)	(-0.004)	(-0.009)	(-0.010)
Lagged	0.001	0.003	0.003	0.002	0.005	0.005	-0.002	-0.003	-0.005
	(-0.004)	(-0.011)	(-0.011)	(-0.004)	(-0.009)	(-0.009)	(-0.014)	(-0.032)	(-0.032)
Future	0.001	0.002	0.002	-0.002	-0.006	-0.006	0.012*	0.029**	0.028*
	(-0.004)	(-0.008)	(-0.008)	(-0.005)	(-0.011)	(-0.011)	(-0.006)	(-0.014)	(-0.014)
Wages									
Non-Defence Govspend									
Contemporaneous	0.004	0.008	0.008	0.008**	0.017*	0.017*	-0.007	-0.017	-0.019
	(-0.003)	(-0.008)	(-0.008)	(-0.004)	(-0.009)	(-0.009)	(-0.005)	(-0.013)	(-0.013)
Lagged	0.002	0.005	0.005	0.002	0.006	0.006	0.002	0.004	0.004
	(-0.004)	(-0.008)	(-0.008)	(-0.004)	(-0.009)	(-0.009)	(-0.010)	(-0.023)	(-0.023)
Future	-0.006	-0.015	-0.013	-0.007	-0.019	-0.017	-0.002	-0.008	-0.003
	(-0.005)	(-0.011)	(-0.011)	(-0.007)	(-0.016)	(-0.016)	(-0.007)	(-0.015)	(-0.015)
Defence Govspend									
Contemporaneous	-0.001	-0.003	-0.003	-0.003	-0.008	-0.008	0.007*	0.014	0.013
	(-0.003)	(-0.007)	(-0.007)	(-0.004)	(-0.009)	(-0.009)	(-0.004)	(-0.009)	(-0.009)
Lagged	0.001	0.003	0.003	0.002	0.005	0.005	0.006	0.014	0.015
	(-0.003)	(-0.008)	(-0.008)	(-0.003)	(-0.008)	(-0.008)	(-0.011)	(-0.025)	(-0.025)
Future	0.002	0.002	0.004	0.000	0.000	0.001	0.009**	0.019*	0.022**
	(-0.004)	(-0.009)	(-0.009)	(-0.005)	(-0.012)	(-0.012)	(-0.004)	(-0.010)	(-0.010)

Notes: See notes to tables 4.19 and 4.20. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level. Baseline column results are estimated without normalising government spending, TA column are results estimated with government spending normalised by total assets, while in the TU column, government spending is normalised by turnover.

Table 4.33: Effect of normalising government spending from baseline specification – medium–run effects of government spending

	All			Service			Manufacturing		
	Baseline	TA	TU	Baseline	TA	TU	Baseline	TA	TU
Employment									
All	0.019***	0.016***	0.016***	0.021***	0.018***	0.018***	0.009*	0.006	0.006
	(-0.003)	(-0.003)	(-0.003)	(-0.003)	(-0.003)	(-0.003)	(-0.005)	(-0.005)	(-0.005)
Small	0.028***	0.027**	0.027**	0.034***	0.033***	0.033***	-0.004	-0.009	-0.009
	(-0.010)	(-0.011)	(-0.011)	(-0.011)	(-0.012)	(-0.012)	(-0.025)	(-0.026)	(-0.026)
Small+Micro	0.031***	0.029***	0.029***	0.036***	0.035***	0.035***	-0.004	-0.009	-0.009
	(-0.010)	(-0.011)	(-0.011)	(-0.012)	(-0.012)	(-0.012)	(-0.025)	(-0.026)	(-0.026)
Medium	0.014***	0.012***	0.012***	0.016***	0.014***	0.014***	0.006	0.003	0.003
	(-0.004)	(-0.004)	(-0.004)	(-0.005)	(-0.005)	(-0.005)	(-0.005)	(-0.006)	(-0.006)
Large	0.018***	0.014***	0.014***	0.019***	0.015***	0.015***	0.015**	0.013**	0.013**
	(-0.004)	(-0.004)	(-0.004)	(-0.005)	(-0.005)	(-0.005)	(-0.006)	(-0.006)	(-0.006)
Wages									
All	0.002	0.001	0.001	0.003*	0.002	0.002	-0.001	-0.002	-0.002
	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.003)	(-0.003)	(-0.003)
Small	0.009	0.009	0.009	0.011**	0.011*	0.011*	-0.007	-0.007	-0.007
	(-0.006)	(-0.006)	(-0.006)	(-0.006)	(-0.006)	(-0.006)	(-0.015)	(-0.015)	(-0.015)
Small+Micro	0.010*	0.010	0.010	0.012**	0.011*	0.011*	-0.007	-0.007	-0.007
	(-0.006)	(-0.006)	(-0.006)	(-0.005)	(-0.006)	(-0.006)	(-0.015)	(-0.015)	(-0.015)
Medium	0.002	0.001	0.001	0.004	0.003	0.003	0.001	0.000	0.000
	(-0.002)	(-0.002)	(-0.002)	(-0.003)	(-0.003)	(-0.003)	(-0.003)	(-0.004)	(-0.004)
Large	-0.002	-0.003	-0.003	-0.001	-0.003	-0.003	-0.002	-0.003	-0.003
	(-0.002)	(-0.002)	(-0.002)	(-0.003)	(-0.003)	(-0.003)	(-0.007)	(-0.007)	(-0.007)

