Three essays on open-economy Stock-Flow Consistent Models

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"The more I studied economic science, the smaller appeared the knowledge that I had of it,
in proportion to the knowledge that I needed;
and now, at the end of nearly half a century of almost excursively study of it, I am conscious of more ignorance of it than I was at the beginning of the study"
Alfred Marshall
(quoted in Keynes, Essays in Biography, 1933)

ABSTRACT

This thesis is focused on open-economy Stock-Flow Consistent (SFC) models, following the methodology pioneered by the American economist James Tobin (1918-2002) and the British economist Wynne Godley (1926-2010).

In order to justify the choice of this approach, the first chapter presents a summary of the debate on the 'state of macro' as it developed after the financial crisis of 2007-2008. It also provides some arguments on why Stock-Flow Consistent models have emerged in recent years as a credible and relatively popular alternative to 'mainstream' Dynamic Stochastic General Equilibrium (DSGE) models.

Chapters 2, 3 and 4 of the thesis cover the following topics: 1) A comparison between a benchmark 'mainstream' open economy model and a 'standard' SFC open economy model; 2) The mathematical demonstration of a new condition that should hold to have an improvement of the trade balance following a depreciation of the currency. It is argued that the classical Marshall-Lerner condition cannot be considered a 'useful approximation' in the context of SFC open economy models; 3) The explanation of the 'paradox of sticky prices' in SFC open economy models, for which the lower is sensitivity of prices to change in exchange rates, the higher is the speed of adjustment to negative shocks of external position; 4) A review of the most recent developments of the SFC literature, with particular attention to open economy SFC models; 5) The presentation of two original SFC two-country models. The first is used to test the implications of productivity equations inspired by the so-called Verdoorn-Kaldor law (Verdoorn 1949, 1980, Kaldor 1966). The second introduces a new 'closure' for the flexible exchange rate regime based on a pure 'balance of payment approach' and a double redundant equation. The new 'closure' is combined with a more advanced representation of the financial system and emulative behaviours inspired by the 'relative income' hypothesis of Duesenberry (1949). Then the model is employed to study the relationship between financialization and distributional issues within a SFC open-economy framework.

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INTRODUCTION: WHAT IS THIS THESIS ABOUT

In a recent interview in *The Economist*, Emi Nakamura – the 2019 winner of the Clark medal – rejected the idea that the years of the financial crisis were a bad time to start a PhD in economics (like joining the cavalry in 1914, according to the British magazine): “I think it was a good time”, she replied, “macroeconomics is a countercyclical field” (*The Economist,* May 2nd 2019, p.71).

Indeed, as Olivier Blanchard pointed out when he was still the chief economist of the International Monetary Fund, the crisis has been “a traumatic event during which we all had to question many cherished beliefs” (Blanchard 2015).

This has not resulted in a ‘paradigm shift’ similar to the one that occurred after the Great Depression in the Thirties, when the publication of the “General Theory” by Keynes turned upside down the world of economics and paved the way for a long-lasting ‘new consensus’ within the discipline. Still, it seems fair to say that macroeconomics is less ‘monolithic’ today than it used to be just before the financial crisis of 2007-2008.

This PhD thesis tries to value one of the lessons it is possible to draw from the financial crisis. As Joseph Stiglitz has observed “not only didn’t the [‘mainstream’ DSGE, Dynamic Stochastic General Equilibrium] model fail to predict the crisis, it effectively said that it could not happen. Under the core hypothesis (rational expectation, exogenous shocks), a crisis of that form and magnitude simply couldn’t occur” (Stiglitz 2018, p. 76). Economics could benefit from a more pluralistic theoretical environment. That is why the thesis is focused on one of the several, promising strands of research that in recent years have attempted to put forward alternative ways to develop macroeconomic models, namely the Stock-Flow Consistent (SFC) models pioneered by James Tobin and Wynne Godley.

The first chapter is dedicated to the contemporary debate about the ‘state of macro’. The evolution of the ‘mainstream’ approach is outlined via a ‘benchmark’ of the new generation of DSGE models (Lindé, Smets and Wouters 2016). This part also recapitulates the stance of those scholars who think that “there is simply no credible alternative” to DSGE in macro modelling (Christiano, Eichenbaum and Trabandt 2018, p. 136).

Then the focus is shifted to a variety of projects of 'reform' of the discipline of macroeconomics, including the ones championed by academics who think that "providing new clothes to the Naked Emperor of mainstream economics won't do; the Emperor needs to be dethroned" (Lavoie 2016).

Indeed, Stock-Flow Consistent models are part of a broader 'movement' for the renewal of economic thinking based on the Keynesian tradition. Three elements can give a first, general idea of their strengths:

1) They provide a rigorous accounting framework which sets a 'logical constraint' for every transaction and ensure the consistency of the relationships between flows and stocks ("Everything comes from somewhere and everything goes somewhere", Godley and Lavoie 2007 b, p. XXXIV);
2) Whereas mainstream DSGE models had almost neglected the financial sector until very recently, SFC models are structurally based on the integration of the real and financial sides of the economy. Numerous assets and liabilities of different sectors are usually included in SFC models. The interactions between financial stocks of wealth (even negative wealth, such as debts) and the economic variables of flows offer a more realistic representation of the dynamics of contemporary economies involved in complex processes of financialization.
3) SFC modellers have provided a persuasive analysis of the fragility of the US economy (Godley 1999, Godley and Wray 2000, Godley, Papadimitriou, Hannsgen and Zezza 2007) and of the euro area (Godley and Lavoie 2007 a) well before those fragilities were exposed by the sub-prime financial crisis (in the US) and the sovereign debt crisis (in the EU). This is one of the reasons for the growing popularity of the SFC methodology even beyond the academia (see, for instance, the empirical model for the UK built by a group of academics and economists of the Bank of England: Burgess, Burrows, Godin, Kinsella, Millard 2016).

Concerning the last point, it is not actually possible to understand the weakness of the American model of growth in the era of the Great Moderation preceding the financial crisis of 2007/2008 without taking into consideration the increasing negative *external* position of the United States since the beginning of the Nineties. Likewise, the crisis that in Europe has challenged the survival of the single currency is profoundly related with the *trade imbalances* within the eurozone and the lack of readjustment mechanisms as a continental fiscal policy or the mutualisation of the public debt.

The acknowledgement of the importance of studying an economy not as a self-contained entity, but as a system profoundly affected by its interchanges with the external world, is behind the choice of this PhD thesis to concentrate on open economy models. Hence the title: "Three essays on open-economy Stock-Flow Consistent models".

In particular, chapters 2, 3 and 4 cover the following topics:

1) A comparison between the basic assumptions, the principles, the 'physiology' and the political implications of the benchmark 'mainstream' open economy model and the 'standard' SFC open economy model (Chapter 2).
2) An assessment of the classical Marshall-Lerner condition in the context of the 'standard' SFC model. It is argued that the condition cannot be regarded as an acceptable approximation any more. The mathematical demonstration of a new condition is then developed. The latter is consistent with an incomplete pass-through of changes in the exchange rate to import and export prices. Furthermore, it is shown the paradox of the 'stabilizing function' of sticky prices that characterises SFC open economy models where an incomplete pass-through mechanism is assumed (Chapter 2).
3) A review of the most recent developments of the SFC literature, with particular attention to open economy SFC models (Chapter 3).
4) The presentation of a new two-country open economy model (OPENPROD model) characterized by a different price structure with respect to the 'standard' open economy SFC model. The model is used to test the implications of productivity equations inspired by the so-called Verdoorn-Kaldor law (Verdoorn 1949, 1980, Kaldor 1966).

   Productivity – the 'productivity conundrum' – is at the centre of many contemporary economic debates. However, in the background of these discussions, there is often a more comprehensive vision of how an economic system works and which are the better policies to boost growth and address structural imbalances between economies and countries (especially in the euro area). Many scholars and policy makers have stressed the importance of improvements in productivity which would make the production systems more competitive. These improvements could be achieved via the 'liberalization' of labour markets and the corrective power of competition among workers that would follow. On the other side of the dispute, there have been those researchers who have pointed out that the disappointing trajectory of productivity in many advanced countries could be the *product* of struggling economies, rather than the *cause* of the crisis and the *vindication* of austerity measures. The OPENPROD model puts forward further arguments in support of this second interpretation of the productivity conundrum. (Chapter 3).

5) The construction of an alternative 'closure' for the flexible exchange rate regime based on a pure 'balance of payment approach' and a double redundant equation (OPENSIME model). In comparison to the closure of the 'standard' model, the new one offers a more transparent explanation behind the dynamics of the exchange rate and make the model more flexible and able to incorporate additional building blocks. (Chapter 4).

6) An application of the new closure (see point 5 above) to a more complex structure (the OPENTWOFOUR model) which includes two groups of households for each country (rich and poor), a more advanced representation of the financial system and equations accounting for emulative behaviours and the 'relative income' hypothesis (Duesenberry 1949). The OPENTWOFOUR model is then used to test the effects of different 'emulative regimes' and changes in the primary distribution of income. The computer simulations show that an increase in the emulative behaviour of the poorer portion of the population of a country has mid-long-term negative consequences not only on the economy as a whole, but also on the total disposable income both of the poorer *and the richer* part of the population of that country. Furthermore, a change in the primary income distribution in the direction of a more unequal pattern in a country is beneficial to the rich of that country but not to the economy as a whole. By contrast, a trading partner can benefit – in the long-run – from a more uneven income

distribution of the neighbour's income. These results are particularly interesting given the fact that they are produced by the interaction of a country with its 'external world' (the exchange rate and the stock of foreign assets held by households are crucial variables in this context). In other words, the same results would not come out from an 'equivalent' closed economy model.

Although the four chapters of the thesis are strictly connected by the approach, the methodology and the research topics just described, they can also be read as independent pieces of research.

CHAPTER 1: THE STATE OF MACRO

"A study of the history of opinion is a necessary preliminary to the emancipation of the mind. I do not know which makes a man more conservative – to know nothing but the present, or nothing but the Past".