Notes: See notes to table 4.22. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level. Baseline column results are estimated without normalising government spending, TA column are results estimated with government spending normalised by total assets, while in the TU column, government spending is normalised by turnover.

Table 4.34: Unit root test results

Variables	Harris–Tzavalis	Im–Pesaran–Shin
Employment	-0.907	10.425
	(0.182)	(1.000)
Wages	-30.483***	-4.375***
	(0.000)	(0.000)
Govspend	-26.748***	-3.173***
	(0.000)	(0.001)
Private Demand	-21.151***	5.59
	(0.000)	(1.000)
Capacity	-27.907***	-0.673
	(0.000)	(0.250)

Notes: Table displays test statistics, with p-values in brackets. *** indicate significance at 1%, meaning we reject the null hypothesis of a unit root.

Table 4.35: Robustness – empirical approach, fixed effects compared to maximum likelihood

	Employment			Wages		
	FIS	FID	ML	FIS	FID	ML
All	0.019***	0.010***	0.008***	0.002	0.002	0.003*
	(-0.003)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)
Services	0.021***	0.010***	0.008***	0.003*	0.003*	0.004**
	(-0.003)	(-0.003)	(-0.002)	(-0.002)	(-0.002)	(-0.002)
Manu	0.009*	0.005	0.005	-0.001	-0.001	0
	(-0.005)	(-0.004)	(-0.004)	(-0.003)	(-0.004)	(-0.003)
Small+Micro	0.031***	0.011	0.007	0.010*	0.010*	0.009*
	(-0.010)	(-0.007)	(-0.006)	(-0.006)	(-0.006)	(-0.005)
Small	0.028***	0.01	0.005	0.009	0.009	0.008*
	(-0.010)	(-0.007)	(-0.006)	(-0.006)	(-0.006)	(-0.005)
Medium	0.014***	0.009***	0.008***	0.002	0.002	0.004
	(-0.004)	(-0.003)	(-0.003)	(-0.002)	(-0.002)	(-0.002)
Large	0.018***	0.006*	0.003	-0.002	-0.002	-0.001
	(-0.004)	(-0.004)	(-0.003)	(-0.002)	(-0.003)	(-0.002)

Notes: FIS presents results from a static fixed effect model, FID a dynamic fixed model, and ML captures result from the maximum likelihood approach. See notes to table 4.22 for model specification for FIS. For FID and ML, specification is $y_{i,t} = y_{t-1} + \beta X_{i,t} + \gamma g_{i,t} + \eta_t + \nu_i + \varepsilon_{i,t}$, Where y is the variable of interest such as employment, g captures government spending, X contains a vector of control variables, ν is the firm-specific fixed effect, and η is the year fixed effect.. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level. The table shows results for the full sample and subsamples. Only the estimated coefficients of government spending are reported.

Table 4.36: Robustness – empirical approach, fixed effects compared to maximum likelihood estimation: accounting for government demand size

		Employment			Wages		
		FIS	FID	ML	FIS	FID	ML
d10							
	Gov-spend	0.010***	0.005**	0.004**	0	-0.001	0
		(-0.003)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)
	Gov-spend x D	0.067***	0.034***	0.027***	0.017***	0.022***	0.022***
		(-0.010)	(-0.007)	(-0.006)	(-0.005)	(-0.005)	(-0.005)
d20							
	Gov-spend	0.016***	0.008***	0.006***	0.001	0.001	0.002
		(-0.003)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)
	Gov-spend x D	0.091***	0.060***	0.052***	0.024**	0.030**	0.028***
		(-0.020)	(-0.017)	(-0.013)	(-0.009)	(-0.012)	(-0.010)
d30							
	Gov-spend	0.018***	0.009***	0.007***	0.002	0.002	0.003*
		(-0.003)	(-0.002)	(-0.002)	(-0.002)	(-0.002)	(-0.002)
	Gov-spend x D	0.160***	0.097***	0.083***	-0.001	0.018	0.023
		(-0.044)	(-0.035)	(-0.023)	(-0.024)	(-0.022)	(-0.018)

Notes: FIS presents results from a static fixed effect model, FID a dynamic fixed model, and ML captures results from the maximum likelihood approach. See notes for tables 4.15, 4.22, and 4.35 for model specifications. All standard errors in parenthesis are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level.

Table 4.37: Robustness – empirical approach, fixed effects compared to maximum likelihood estimation: defence and non–defence firms

	Employment			Wages		
Independent Variable	FIS	FID	ML	FIS	FID	ML
All						
Non-Defence	0.018***	0.009**	0.008**	0.004*	0.001	0.002
	(-0.006)	(-0.004)	(-0.004)	(-0.002)	(-0.003)	(-0.003)
Defence	0.010**	0.003	0.003	0.001	0.000	0.000
	(-0.005)	(-0.004)	(-0.003)	(-0.002)	(-0.002)	(-0.003)
Services						
Non-Defence	0.024***	0.012**	0.010**	0.007**	0.003	0.004
	(-0.007)	(-0.005)	(-0.004)	(-0.003)	(-0.003)	(-0.004)
Defence	0.008	0.001	0.001	-0.002	-0.003	-0.004
	(-0.006)	(-0.005)	(-0.004)	(-0.003)	(-0.003)	(-0.004)
Manufacturing						
Non-Defence	0.008	0.003	0.001	-0.005	-0.01	-0.005
	(-0.010)	(-0.008)	(-0.009)	(-0.005)	(-0.007)	(-0.006)
Defence	0.024**	0.012	0.008	0.011**	0.010**	0.009*
	(-0.009)	(-0.007)	(-0.007)	(-0.004)	(-0.004)	(-0.005)
Large						
Non-Defence	(0.018***)	(0.007)	(0.005)	(0.000)	(0.000)	(-0.001)
	-0.007	-0.004	-0.004	-0.002	-0.002	-0.003
Defence	(0.008)	(0.002)	(0.001)	(-0.001)	(-0.001)	(-0.001)
	-0.007	-0.005	-0.004	-0.003	-0.002	-0.003
Medium						
Non-Defence	0.019*	0.013*	0.009	0.009*	0.003	0.006
	(-0.010)	(-0.008)	(-0.006)	(-0.005)	(-0.006)	(-0.006)
Defence	0.010	0.002	-0.001	0.000	0.000	-0.001
	(-0.007)	(-0.006)	(-0.005)	(-0.005)	(-0.005)	(-0.006)

Notes: FIS presents results from a static fixed effect model, FID a dynamic fixed model, and ML captures result from the maximum likelihood approach. See notes for tables 4.19, 4.20, 4.22, and 4.35 for model specifications. All standard errors in parentheses are clustered at the firm level to correct for correlation between error terms. *** indicates significance at 1%, ** at 5%, and * at 10% level.