John Maynard Keynes, The end of laissez-faire, 1926

1.1 INTRODUCTION

This chapter will analyze some of the main topics of the debate on macroeconomics that has taken place in recent years, especially after the global financial crisis of 2007-2008.

Before the outbreak of the crisis – in the years of the 'Great Moderation' – the so-called 'New Consensus' had emerged. Its ultimate origin could be identified in the Real Business Cycle (RBC) theory and in the rational expectations' revolution that has swept out the post-war Keynesian hegemony[1] at the end of the Seventies.

The New Consensus has inherited many theoretical elements from the Real Business Cycle school, first of all the ambition of a complete microfoundation of macroeconomics. However, it tended to reject its most 'extreme' implications. Contemporary Dynamic Stochastic General Equilibrium (DSGE) models are primarily the result of the introduction of a series of frictions – namely of prices and wages frictions – in the RBC core structure.

The dominance of the New Consensus can be dated back to the mid-Nineties. The rationale and the main features of the DSGEs will be outlined in the first part of the chapter. A brief presentation of what can be considered a kind of 'benchmark model' in this field (Lindé, Smets and Wouters 2016) will be followed by some notes on the latest developments in the DSGE modelling, which are mainly an attempt to address the weaknesses exposed by the financial crisis.

[1] Here it is used the term 'Keynesian' in a quite broad sense. More rigorously, until the beginning of the Seventies the hegemonic position was held by the so-called Neoclassical Synthesis, as it has been labelled the blend of Keynesian insights and neoclassical economic 'grammar' developed by economists such as John Hicks and Paul Samuelson

Then it will be the turn of the criticisms that have been raised towards the New Consensus before and, more extensively, after the crisis, when even several 'mainstream' economists had started to "question many cherished beliefs" and when "propositions that would have been considered anathema in the past" received a renewed attention (Blanchard 2015).

For the sake of simplification two groups of critics of the New Consensus have been identified, although every simplification and categorization in this complicated subject should be handled with care: the 'reformists' *à la* Blanchard, who think that, even if "seriously flawed", DSGE models "are eminently improvable and central to the future of macroeconomics" (Blanchard 2016, p.3); and the 'revolutionaries' *à la* Lavoie, according to whom it is not enough to provide "new clothes to the Naked Emperor of mainstream economics": "the Emperor needs to be dethroned" (Lavoie 2016).

Since the economists who suggest the rejection of a dominant paradigm obviously champion the adoption of an alternative approach, in the second part of the chapter some of the most promising areas of research in the 'heterodox' macroeconomics will be presented.

The Stock-Flow Consistent (SFC) macro modelling – pioneered by the American economist, and Nobel laureate, James Tobin and by the British economist Wynne Godley – has emerged in recent years as one of the most popular fields of research within the Keynesian tradition. Three sections in the second part of the chapter will present some of the strengths of the methodology and the opportunities opened by the approach[2]. These arguments are strictly intertwined with the acknowledgement of the importance of the analysis of economies not as closed worlds, but as systems integrated with other systems via a complex web of *inflow* and *outflows* of money, goods and financial assets. In turn, the latter cannot be considered independently from the *stocks* of money, capital and financial assets and liability that underpin them.

Ultimately, these three sections are also an implicit justification of the choice of open economy SFC models as the main topic of this PhD thesis.

The SFC methodology has deep roots in the work of John Maynard Keynes, in particular due to the central role played in SFC models by the aggregate demand as

[2] A more detailed overview of the history, the theoretical foundations and the current state of SFC models will be offered in chapter 2 and 3.

a driver of growth both in the short-run and in the long-run. However, the legacy of Keynes cannot be restricted in one particular school or field of the contemporary macro. It will soon become evident from the content of the chapter that many of the issues discussed in the contemporary debate on the 'state of macro' have their origin in the questions raised by "The General Theory". That is why a couple of short detours to investigate Keynes' thought in its very original version will be necessary.

At this point, a 'methodological note' could be appropriate, before a full immersion in the themes of this inquiry. One of the most fascinating and challenging aspects of the current debate on the 'state of macroeconomics' is that it has largely spilt over the academic world. Public opinions in Western countries have engaged with passion and curiosity in topics that until a few years ago were the exclusive dominion of specialists. And economists of all tides have generally not abstained from getting involved in these discussions with interventions in TV programmes, newspapers, websites and blogs. Books written by university professors that in 'normal times' would have been printed in few thousands of copies have become international bestsellers.

The influence of these contributions, even within academia, cannot be ignored. Contemporary academic debate about the 'state of macro' cannot be fully understood without taking into account the cultural, social and political context in which it has developed. The recommendation is undoubtedly useful in many circumstances, but it is particularly important for this debate. That is why, although the present chapter will analyse mainly academic papers, it will occasionally draw on non-academic materials – such as posts and web articles of very authoritative authors – in order to describe different positions, theories and controversies which have animated the discussions. Some of these 'spurious sources' have indeed played a crucial role in shedding light on the evolution and the terms of the current discussion.

Finally, it is legitimate to wonder if it is possible to draw a 'moral of the story' after all the efforts to reconstruct the main drivers of the discussion of the 'state of macro'. If something similar to a moral can be found, this rests on the importance of the *competition* between different theories. Economics as a discipline has been dominated by a conformist and monolithic approach in the last decades. The outbreak of the global economic crisis in 2007-2008 has encouraged the opening of a long-overdue debate. Economic theory can really benefit from a more pluralistic environment and this thesis would like to represent a contribution, albeit tiny, in this direction.

1.2 THE STATE OF MACRO (PRIOR THE CRISIS)

1.2.1 The 'Michael Fish moment' of macroeconomics

The debate on the 'state of macro' that followed the financial crisis of 2007-2008 has been quite unprecedented in recent times. According to Steve Keen, this is the "5th great conflict over the nature of economics" (Keen 2016), being the previous four: the challenge between the Austrian and German Historical Schools; the marginalist – neoclassical – revolution against the classical theory that bound together Adam Smith, David Ricardo and Karl Marx; the prevailing of Smith's conception of productivity based on the division of labour over the Physiocratic approach; and, finally, in the Thirties of the Twentieth Century, the publication of "The General Theory" by John Maynard Keynes.

The importance and the power of the debate are testified by the spillover of many of its themes outside the ivory tower of academic departments and professional institutions.

In November 2008, in the middle of the financial meltdown that was engulfing the world economy, Queen Elisabeth visited the London School of Economics. There, she raised a quite provocative question: "Why did nobody notice it?". The episode received extensive coverage by the press around the world and triggered countless comments and interventions.

A few months later the British Academy summoned several important personalities of the academia, government agencies, and business to discuss the question of the Queen – from Professor Charles Goodhart, of the London School of Economics, to Goldman Sachs's analyst Jim O'Neill. Their conclusions were summarised in a letter addressed to Her Majesty, which stated: before the crisis "there was a firm belief that financial markets had changed. And politicians of all types were charmed by the market. These views were abetted by financial and economic models that were good at predicting the short-term and small risks, but few were equipped to say what would happen when things went wrong as they have" (Besley and Hennessy 2009, p. 2). The text also stigmatised the so-called "psychology of herding" and the "failure of the collective imagination of many bright people, both in this country and internationally, to understand the risks to the system as a whole" (Besley and Hennessy 2009, p. 2).

It is possible to find an echo of these words in a more recent article – meaningfully entitled "Where the danger lurks" – written by Olivier Blanchard, former chief economist at the International Monetary Fund and one of the most renowned economists in the world:

> "Until the 2008 global financial crisis, mainstream U.S. macroeconomics had taken an increasingly benign view of economic fluctuations in output and employment. The crisis has made it clear that this view was wrong and that there is a need for a deep reassessment. That small shocks could sometimes have large effects and, as a result, that things could turn really bad, was not completely ignored by economists. But such an outcome was thought to be a thing of the past that would not happen again, or at least not in advanced economies thanks to their sound economic policies". (Blanchard 2014).

This plea for a "deep reassessment" is even more important if it is taken into consideration the fact that not only was it raised by one of the worldwide leading 'mainstream' economists, author of the macroeconomics handbooks used by entire generations of economics students, but also by an academic that just a few years earlier had written a quite optimistic assessment of the 'state of macro' (Blanchard 2009).

With a pinch of irony, it could be noticed that in Britain similar calls for an overhaul of the discipline have come from two of the most respected and venerate institutions of the country: the monarchy, as we have just seen; and Bank of England (BOE). The chief economist of the BOE, Andrew Haldane, has denounced the "rather narrow and rather fragile" models at the core of mainstream economics (Haldane 2017). Speaking at the Institute for Government in central London in January 2017, he defined the financial crash of 2008 as a "Michael Fish moment" for economics (Michal Fish was the BBC weather forecaster that in 1987 ruled out the possibility of hurricanes just before a hurricane devastated the south of England). Haldane admitted that "it's a fair cop to say the profession is to some degree in crisis". "It is not the first time it happens", he added. "It happened back in the Thirties, at the time of the Great Depression". But "out of that, something good actually happened: out of that came Keynes and the birth of modern macroeconomics. Out of this crisis, I think could come a rebirth of economics" (Haldane 2017).

The following section will provide a summary of the contents of Blanchard's 2009 article. To some extent, it has represented a milestone in the shift of 'attitude' towards 'mainstream' macroeconomics achievements before and after the Great Recession.

1.2.2 The New Consensus era

After the Second World War, it appeared that macroeconomics had found a core content that could rely on a widespread consensus among 'mainstream' economists. The so-called Neoclassical Synthesis gave a rigorous formalisation, within a neoclassical theoretical framework, to some of the critical insights of Keynes' "The General Theory of Unemployment, Interest and Money" (1936). This new hegemony dominated in academia and even in policy making institutions for nearly thirty years. *Les Trente Glorieuses* (Fourastié 1979) were characterised by rapid and stable growth in Western countries and by a constant improvement of the living standards of the population.

In 1955 one of the leading exponents of the Neoclassical Synthesis, Paul Samuelson (who would win the Nobel Prize[3] in 1970), described in these terms the strength of the grip that the then consensus held on macro theory:

> "In recent years, 90 per cent of American economists have stopped being 'Keynesian economists' or 'Anti-Keynesian economists'. Instead, they have worked toward a synthesis of whatever is valuable in older economics and in modern theories of income determination. The result might be called neo-classical economics and is accepted, in its broad outlines, by all but about five per cent of extreme left-wing and right-wing writers" (Samuelson 1955).

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[3] That is actually the "The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel". It was first awarded in 1968 and therefore is not one of the prizes that Alfred Nobel established in his will in 1895. However, from now onwards we will refer to it as the Nobel Prize in economics, since this is how the public commonly knows it.

Neoclassical Synthesis' hegemony came to an end with the New Classical Macroeconomics revolution based on rational expectations and the so-called Lucas' Critique of Keynesian structural models (Lucas 1976).

In 2009 Olivier Blanchard renewed a claim very similar to Samuelson's one: yet this time the hegemonic consensus was not built on the old Neoclassical Synthesis, but on a brand-new blend. The staple was provided by the evolution of models based on the rational expectations' hypothesis. These models were completely microfounded, following the principles of the Real Business Cycle school: their equations had to be derived through a series of constrained maximisations at the micro level of the utility functions of representative households and firms. However, the basic theoretical framework had been amended by the introduction of a series of markets' imperfections, distortions and rigidities. The latter had to account for 'real world' situations that did not find any explanation in the 'neo-Walrasian' perfect markets equilibrium of the RBC models. Hence the label 'New Keynesian' that is often used for the latest generation of Dynamic Stochastic General Equilibrium (DSGE) models[4]. In other words, "the new tools developed by the new-classicals came to dominate. The facts emphasised by the new-Keynesians forced imperfections back in the benchmark model. A largely common vision has emerged" (Blanchard 2009, p. 212). Analogous statements about the convergence upon which the New Consensus has been built could be found in Galì and Getler 2007, Woodford 2009 and Chari, Kehoe, McGrattan 2009.

Incidentally, it is possible to notice that there is no need to share the theoretical perspective of these authors to agree with their reconstruction of the birth and the consolidation of the New Consensus, which ended up to dominate even the training programs of the economics departments around the world, at least at a postgraduate level. For instance, a very similar point of view can be identified in the analysis of the Post-Keynesian economist Giuseppe Fontana, University of Leeds: "The new consensus model has shown remarkable flexibility, being able to encompass several New Keynesian analyses of nominal rigidities, and the expectations-augmented or inertial Phillips curve, as well as the new classical natural rate hypothesis and the rational expectation hypothesis. The new consensus model is slowly but

[4] Notwithstanding these frictions, the ultimate foundation of DSGE models on the neo-Walrasian general equilibrium theory is made clear by the label "neo-Walrasian macroeconomics" which has also been used to indicate the 'new consensus' (Marchionatti and Sella, p. 444).

increasingly used to replace the iconic IS-LM model in (…) macroeconomic textbooks". (Fontana 2009 b, p. 587).

With an explicit reference to Samuelson's famous sentence, Blanchard concluded that macroeconomics was "not yet at such a corresponding stage today. But we may be getting there" (Blanchard 2009, p. 213). More importantly, the acknowledgement of the presence of a new 'mainstream' consensus was accompanied with a very optimistic assessment of the perspective of this hegemonic path of research: "Not everything is fine", wrote Blanchard. "Like all revolutions, this one has come with the destruction of some knowledge and suffers from extremism, herding, and fashion. But none of this is deadly. The state of macro is good" (Blanchard 2009, p. 210).

It will be shown later how much criticism this final judgment – "the state of macro is good" – would attract after the breakout of the worst economic crisis in the last seventy years. Yet it is worth to anticipate that as recently as August 2016 the Nobel Prize winner Paul Krugman has written a post in his *New York Times*' blog sharply entitled "The state of macro is sad". The contrast with Blanchard's controversial conclusion could not be more evident.

1.2.3 From academia to central banks: the dominance of the New Consensus and its early critics

In the last three decades, New Keynesian-DSGE models have become the staple of contemporary macro not only within the academia but even in the central banks of the most advanced economies.

The work by Lawrence J. Christiano, Martin Eichenbaum and Charles Evans, "Nominal rigidities and the dynamic effects of a shock to monetary policy" (2005), can be considered an academic benchmark of this generation of macro modelling, together with Frank Smets and Raf Wouters' paper "Shocks and frictions in US business cycles: a Bayesian DSGE approach" (2007), which combines the main structure of Christiano, Eichenbaum and Evans' model with a broader set of stochastic shocks.

On the side of institutions and central banks 'DSGE like' models are adopted in almost all the most advanced industrial economies. Among them: the COMPASS (Bank of England), the BoC-GEM (Bank of Canada), the NAWM (European Central

Bank), the QUEST (European Commission), GIMF (International Monetary Fund) and OECD Fiscal (OECD), the EDO and the SIGMA (respectively a US economy model and a multi-country model used at the Federal Reserve, USA) [5].

This does not mean that older 'Keynesian structural models' have simply disappeared. A noteworthy exemplar is represented by the FRB/US and the FRB/Global of the Federal Reserve. They do encompass some key elements of the New Consensus in order to address two major criticisms raised against the old structural models in the 1980s, namely Lucas's Critique (Lucas 1976) on the role of rational expectations, and Sim's critique (Sim 1980) on the econometric methods used to estimate the parameters of those models. Yet they also keep some of the pillars of the 1960s Neoclassical Synthesis: "credit effects, wealth effects and exchange rate effects, which were the key channels of the monetary transmissions mechanism in the old MPS model[6], still play an important role" (Fontana 2008, p. 84). Essentially, those models take the shape of a kind of 'compromise' between the 'old' and the 'new' consensus in macroeconomics (Fontana 2008).

Said that, it is fair to recognise that since the mid-Nineties onwards DSGE models have become the "workhorse framework of macroeconomic analysis" (Gürkaynak and Tille 2017, p. 9) not only in academia but also in policy institutions and central banks.

In the 'golden era' of DSGE models – when Blanchard wrote about the "enormous progress and substantial convergence" (Blanchard 2009, p. 210) that had been reached under their guide – criticism towards 'mainstream' macroeconomics was much less popular than today.

Still, even then some voices focused on serious flaws of DSGEs that later would have been acknowledged even by academics, scholars and officials in policy making institutions still convinced of the validity of DSGEs models as the most suitable approach to macroeconomic modelling. Indeed, some of the most recent

[5] This list draws mainly on Lindé, Smets and Wouters 2016 and Williams 2017; it is possible to find an interesting overview of the principal estimated macroeconomic models – both academic or actually used at a policy making level – in Coenen et al. 2012 and Wieland et al. 2012. For a recent 'story' of the model adopted at the Bank of England and their description see Hendry and Muellbauer 2018.

[6] The MPS was the first model used for monetary policy-making at the Federal Reserve Board (FRB) in the mid-1960s. It was a joint project from staff members at the FRB led by Frank de Leeuw, and academic economists led by Franco Modigliani at the MIT and Albert Ando at the University of Pennsylvania (Fontana 2008).

developments of DSGE models are an attempt to tackle several of those defects, now widely recognised.

The weaknesses that were denounced at that time could be summarised as follows (we partially draw on Philip Arestis' "New Consensus Macroeconomics: A Critical Appraisal", 2009, for the categorization of these contributions):

a) Lack of a sound correlation between low level and stability of prices and macroeconomic stability (see, for instance, Angeriz and Arestis 2007, 2008).

b) Underestimation of the role of the exchange rate (Angeriz and Arestis, 2007).

c) Lack of sound theoretical foundation and empirical evidence in support of the idea of a vertical Philips curve in the long-run (Juselius 2008; Fontana and Palacio-Vera 2007).

d) Lack of acknowledgement of the possible correlation between the long-run level of the NAIRU – Non-Accelerating Inflation Rate of Unemployment – and shifts in aggregate demand and economic policy: hysteresis effects of demand shocks are ignored (Arestis et al. 2007; Fontana 2009 a).

e) Lack of sound theoretical and empirical foundation for the rejection of fiscal policy (Angeriz and Arestis, 2009; Fontana 2009 b): within the New Consensus framework – at least until the Great Recession – fiscal policy should solely have aimed to balance public spending and unemployment problems should have been addressed through 'supply side' interventions.

f) Problems related to the (monetary) policy response to inflation when the latter is cost-push rather than a demand-pull (Arestis and Sawyer 2008, 2009; Fontana 2009 a).

Apart from this very rough and preliminary list, the most criticised aspect of the New Consensus was the absence of proper treatment of the financial sector: "The money market and financial institutions are typically not mentioned let alone modelled" (Arestis 2007). This led to the overlooking of major dynamics of contemporary economies, first of all of the role played by banks and financial institutions in the mechanism of the transmission of monetary policy.

It was precisely to address this kind of complexity that central banks all over the world had to resort to a comprehensive set of unconventional measures after 2007-2008. As Mario Draghi explained in a speech held at the IMF in the aftermath of the euro crisis:

"Banks were attaching higher margins to new loans to reflect their elevated risk perceptions; those higher interest rates were then taxing borrowers with outstanding credit and limiting the demand for new credit; this was in turn weighing on the economic recovery and contributing to higher loan delinquencies for banks; and then banks were justified in charging those higher risk premia *ex-post*" (Draghi 2015).

The dynamics described by Draghi underlined the limits of a monetary policy exclusively reliant on the fine-tuning of the key interest rates under the direct control of the central bank (and, generally speaking, the limits of an economic policy exclusively reliant on monetary policy).