Appendix C4: Summary statistics and tables of results

Table 4.38: Chapter four: description of variables and sources

Variable	Description	Sources
Central government expenditure (at firm level)	Government spending captures the amount spent on goods and services for each firm.	Crown Commercial Service (CCS)
Turnover	This measures the total sale of goods and services by a firm	FAME database, Bureau van Dijk (BvD)
Number of employees	The total number of employees per firm	FAME database, BvD
Wages and salaries	Total wage bill of a firm	FAME database, BvD
Total assets	Total asset includes both fixed and current assets, including intangible assets	FAME database, BvD
Capacity utilisation	Capacity utilisation is defined as turnover divided by total assets	Calculation, BvD
Private demand	Private demand is defined as turnover minus government spend	Calculation, BvD and CCS
Wages per employee	Wages is defined as the average wage per employee, where the total wage bill is divided by total number of employees	Calulation, BvD

General Conclusions

The present study investigates the impact of government spending on economic activity. Arranged over four chapters, the first chapter reviewed the theoretical and empirical literature, while the three contribution chapters are empirical investigations focused on the UK economy. Moving beyond aggregate government spending and aggregate effects, the contribution chapters investigate the disaggregated effects of disaggregated government spending, with distinction made at sectoral, industry and firm size levels. In addition, the importance of government demand size is examined.

What are the main lessons to extract from this study? First, the lack of general consensus in the theoretical literature on the short-run effects of government spending seems unresolvable at present. This is because the short-run effect of government spending is very much dependent on the adopted macroeconomic perspective. While there was a sense of general agreement on the major route with which crowding out could occur (interest rates) in the early debate, such agreement is not present in recent contributions as the *Ricardian equivalence* is not accepted by all. Nonetheless, as recent contributions have shown, when there is general acceptance of prerequisites, such as an accommodative monetary authority and slack in the economy, then government spending can be effective in stimulating the economy. Second, while there is still no consensus in the empirical literature on the size of the effect (i.e. the size of the government spending multiplier), there is a growing acceptance that the size is 'context-dependent', with context not just taking into account the state of the economy and monetary policy stance, but also the structural characteristics of the economy in question and sign of fiscal impulse. In addition, the ongoing debate on the differences in results obtained when using defence or non-defence spending instruments suggests more research is needed to understand the underlying characteristics of both instruments. Developments in the identification debate suggest accounting for the sign, size, distribution and timing of fiscal shock is quite important in the estimation of robust multipliers. Third, leakages have an important role to play in the multiplier process, and as shown in chapter two, accounting appropriately for imports in sectoral government spending has important implications for the multiplier size. Differentiating between government spending on durable goods, nondurable goods, and services in a simple income and expenditure model, the multiplier for services is necessarily larger due to lower import content compared to goods. For the period considered, the multiplier for service expenditure is always above one, but the multipliers for goods can be about or below one, with the multiplier for durable goods lowest of all three expenditure types. Fourth, there is heterogeneity in the industry effects of government spending, with this heterogeneity correlated to imports and the proportion of industry output consumed by the government. These results have implications for the output multiplier effects of government spending as they confirm a held view that aggregated effects are not necessarily replicated across industries. By assessing the aggregate output multiplier implications of this heterogeneity using a simple input-output model, the story of the government spending multiplier becomes one that not only needs to take into account the input-output linkages in the economy, but also the initial responses of industries. Fifth, the impact of government spending on employment and wages varies not only by industry sector, but also by firm size. For employment, the impact of government spending is about five times larger when government demand makes up at least 10% of total demand, while the impact on wages becomes significantly positive, especially for contemporaneous government spending. In addition, results presented in chapter four seem to suggest that the use of defence spending due to its argued exogenous quality to investigate the impact of government spending on employment might need to be reconsidered, especially in the case of the UK. This conclusion is driven by two results: i) defence spending had no statistically significant impact on the employment of firms that supply only defence goods and services, while there was a positive impact when all government spending is considered, suggesting defence spending might not be an appropriate government spending instrument to capture employment elasticities that are not biased downwards; and ii) the results presented for firms that supply both defence and non-defence goods showed that non-defence spending had a positive impact on employment, while defence spending had a statistically insignificant impact, highlighting the need for further investigation into what defence spending really captures, how it is different from non-defence spending, and how this ultimately translates into the impact we can expect it to have on the economy. The results for wages are too mixed to provide a concise conclusion on defence spending being a good instrument for exploring the impact of government spending on wages.

The general conclusion reached by the thesis is that not only is what the government buys important, but the size of government demand is also a key factor in the multiplier effect of government spending for the UK.

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