Furthermore, well before the financial crisis exposed the financial imbalances that characterized in particular the US economy, the early critics of the New Consensus focused in a broader concept of 'inflation', which involved both the change of value of financial assets (e.g. equities) and the change of prices of real economy assets (e.g. houses). Given the role played by the US real estate market in the last financial crisis, it is hard to underestimate the importance of such observations. "The standard argument in terms of asset price control", wrote Philip Arestis and Malcolm Sawyer in a paper presented as a "Keynesian critique" to inflation targeting (2008), "is that asset price inflation (…) is out of the realm of central banks, as it reflects market forces and any control is widely regarded as infringing with the principles of the free market economy". This was precisely the position of the former governor of the Fed, Alan Greenspan (Greenspan 2002). By contrast, Arestis and Sawyer argued that:

"The experience of many countries shows that successful control of CPI-inflation does not guarantee low asset price inflation (…). When asset price inflation gets out of control bubbles are built and while they grow they generate a lot of euphorias. But bubbles have ultimately burst with devastating consequences not only for the investors in the stock markets, but also for the economy as a whole. The experience of the last twenty years shows that the adverse consequences of the burst of a bubble hit not only weak economies, but also strong economies such as the US and Japan. Monetary policy should, therefore, target asset prices in addition to inflation" (Arestis and Sawyer 2008, p. 642).

1.3 THE STATE OF MACRO (POST CRISIS)

1.3.1 “Flawed but improvable models”: Blanchard’s new vision of the future of DSGEs

It has been shown in section 1.2.2 and 1.2.3 that DSGE models enjoyed strong and robust support among academic economists and practitioners before the outbreak of the Great Recession. Dissenting opinions were not common and came almost exclusively from ‘heterodox’ schools of the discipline.

The financial crisis of 2007-2008 has dented this optimistic quasi-unanimity: “The crisis was a traumatic event during which we all had to question many cherished beliefs”, said Blanchard in an interview published on the website of the International Monetary Fund in August 2015, when the French-born scholar was still the chief economist of that institution. “It would have been intellectually irresponsible, and politically unwise, to pretend that the crisis did not change our views about the way the economy works” (Blanchard 2015).

Given the overwhelming vastness of the literature on the ‘state of macro’ after the crisis, it would be impossible to analyse every single intervention related to the topic. Still, it could perhaps be useful to sketch a ‘guide’ to the ‘state of the debate’ about the ‘state of macro’. Then it will be easier to identify the most promising directions of the research for the nearer future.

It seems appropriate to begin with the economist that so far provided the template of the reasoning, so that it will be possible to gauge to what extent the ‘rethinking’ of macroeconomics has characterized even his own vision. Blanchard’s article “Do DSGE models have a future?” (2016)[7] can be considered a sort of ‘second half’ of the “The state of macro” (2009), once that the “traumatic event” of the crisis had been taken into account and its theoretical consequences had been weighed.

It is true that Blanchard has substantially answered with a ‘yes’ to the question raised in the title of the article: “I see the current DSGE models as seriously flawed,

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[7] Together with other web interventions, this article was later included in the paper “On the future of macroeconomic models” published in 2008 in the Oxford Review of Economic Policy. Despite the availability of this ‘academic reference’, it has been preferred to stick to the original web articles as the primary references in this text for two reasons: 1) They have been published earlier; 2) They are the references of many economists who have intervened in the middle of their publication, being the final academic paper essentially a summary of the contents of the web interventions.

but they are eminently improvable and central to the future of macroeconomics". That is why he could add: "I believe the DSGEs make the right basic strategic choices and the current flaws can be addressed" (Blanchard 2016 a, p. 3). However, the general tone of the intervention was quite far from the semi-triumphalist one used back in 2009.

The so-called New Keynesian model – whose benchmark, according to Blanchard, can be found in the 2007 Smet and Wouters' paper (see sections 1.2.3 and 1.3.2) – is based on three main building blocks[8]: an aggregate demand function, a 'Philippe Curve like' prices adjustment function and a monetary rule[9]. "At least the first two are badly flawed descriptions of reality", wrote Blanchard. In particular, the assumptions whereby the first is derived – infinitely lived and foresighted households – put its outcomes "at odds with empirical evidence" (Blanchard 2016 a, p.1).

Some amendments could make the model more realistic. For instance, the introduction of 'hand to mouth' consumers who do not save any portion of their income. Or the inclusion of devices to account for inflation inertia. In fact, several amendments have been actually developed in recent years. Yet, as far as Blanchard was concerned, these "are repairs rather than convincing characterizations of the behaviour of consumers or of the behaviour of price and wage setters" (Blanchard 2016 a, p. 2).

One of the harshest criticism of the former chief economist of the IMF was directed towards the methods of estimation that are currently used in the DSGE models.

It is convenient to briefly summarize these technics drawing on Jasper Lindé, Frank Smets and Rafael Wouters' "Challenges for central banks' macro models" (2016), which could be regarded as the 'new benchmark' of the latest generation of DSGE models as it has tried to address some of the most problematic aspects of the 2007 model (see more on Lindé, Smets and Wouters 2016 in the next section)[10].

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[8] See section 1.2.2 on the pre-condition of a microfoundation of these building blocks along with the RBC school 'commandments'.

[9] Apart from Smets and Wouters' original paper, the description of the general framework of the DSGE models featured in the present work has substantially drawn on Sbordone, Tambalotti, Rao and Walsh 2010.

[10] Several specific works are available if one wants to have a more detailed representation of the state of the debate on the econometrics and empirical estimation of DSGEs: see for instance Fernandes-Villaverde (2010), Herbst and Schorfheide 2015, Marchionatti and Sella (2017), Lavine (2019).

The 2016 model has been constructed over seven key variables: log difference of real GDP, real consumption, real investment, real wage, log hours worked, log difference of the GDP deflator and federal funds rate.
5 out of 41 parameters – the ones that the authors regarded as "weakly identified by the variables" (Lindé, Smets and Wouters 2016) – have received fixed values *a priori.* The authors stated that the figures were taken from the previous model (Smet and Wouters 2007). However, in the latter, it is not possible to find any convincing explanation of why, for instance, the depreciation rate was set at 0.025 and not at any other value, or the exogenous spending-GDP ratio was set at 18%, and not, say, at 22%.
This is a widely used method in works based on DSGE models. Nowadays, it is also regarded as one of their main weaknesses. As Blanchard pointed out: "This approach would be reasonable if these parameters were well established empirically or theoretically. For example, under the assumption that the production function is Cobb-Douglas, using the share of labour as the exponent on labour in the production function may be reasonable". Yet "in many cases, the choice to rely on a 'standard set of parameters' is simply a way of shifting blame for the choice of parameters to previous researchers" (Blanchard 2016, p. 2).
The actual estimation has been conducted via Bayesian techniques, whereby a set of the 'prior distributions' of the remaining parameters (36 in Lindé, Smets and Wouters 2016) is 'updated' through the use of empirical data to find out the 'posterior distributions'. The obtained values are then used to run the model and provide forecasts for the behaviour of the economy in the future. Again, Blanchard underlined that this method would be good if "we had justifiably tight priors for the coefficients. But, in many cases, the justification for the tight priors is weak at best, and what is estimated reflects more the prior of the researcher than the likelihood function" (Blanchard 2016 a, p. 2).
In the very last part of his article the former chief economist of the IMF tried to envisage the two main changes the DSGE approach should undergo in order to reform itself: the first consisted in becoming "less insular", that is to say in being able to draw "on the large amount of work on consumer behaviour going on in the various fields of economics, from behavioural economics, to big data empirical work, to macro partial equilibrium estimation" (Blanchard 2016 a, p. 3). This is the

direction to take if one wants to go beyond fragile "reparations" to the first two building blocks of the DSGE structure.

More importantly, Blanchard pleaded for a "less imperialistic" attitude by the DSGE's community (and the plea was explicitly directed toward the editors of the major economics journal too): DSGE models should share the scene with other possible frameworks. The presence of different approaches would be justified by the various degrees of "theoretical purity" and capability of "fitting the data" that characterise different models, all of them deserving of finding a place under the umbrella of 'modern macroeconomics'. This spectrum runs from DSGE models (the brightest exemplar of "purity", according to Blanchard) to policy making models that do not rely mainly on microfoundation but can better fit the data. Finally, there are much lesser complex models, like the IS-LM or the Mundell-Fleming models, which should not be discarded just as forgone moments of the history of economic thinking, but as useful tools to describe the major insights of the DSGE models "in a lighter and pedagogical fashion" (Blanchard 2016 a, p. 3).

Blanchard has relaunched the idea of the coexistence of different 'categories' of models in a series of subsequent interventions published in 2017 and hosted by the website of the Peterson Institute for International Economics[11]. In these new posts the taxonomy of macro models has been broadened to encompass five different classes: Foundational models, DSGE models, Policy models, Toy models, Forecasting models. Many macroeconomists strive to discover the 'perfect model' that succeeds in providing a strong theoretical justification of the dynamics described and good fitting of the data. They are bound to be disappointed. The two tasks cannot be achieved together. Every choice implies a loss: either it is possible to devote attention to one model's elegance, simplicity and capability to be grounded on strong microfoundations, or it is possible to be focused on real-world data.

Blanchard seemed to apply to macroeconomics what the philosopher and historian of the ideas Isaiah Berlin applied to ethics and to "ideals of mankind": "not all good things are compatible" (Berlin 1958, p. 53). According to Berlin what leads to authoritarian regimes – to 'imperialistic macroeconomics', in Blanchard's words – is the "conviction that all the positive value in which men have believed must, in the

[11] "The need for different classes of macroeconomic models", January 12th; "On the Need for (At Least) Five Classes of Macro Models", April 10th. These interventions have been included in the paper mentioned above "On the future of macroeconomic models", Blanchard 2018.

end, be compatible, and perhaps even entail one another" (Berlin 1958, p. 52). By contrast, the awareness that this conviction is just a dangerous illusion is for Berlin the philosophical basis of liberal institutions. From this point of view Blanchard's pluralist macroeconomics appeared to resemble Berlin's pluralist society, where many different theories live together and none of them can aim to be recognised as the ultimate truth:

"Both classes [of models] should clearly interact and benefit from each other. To use an expression suggested by Ricardo Reis, there should be scientific cointegration. But the goal of full integration has, I believe, proven counterproductive. No model can be all things to all people" (Blanchard 2017 a).

1.3.2 The new DSGE benchmark

Despite all the criticism that Blanchard directed towards the DSGE approach, he has been far from rejecting the entire framework as a whole. He has championed a more pluralistic environment and he has urged a 'reformist' program *within* the DSGE modelling rather than a 'revolution' of the paradigm.

One of the most significant attempts to give shape to these reforms can be identified in the 2016 model by Lindé, Smets and Wouters. This work has been already mentioned in the previous section (1.3.1) as it is crucial to assess the debate about the 'state of macro'. Indeed, the paper comes from the same authors that a few years earlier set the 'benchmark' of DSGEs[12]. Smets and Wouters (together with Lindé, who is not an author of the 2007 model) acknowledged the presence of a series of flaws in their earlier benchmark and have tried to tackle them. In doing that, they have also addressed some of the most contentious topics of the contemporary discussion on 'mainstream' macro modelling.

The starting point is the following: "the fact that the intensification of the crisis in the fall of 2008 was largely unexpected and much deeper" than the central banks – namely the 'DSGE like' central bank models[13] – "predicted and that the subsequent recovery was much slower, has raised many questions about the design of macroeconomic models at use in these institutions. Specifically, the models have

[12] Together with Christiano, Eichenbaum and Evans 2005, see section 1.2.3.
[13] See section 1.2.3 for a brief overview of the models adopted in each of the major western central banks.

been criticised for omitting key financial mechanisms and shocks stemming from the financial sector" (Lindé, Smets and Wouters 2016, p. 1[14]).

The unfitness of these models to deal with the new context of financial turmoil has been directly verified in the paper with a comparison between the *a posteriori* forecast of the 2007 model – newly estimated on data up to the fourth quarter of 2007 – and the actual data referring to the outbreak and the first quarters of the Great Recession (all data refer to US quarterly time series). The path of the recovery that actually took place in the following months has also been contrasted with the model's 'new prediction'.

In both cases the performance of the 2007 model has been very poor: the forecast for the fourth quarter of 2008[15] showed a US GDP almost unchanged, whereas it actually plummeted by 9.75 per cent (at an annualised quarterly rate). Furthermore, the American recovery predicted by the model[16] depicted a V-shape and a rapid recovery: the model suggested "that better times were just around the corner" (Lindé, Smets and Wouters 2016, p. 20). In fact, the recovery has been pretty slow and gradual.

Lindé, Smets and Wouters identified the main reason for this theoretical debacle in the lack of proper treatment of the financial sector. From this point of view, their *ex-post* assessment of the model ends up to indirectly recognise the validity of the pre-crisis criticism raised by the heterodox camp (see section 1.2.3).

Consequently, the original 2007 model was amended with three major introductions:

a) Financial frictions, following the 1999 work by Ben Bernanke, Mark Gertler and Simon Gilchrist ("The financial accelerator in a quantitative business cycle framework"), which has provided a crucial reference for the most recent developments in DSGE modelling and the related effort to deal with the financial sector.

b) Zero lower bound constraint.

c) Time-varying volatility of the shocks.

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[14] For the references of the pages we have used the version of the article published by the European Central Bank. The text has been subsequently included in volume 2 of the *Handbook of Macroeconomics*, edited by J. B. Taylor and H. Uhlig (see the bibliography at the end of the thesis).

[15] Conditional on observing data up to the third quarter

[16] Forecasts for the period between the first quarter of 2009 and the fourth quarter of 2011, conditional on the state of the last quarter of 2008

The first amendment, in particular, turned out to be the most promising and was used to generate a so-called FF-model (financial friction model). It implied one more observable variable, the 'Baa-Aaa corporate credit spread', defined as the difference between the BAA corporate interest rate and the U.S. 10-year government yield: virtually a measure of default risk. Moreover, it included five more estimated parameters. These additional parts allowed "the FF-model to considerably improve the accuracy of the central forecast in the crisis period" (Lindé, Smets and Wouters 2016, p. 55). Yet the improvement of the forecast referring to the last quarter of 2008 (and conditional on the third quarter of 2008) relied on the fact that the model 'had access' to the information of a huge increase in the spread that occurred in the same quarter covered by the 'prediction'. This 'trick' was justified with the argument that the surge of the spread has happened mainly by mid-October, meaning at the very beginning of the fourth quarter. Even with this bold – and contentious – device, "the forecast conditional on the timely information from the spread display a median prediction for annual GDP growth of -2.11 percent in 2008Q4 and -1.92 percent in 2009Q1 (…), which should to be compared to the observed -3.61 and -4.42 percent in the actual data" (Lindé, Smets and Wouters 2016, p. 55).

Lindé, Smets and Wouters 2016 has been just one of the several attempts to introduce financial frictions and take into account the financial sector into a DSGE framework.

Following Christiano, Eichenbaum and Trabandt ("On DSGE Models", 2018), the literature on the integration between DSGEs and financial frictions "can loosely be divided between papers that focus on frictions originating inside financial institutions" (theories of bank run and rollover crisis) "and those that arise from the characteristics of the people who borrow from financial institutions" (theories of collateral constrained borrowers, Christiano, Eichenbaum and Trabandt 2018, p.125). Gertler and Kiyotaki (2015) and Gertler, Kiyotaki and Prestipino (2016) represented examples of the first category, while Christiano, Motto and Rostagno (2014) of the second one. An additional strand of research has focused on the housing sector, given the importance of the housing market and of the financial product linked to housing mortgages in the outbreak of the financial crisis in 2007 (Iacoviello and Neri 2010, Liu, Wang and Zha 2013, Berger, Guerrieri, Lorenzoni and Vavra 2018).

Other important works built on the integration between DSGE and the financial sector were Gerali, Neri, Sessa and Signoretti (2010) Gertler and Kiyotaki (2010), Brunnermeier and Sannikov (2014) and Clerc, Derviz, Mendicino, Moyen, Nikolov, Stracca, Suarez and Vardoulakis (2015).

Notwithstanding all this recent progress, the program of research championed by this bunch of 'DSGE reformists' is far to be completed and several problems still remain largely unaddressed. Lindé, Smets and Wouters (2016) identified two major areas in which the efforts should be directed in order to overcome the most important weaknesses of the New Keynesian model *within* the same theoretical paradigm.

The first area should deal with the monetary policy tools that have characterised the response to the crisis by the major central banks (e.g. the so-called 'quantitative easing'). These tools went far beyond the fine-tuning of basic interest rates and should be incorporated into the new models.

The second area should cover the innovations in the 'macroprudential policies' (such as stress test exercises or changes in the legal requirements of capital) that the crisis has indirectly brought about and whose interaction with other macro dynamics has to be studied.

The publication in 2017 of the ebook "DSGE models in the conduct of policy: use as intended" has provided a profound description of 'state of the art' in DSGE modelling and an interesting sketch of a prospective program of research for years to come.

In the opening contribution John C. Williams, of the Federal Reserve Bank of San Francisco, pointed out three key improvements that the next generation of DSGE models has to achieve for a better comprehension of the functioning of modern economies and for more effective policy responses: a "more thorough representation of the labour market", an analysis of medium-term shocks focused on "demographics, productivity, and other structural shifts" and a much more detailed "description of the financial system and unconventional monetary policies" (Williams 2017, p. 20).

In the same publication, Jordi Galì criticised two features of DSGE models defined as "unpleasant straitjackets: (i) the assumption of an infinitely-lived representative household, and (ii) the stationarity hardwired into most existing models" (Galì 2017, p. 87). Yet in both cases, according to Galì, the most recent research has deployed several interesting efforts to overcome the constraints.

With regard to the first point, the introduction of different forms of heterogeneity among households has paved the way for a broader analysis of the effects of monetary policy on income distribution (Gornemann, Kuester and Nakajima 2016), and of the consequence of this heterogeneity of agents on the transmission of the monetary policy (Kaplan, Moll and Violante 2018, Debortoli and Galì 2018) and on the forward guidance (McKay, Nakamura and Steinsson 2016, Farhi and Werning 2017). The use of overlapping generations of finitely-lived individuals (Eggertsson and Mehrotra 2014, Galì 2014), could also represent an important improvement in order to take into account the phenomenon of asset bubbles, in fact neglected by DSGE models so far. This is one of the most promising fields also for Christiano, Eichenbaum and Trabandt (2018), who emphasised the important implications of the heterogeneous agents approach for the study of monetary policy within the DSGE framework: "This area of research typifies the cutting edge of DSGE models" (Christiano, Eichenbaum and Trabandt 2018, p. 132). Other works have concentrated on the heterogeneity of firms rather than heterogeneity of households (Gilchrist, Schoenle, Sim and Zakrajšek 2017 and Ottonello and Winberry 2017).

With regard to the stationarity issue (the second "unpleasant straitjacket"), Galì reckoned that "the kind of fluctuations generated by those models tend to rule out, by construction, some of the more interesting macroeconomic phenomena which are associated with financial crises and which are inherently non-stationary and/or nonlinear" (Galì 2017, p. 90). Nevertheless, the work by Boissay, Collard and Smets "Booms and Banking Crises" (2016) is for Galì the proof that the topic is already in the target of the new generation of models.

This pretty optimistic appraisal on the state of the research made Galì conclude that he agreed with Blanchard about the destiny of DSGE models: although there is ample room for improvements, they are still the 'future' of macroeconomics.

In the survey "The state of DSGE modelling" (2019) Paul Levine produced a summary of a number of criticisms regarding DSGE models and of the ways in which the DSGE community has tried to tackle those criticisms. Apart from the themes already covered in this section, it is worth to mention the attempts of incorporating "bounded rationality" (from the pioneering work of Brock and Hommes 1997) into the standard New Keynesian model, and the new strand that tries to compound DSGE and Agent-Based (AB) models. In DSGE models the agents are assumed to live in a very simple environment and to have very sophisticated computational capabilities. By contrast, the world of the AB models is far more complicated, but their agents use simplified rules of behaviours to drive their actions. An in-depth description of what has been done so far combining these two approaches is contained in Dilaver, Calvet Jump and Lavine (2018).

An analogous spirit of ‘progressive evolution within the paradigm’ seems to have inspired the “Rebuilding Macroeconomic Theory Project” launched by the *Oxford Review of Economic Policy*. The aim of the initiative was to assess the state of macro and of its ‘core model’ up to the crisis[17]. A complementary objective was to figure out the main amendments that this core model needed in order to incorporate the lesson of the crisis. The Project took the form of two conferences held in Oxford in October 2016 and February 2017. Revised versions of the papers presented in the second conference were published in a special issue of the *Oxford Review of Economic Policy*.

Setting aside more critical contributions[18] – which will be extensively dealt with in subsequent sections of the chapter – the conclusions of the Project have been summarised by David Vines and Samuel Wills as follows: a ‘new DSGE’ core model has to feature these characteristics:

> “(i) incorporating financial frictions rather than assuming that financial intermediation is costless;
> (ii) relaxing the requirement of rational expectations;
> (iii) introducing heterogeneous agents; and
> (iv) underpinning the model – and each of these three new additions – with more appropriate microfoundations” (Vines and Wills 2018, p. 4).

The programme clearly overlapped with many strands of research described earlier. Vines and Wills did not think ‘a paradigm shift’ was needed: the favourite outcome was a more sophisticated and realistic DSGE core model. And yet they called for new behavioural equations for consumption, investment and price setting and they

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[17] The ‘core model’ was identified by the Rebuilding Macroeconomic Theory Project in Smet and Wouters 2007 and Christiano, Eichenbaum and Evans 2005. Exactly the same papers indicated as benchmarks of the New Keynesian model in the present work.

[18] According to Vines and Wills “most” of the economists who took part to the project share the opinion that the benchmark New Keynesian DSGE model “is flawed” but “should be rebuilt rather than abandoned” (Vines and Wills 2018, p. 17). Only a minority, including Krugman and Stiglitz, thought “the existing benchmark DSGE model should be discarded” (Vines and Wills 2018, p. 17)

maintained that different models could be required for different purposes[19], included non-microfounded policy models. If a 'revolution' is rejected, radical reforms in a more pluralistic environment are explicitly encouraged.

A more assertive and one-dimensional conclusion has been drawn by Christiano, Eichenbaum and Trabandt in their aforementioned paper of 2018: "We do know that DSGE models will remain central to how macroeconomists think about aggregate phenomena and policy. There is simply no credible alternative to policy analysis in a world of competing economic forces operating on different parts of the economy" (Christiano, Eichenbaum and Trabandt 2018, p. 136).

1.3.3 A Nobel laureates uprising against the 'New Consensus'

As it should be clear at this point, there has been no lack of proposals to reform the so-called New Consensus *from within.* Having said that, the striking fact about the state of the current debate is perhaps that the very concept of the existence of a 'consensus' has been seriously challenged.

It would be exaggerated – and ultimately wrong – to state that we are attending the kind phenomenon that Tomas Kuhn would have defined as a "paradigm shift" (Kuhn 1962). In his reply to Blanchard's essay, Simon Wren-Lewis correctly pointed out that DSGE models are still the 'mainstream', the framework in which the last two generations of economists have been brought up and have worked on: "there is no way that all these academics are going to suddenly decide this research programme is a waste of time" (Wren-Lewis 2016 a). Roger Farmer put forward a very similar opinion: "DSGE models are here to stay" (Farmer 2014). However, "what is at issue", Wren-Lewis added, "is not the existence of DSGE models, but their hegemony" (Wren-Lewis 2016 a).

The last statement appeared to be pretty fair not only given the harsh and widespread criticism that these models received in the last years, but also given the status and the prestige *within* 'mainstream circles' of some of the critics.

[19] Not only did Vines and Wills endorse the call by Blanchard for a large variety of macro model which ends the 'microfoundations hegemony'. They reckoned this was the lesson that could have been drawn from the whole 'Rebuilding Macroeconomic theory Project' because there had been large consensus on the issue among the economists that took part in the project.

The Nobel Prize laureate, and City University of New York's economist, Paul Krugman has used his highly influential blog on *The New York Times* to express – in his characteristic, 'very direct' style – some scathing comments about macroeconomics focused on the DSGE's approach.

"Economists who knew and still took seriously good old-fashioned Hicksian IS-LM type analysis made some strong predictions after the financial crisis that were very much at odds with what lay commentators, and quite a few economists, were saying. Can you say anything comparable about DSGE? Were there any interesting predictions from DSGE models that were validated by events? If there were, I'm not aware of it" (Krugman 2016).

Krugman's words were in stark contrast with Blanchard's famous assessment of 2008: "Now, I don't know how to reform all of this", wrote the City University of New York's economist. "At the very least we should admit to ourselves how very sad the whole story has become" (Krugman 2016). Indeed, the pessimistic conclusion was effectively reflected in the title of the post: "The state of macro is sad (wonkish)" (Krugman 2016).

In a subsequent paper (Krugman 2018), Krugman laid down in more detail his vision. That was essentially based on the contrast between an 'old school', whose theoretical 'mindset' is largely rooted in the Neoclassical Synthesis of the pre-Lucas era, and the 'innovative school', inaugurated with the Real Business Cycle theory.

The latter was labelled as "absurd enterprise" (Krugman 2018, p. 163). That is why it was completely unable to deal with the reality of the financial crisis and could not offer any reasonable solution to the policy makers. Not by chance, when the situation became really dangerous, the Fed and the US government resorted to the recipes suggested by the "good old" IS-LM-style models and the traditional tools of post-war Keynesianism:

"[These models] made at least three strong predictions that were very much at odds with what many influential figures in the political and business worlds (backed by a few economists) were saying.

— First, Hicksian macroeconomics said that very large budget deficits, which one might normally have expected to drive interest rates sharply higher, would not have that effect near the zero lower bound.

— Second, the same approach predicted that even very large increases in the monetary base would not lead to high inflation, or even to corresponding increases in broader monetary aggregates.

— Third, this approach predicted a positive multiplier, almost surely greater than 1, on changes in government spending and taxation (Krugman 2018, p. 161).

During the most acute phase of the financial crisis the US Central bank was led by Ben Bernanke and the European Central Bank by Mario Draghi[20]. Economists such as Larry Summers and Christina Romer were the economic experts[21] of the Obama administration. Krugman noticed that all these people had in common one thing: they have been trained at the MIT or at Harvard in the Seventies; this meant that they shared a kind of 'instinctive' Keynesianism which spared them from completely buying the 'new fashion' of the discipline even in its heydays. When the 'new school' showed all its theoretical and practical limits, they were able to come back to the fundamentals of the lesson of Keynes and they managed to avoid the free fall which happened in the Thirties.

Once the catastrophe was shunned, austerity policies – particularly in Europe – were ushered in by politicians less aware of the lesson of Keynes. However, at least from an American perspective, the emergency has been managed far better than in the wake of the 1929 crisis. And here is the paradox: for Krugman this success will likely prevent the re-thinking of the discipline invoked by many.

To sum up, Krugman's thought of the 'state of macro' can be interpreted as the result of a peculiar combination of pessimistic and optimistic insights. On the one hand, he defined the 'state of macro' as "sad" (Krugman 2016), since a large part of the 'cutting edge' research is still heavily embroiled in models like the DSGE which are the ultimate legacy of the Real Business Cycle school. This part of the community is not going to change its mind as the vast majority of the economists in the Thirties or even in the Seventies, when the stagflation eroded the post-war consensus of the Neoclassical Synthesis. The shock has not been as big as in those days, and this will allow the scholars to carry on their 'business as usual'. From this point of view, the closest historical similarities is the 1979-1981 Volker 'double-dip recession', which *should have* triggered a re-thinking of the idea that anticipated monetary contractions can tame inflation with no cost in terms of employment and growth. But it *did not*. And this because the recession was essentially 'light' and 'too short-lived'. Krugman has been quite dismissive, even sarcastic, towards recent

[20] Mario Draghi actually became President of the European Central Bank in 2011, but he played a crucial role in the eurocrisis ever since. Previously, he served as Chairman of the Financial Stability Board from 2009 to 2011 and as Governor of the Bank of Italy from 2005 to 2011.

[21] Larry Summers served as Director of the National Economic Council (NEC) for President Obama in 2009–2010. In the same period Christina Romer was the Chair of the Council of Economic Advisers (CEA)

developments in the DSGE field (of the kind described in section 1.3.2): "there are lots of proclamations about things researchers should or must do differently (…). We need to put finance into the heart of the models! We need to incorporate heterogeneous agents! We need to incorporate more behavioural economics! And so on. But while many of these ideas are very interesting, none of them seems to have emerged as *the* idea we need to grapple with" (Krugman 2018, p. 157).
On the other hand, Krugman has not drawn a purely bleak picture. Economic theory is not devoid of good ideas and good theories: the Keynesian tradition – or the 'saltwater macroeconomics'[22], as Krugman loves to call it – has proved itself essentially right in recent years and its theoretical background is sound, even if it still lacks convincing explanations for phenomena like the 'missing deflation' during the recent crisis. From this point of view, we are not facing a crisis of legitimacy of the discipline as a whole and of its professionals. The problem is that 'bad' macroeconomics – essentially 'lakewater macroeconomics' – often overshadows the 'good' one and exerts a huge political influence, with long-lasting damages on welfare and growth.

An even more severe assessment on the state of 'mainstream' macroeconomics has been put forward by another Nobel laureate, and worldwide celebrated economist, such as Joseph Stiglitz.
"No one would say, or at least should say, that macroeconomics has done well in recent years" (Stiglitz 2015, p. 20), wrote the Columbia University economist in the essay "Reconstructing macroeconomic theory to manage economic policy" (in Eloi Laurent and Jacques Le Cacheux, eds. "Fruitful Economics: Papers in Honour of and by Jean-Paul Fitoussi", 2015).
In that text Stiglitz described the history of macroeconomics in the last three decades as the triumphant march of two – slightly different – armies. Better, if one wants to reproduce the metaphor used by Stiglitz, of two "churches" (and the Nobel laureate even hastened to specify: "I use the term advisedly, because both were dominated by strong beliefs, which could be little altered by evidence and

[22] US Universities on the coasts are traditionally strongholds of a more interventionist approach in economics, while free marketers scholars are more common to be found in institutions such as the University of Chicago, in the North American Great Lakes region.

experience, though the style of argument seemed to suggest that both based their faith on a close examination of the empirical record", Stiglitz 2015, p. 24).

The first "church", which could be regarded as the original worship, was built on the rational expectations revolution of the Seventies, with its dismissal of monetary and fiscal policies as ineffective and its ambitious program of reconstructing macroeconomics on a sound microfoundation. The attempt to reconcile micro and macro was not wrong in itself, as far as Stiglitz was concerned. Yet this endeavour could have been driven along two very different lines.

A first option could have drawn on Keynesian macroeconomics to tinker the flaws of a micro theory based on unrealistic assumptions. This could have happened in a time when standard microeconomics was under the harsh scrutiny of theorist of imperfect and asymmetrical information and behavioural economics: for instance, the Greenwald-Stiglitz theorem (Grennwald and Stiglitz 1986) showed how market equilibrium could be non-Pareto efficient – meaning that the first fundamental theorem of welfare economics does not hold – in presence of asymmetrical information and imperfect risk markets.

The second option, the one that ultimately prevailed, would have led to a return to neoclassical, pre-Keynesian macroeconomics. In this imaginary world, the markets perfectly clear and the theory is developed via the utility maximisation process of a unique and fully rational representative agent. Unemployment is explained through the preference of some individuals for leisure (Stiglitz 2015).

The theoretical fragility of the second option undermined the whole subsequent evolution. It is noteworthy to point out that some of Stiglitz's criticism towards the New Classical school echoed the arguments advanced by post-Keynesian scholars at the peak of the popularity of the New Consensus (see section 1.2.3), such as the lack of a proper treatment of the financial sector:

"It is hard to have a robust financial sector in representative agent models: who is lending to whom? Since all risk is borne by the same (representative) agent, financial structure can't matter. Not surprisingly, banks then play no role. With the financial sector at the centre of this, and many other crises, it is no wonder that these models had little to say – either before or after the crisis" (Stiglitz 2015, p. 25).

"To me, the strongest aspect of modern macroeconomics was that central banks were using a model in which banks and financial markets played no role (Stiglitz 2015, p. 28).

Stiglitz's assessment was not less severe with respect to the so-called second "church" of macroeconomics. This 'schismatic tide' – represented by the New Keynesian model – was generated by the introduction of a series of wages and prices rigidities into a general equilibrium framework. The aim of these 'corrections' was to account for the fluctuations of the cycle, involuntary unemployment and the effectiveness of policy (more specifically, of monetary policy). Still, the implications of this approach were not less flawed and dangerous than the derived from New Classical macroeconomics:

"It essentially blamed the victim for unemployment. If only workers would accept lower wages then unemployment would disappear, and the economy would be restored to its potential. The belief on this notion helps explain why central bankers, rather than sticking to their knitting – trying to ensure financial stability – were so fond of discussing labour market rigidities. It was unions and government intervention in labour markets (through labour protection legislation, minimum wages, etc.) that were at the root of the problem. If the government allowed markets to work as markets then the macroeconomy would behave as classical economist had predicted" (Stiglitz 2015, p. 26).

The extract has been reproduced in its integrity because it offers the opportunity to make a short but important digression about the relationship between the contemporary New Keynesian school and its alleged links with the work of John Maynard Keynes. The following paragraphs do not deal directly with Stiglitz's recent interventions, but they can help to frame the whole discussion about the legacy of Keynes in contemporary macro, which so often looms in more technical contributions on these themes. Stiglitz's point of view will be recovered in the final part of the section, where the rationale for the digression will appear even clearer.

It would be probably too simplistic to describe contemporary New Keynesians merely as 'theorists of wage rigidities'. This particular strand of research sprang from some seminal papers in the late Seventies-mid Eighties of the last century which were mainly focused on price rigidities (Fisher 1977, Taylor 1979, Calvo 1983, Akerlof and Yellen 1985, Mankiw 1985, Parkin 1986, Blanchard and Kiyotaki 1987). Some of them were not even microfounded, yet they have been 'rediscovered' in the late Nineties and their principles are still incorporated in the last generation of macro models (Rankin 2011): for instance, most of the contemporary DSGEs feature some form of staggered pricing mechanism devised by Guillermo Calvo in his 1983 contribution ("Staggered prices in a utility-maximizing framework"). Therefore, wage rigidities is just a part of a more complex picture.

It is true that in Keynes' "General Theory" (1936) the boundary between prices and wages' trends tend to blur, since the wage-unit is the device that the English economist used as a price deflator for the nominal variables of his model. And it is true that Keynes assumed fixed wages for a large part of the development of his theory (the assumption is lifted just from chapter 19 onward).

Nonetheless, Keynes explicitly denied that the main results of his theory, namely the demonstration of the non-existence of 'natural forces' that in a capitalist economy maintain the system in an equilibrium of full employment, was due to the presence of wage rigidities.

Chapter 19 of "The General Theory" is entirely devoted to the explanation of why, even if complete flexibility of wages was ensured, a market economy could not offset the consequence of a lack of demand in term of employment and output without external intervention. Since the overall level of production, and of employment, is determined by the level of aggregate demand, Keyes tried to construe the channels through which a downward trend of real wages (and prices) could affect the level of demand. They were identified in the improvement of international competitiveness of a country (in the case of a sufficiently open economy) and in the decreasing level of demand of money, which in turn would usher in lower interest rates and boost investment.

However, these positive outcomes would be offset by:

a) The negative impact of lower wages, and a less even distribution of income and wealth, on consumption;

b) The negative impact of the expectation of decreasing prices on the marginal efficiency of capital and therefore on investment;

c) The deterioration of industrial relations;

d) The negative consequences of deflation on the sustainability of the debts of firms.

Keynes considered socially unfair and unrealistic to address a recession via the reduction of real wages, at least in decentralized capitalist economies. Moreover, even in the hypothesis it could be achieved, he regarded the measure as dangerously ineffective: "The chief result of this policy would be to cause a great instability of prices, so violent perhaps as to make business calculations futile in an economic society functioning after the manner of that in which we live" (Keynes 1936, p. 269).

The flexibility of wages and prices is not the magic wand that can conjure up a recovery. Likewise, the rigidity of wages and prices is not the cause of the slump of employment and output which follows a drop of the aggregate demand.
These references to "The General Theory" – although very concise – should have made clear that the label 'New Keynesians' used for the last generation of 'theorists of rigidities' risks to be misleading. In the present work it is used as a 'discipline convention' rather than a rigorous analytical classification.
The fact that the study of the "The General Theory" in its original version is not part of the standard curriculum of economics students all over the world could perhaps provide an explanation of the somehow deceptive label. Bill Gerrard has classified many types of confusion in the interpretation of Keynes. This particular one seems to be based on "Reliance on secondary sources", that is to say on the "tendency to read about Keynes rather than to read Keynes himself" (Gerrard 1991, p. 278).

Let's come back to Stiglitz's contribution (2015) now. As it has been said previously, his assessment of the so-called New Keynesian model was almost as severe as the one towards the Business Cycle school. The economic crisis of 2008 has exposed all the limits and the shortcomings of a mechanism essentially based on a modular composition of rational expectations, representative agents, utility maximization, general equilibrium and prices/wages rigidities. For the Columbia University economist the fact that the highly flexible US labour market fared worse than the Northern Europe in the immediate aftermath of the economic downturn should be regarded as a wake-up: external shocks are not better absorbed in a more flexible environment. And this is in contradiction with the theory that inspires the model.
Stiglitz acknowledged that some of the most prominent advocates of the New Keynesian-DSGE approach have taken seriously the criticism that has been raised after the crisis and they have started to work to improve their models, in particular on the financial sector (see section 1.3.2). However, in stark contrast with Blanchard and the other 'reformists', he did not think that the general enterprise was amendable: "I believe these models are not a good starting point. Such Ptolemaic exercises in economics will be no more successful than they were in astronomy in dealing with the fact of the Copernican revolution. It should be clear then why a reconstruction of macroeconomics is necessary" (Stiglitz 2015, p. 26).

In a subsequent paper (Stiglitz 2018) – which revisited and relaunched many of the arguments of the 2015 essay – Stiglitz even stated that the attempted improvements of the benchmark DSGE model have made the things worse. Two arguments were behind the tough remark: 1) one of the few advantages of these models was the formal elegance and the limited number of equations in comparison to the old-style structural model of the Seventies. With all these amendments "whatever elegance they might have" is lost (Stiglitz 2018 p. 72). Furthermore, it becomes very difficult, given this level of complexity, to track the dynamics of the system, the economic forces we are supposed to study. 2) As the number of ad hoc amendments grows, microfoundations are weakened. This results in a parallel weakening of "the confidence in the analyses of policies relying on them" (Stiglitz 2018, p. 72).

If the house of macroeconomics cannot be fixed, it has to be demolished and built it again from the foundations. Two 'theoretical pillars' should sustain the building according to the Columbia University economist: 1) the rejection of the simplified picture of the economic system presented by the first fundamental theorem of welfare economics. 2) The return to an interpretation of price and wages flexibility as a 'problem'. Point 2 is very much in line with the original thought of Keynes as expressed in "The General Theory", where we can read that "it is more expedient to aim at a rigid money-wage policy than at a flexible policy" (Keynes 1936, p. 266). The argument also owes Irvine Fisher some important insights about the pernicious consequences of debt deflation (see Fisher 1933).

In his 2018 paper, Stiglitz wrote that the behaviour during the recent financial crisis of central bankers in Europe, Japan and – to some extent – the United States has been quite interesting from a theoretical point of view. All these policy-makers put a lot of efforts into avoiding the deflation, evidently well aware of its risks. This would be quite difficult to understand if we assumed that the economic systems tend to converge to equilibrium unless price rigidities obstruct the mechanism; if this was the way economies work, deflation should be considered a blessing, not a danger. As it is evident the observation is not far in its core from Krugman's argument about an 'instinctive Keynesianism' held by key policy-makers during the crisis, in spite of the models officially adopted by their own institutions.

Stiglitz's conclusion was that "the reconstruction of macroeconomics based on alternative models to those of the two prevailing 'churches' of mainstream economics is likely to provide better answers" to the challenges that contemporary macroeconomics has to face (Stiglitz 2015, p. 28). And the Nobel laureate has indeed taken part in this effort of reconstruction via a new generation of macro models, as testified by two papers that will be discussed in the following chapters of this work: "Agent Based-Stock Flow Consistent macroeconomics: towards a benchmark model (2016, with Alessandro Caiani, Antoine Godin, Eugenio Caverzasi, Mauro Gallegati and Stephen Kinsella); "Inequality and finance in a rent economy" (2019, with Alberto Botta, Eugenio Caverzasi, Alberto Russo and Mauro Gallegati).

Finally, there is a third Nobel Prize winner, Paul Romer, who has engaged in the current debate on the 'state of macro'. However, given the peculiarity of his arguments, and given the fact that he had not yet received the accolade[23] when these arguments have been put forward, Romer's view will be presented in an independent section (1.3.8), focused on the 'psychological roots' of the "trouble with Macroeconomics".

1.3.4 Challenging the program of a full microfoundation of macroeconomics

A key point of the current debate on the 'state of macro' is the relationship between macro and micro, and the related program of full microfoundation of macroeconomics. For Stiglitz, microeconomics should have taken inspiration from macroeconomics to re-build itself (Stiglitz 2015, see section 1.3.3). On the opposite side of the spectrum there are the economists who think no actual alternative exists to a sound microfoundation of macro: "This is not because models with microfoundations are holier than others" – wrote Blanchard in his counter-reply[24] to the numerous interventions[25] triggered by his previous article "Do DSGE models have a future? – "but because any other approach makes it difficult to integrate new elements and have a formal dialogue" (Blanchard 2016 b). In other words, this approach is valuable because offers a "core structure around which to build and organise discussions" (Blanchard 2016 a, p. 4).

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[23] Romer has received the Nobel Prize in 2018 together with William Nordhaus

[24] "Further Thoughts on DSGE Models", 2016

[25] Several of these contributions will be examined later on in the present work

Krugman's comment about this kind of justification has been quite barbed: "It sounds (…) exactly like the defences I heard of academic Marxism when I was young: never mind whether it's right, it provides a framework" (Krugman 2016).

Criticism towards an 'extremist' approach to macro exclusively dominated by neoclassical microfoundation has not been confined to heterodox schools. Even economists who have contributed to the New Keynesian agenda expressed in the past some quite flexible and articulated opinions on the theme. In the Eighties Gregory Mankiw was one of the pioneers of the 'Menu cost model' and the so-called 'PAYM insight' (an acronym created by Rotemberg in 1987 to describe the work on nominal price rigidities of Akerlof and Yellen 1985, Mankiw 1985 and Parkin 1986. See section 1.3.3). Still, in an interview conducted a few years later, the Harvard economist declared:

> "I am not sure that all macroeconomics necessarily has to start off with microeconomic building-blocks. To give an analogy, all biology is in some sense the aggregate of particle physics, because all biological creatures are made up of particles. That doesn't mean that the natural place to start in building biology is to start with particle physics and aggregate up. Instead, I would probably start with theory at the level of the organism or the cell, not the level of the sub-atomic particle" (in Snowdon and Vane 2005[26], p. 434).

Nowadays the biological analogy has become quite popular to describe the relationship between micro and macro. One of its users has been an economist cited in Blanchard's reply (2016 b): Anton Korinek, of the Johns Hopkins University, in his own words "a member of the macro profession who himself at times employs DSGE models to analyse interesting macroeconomic questions" (Korinek 2015).

According to Korinek, many fields of knowledge encompass a distinction between a micro and a macro level: nuclear physics and chemistry study essentially the same subject, but with different degree of 'precision'. So chemistry and biology do, and biology and medicine too. Different methodologies must be applied to different levels: in the macro context, for instance, it is possible to use principles that come from a rather rough approximation but that can explain phenomena otherwise unexplainable relying just on the micro-laws.

[26] Even if the publication date of the book is 2005, the interview was conducted 1993, with some later integration in 1998

Korinek borrowed the expression "emergent phenomena" from systems theorists to describe events that "emerge from the interactions of entities at the micro level but are too complex to be satisfactorily described from a micro perspective given our current state of knowledge" (Korinek 2015. See also Solow 2008 on the fallacy of composition of microfounded macroeconomics).

Macroeconomics is full of exemplars of phenomena or concepts that do not have counterparts in micro. Korinek pointed out that aggregate demand is one of them. In his 2014's paper "Micro vs Macro", the Swedish economist Lars Pålsson Syll used the biological analogy in an even more vivid way: "Murder is probably the only way of reducing biology to chemistry": "disregarding Sonnenschein-Mantel-Debreu and trying to reduce macroeconomics to Walrasian general equilibrium microeconomics basically means committing the same crime" (Pålsson Syll 2014, p. 27).

Korinek's example of the aggregate demand as a typical concept which can find a proper *raison d'être* only in a macro context gives us the opportunity to make a second digression on the work of John Maynard Keynes. The aim, once again, is to underline how many of the arguments that have been raised in the contemporary debate by economists with very different backgrounds are ultimately rooted in the insights of the author of "The General Theory".

Macroeconomics as a discipline was virtually born from the intuition of Keynes that the economic system as a whole is driven by forces and variables that have to be studied at the aggregate level. Even when Keynes dealt with the psychological factors that play such an important role in his comprehension of the dynamics of capitalist economies, he always referred to a "social psychology": the "subjective factors" of the propensity to consume analysed in chapter 9 of "The General Theory" are "subjective" in the sense that they are linked to a specific social, cultural and religious environment, not in the sense that they are referred to different characteristics at the individual level.

Strictly related to 'problem of aggregation' is the issue of how to keep together the principles of the mathematical formalisation and the acknowledgement of its limits. It could help to develop this argument via a practical example. Chapter 11 of "The General Theory" is focused on the concept of marginal efficiency of capital, which Keynes essentially inherited from Alfred Marshall ("Principles of economics", 1890) and Irving Fisher ("Theory of Interest", 1930). The marginal efficiency of capital was defined as the rate of discount that equals the prospective yields of an investment to the supply price of the capital-asset that represents the investment. The interaction between the curve of the marginal efficiency of capital and the interest rate – with the latter no longer explained through the neoclassical theory – set the level of investment. The overall level of the aggregate demand, and of output, is essentially driven by the behaviour of this autonomous investment component, being the consumption determined by the level of income-output.

However, this was not the end of the story for Keynes. Once provided the analytical definition of the marginal efficiency of capital, in the second part of chapter 11 the British economist discussed the reasons behind the instability of that very curve and therefore the factors that make the investment so unstable. These pages – featuring the example of the 'beauty contest' and the description of the short-term obsession of professional investors in the stock market – are some of the most famous of Keynes' work and of economic literature of all times. Unfortunately, they have been too often reduced to a lively description of the 'irrational behaviour' that can sometimes characterise capitalist economies. Their content is much more profound. They evoke the 'eternal struggle' within the economic discipline between the aim to build a rigorous formalisation of the economic aggregates, and the necessity to provide a broader comprehension of their political, psychological, sociological and even philosophical dimensions[27]. With regard to the calculus of the marginal efficiency of capital as a function of prospective yields of an investment, Keynes wrote:

> "The outstanding fact is the extreme precariousness of the basis of knowledge on which our estimates of prospective yield have to be made. Our knowledge of the factors which will govern the yield of an investment some years hence is usually very slight and often negligible. If we speak frankly, we have to admit that our basis of knowledge for estimating the yield ten years hence of a railway, a copper mine, a textile factory, the goodwill of a patent medicine, an Atlantic liner, a building in the City of London, amounts to little and sometimes to nothing; or even five years hence. In fact, those who seriously attempt to make any such estimate are often so much in the minority that their behaviour does not govern the market" (Keynes 1936, p. 129).

[27] The historical background of the controversy on the use of mathematical formalisation in economics has been provided here with a specific focus on Keynes's work. In Marchionatti and Sella (2017) it is possible to find a wider survey of the origins of the dispute – which harks back at least to the dispute between Walras and Edgeworth in the occasion of the second edition of the "Éléments d'économie politique pure" (1899) – and some acute considerations of its links with the contemporary debate on the 'state of macro'.

Few pages later, the British economist added:

> “Our decisions to do something positive, the full consequences of which will be drawn out over many days to come, can only be taken as a result of animal spirits — of a spontaneous urge to action rather than inaction, and not as the outcome of a weighted average of quantitative benefits multiplied by quantitative probabilities” (Keynes 1936, p. 139).

If a mathematical calculus of prospective yields is not only exposed to the failure of the expectations, but is practically impossible to be carried out, the entire analytical concept of marginal efficiency of capital is at risk. It is true that in some other passages Keynes tended to scale down the implications of all this, underlining “certain important factors which somewhat mitigate in practice the effects of our ignorance of the future” (Keynes 1936, p. 140). However, the tension between the need of modelling the economic system via quantitative aggregates and the necessity of understanding the reality with a wider point of view remained at the very core of “The General Theory”.

To some extent, that’s the same tension that shapes the debate about the ‘state of macro’ today. It seems useful to draw again on Korinek 2015 to show a typical argument deployed by the critics of the excess of formalisation: the ‘obsession’ for a very complex mathematical structure that seems to characterise modern DSGE modelling “impose serious restrictions on the set of models”, and therefore on the set of phenomena “that DSGE macroeconomists can analyse. In other words, the set of ideas that we can describe in rigorously quantified DSGE models is smaller than the set of ideas that we can express in simpler models. These methodological restrictions limit our modelling and, ultimately, our thinking” (Korinek 2015).

Similarly, Pålsson Syll (2014) has spoken of a pure trade-off between mathematical-statistical tractability and ability to make an accurate statement on the real world. None can eliminate the necessity of formalising economic facts in order to render them manageable from a modelling point of view. Nonetheless “mathematical tractability cannot be the ultimate arbiter in science when it comes to modelling real-world target systems” (Pålsson Syll 2014, p. 13). This sacrifice of realistic assumptions could have been regarded more graciously if it had provided good predictions on the actual behaviour of the economic system: but it did not, as Pålsson Syll, Krugman and many others underlined. “Therefore, the burden of proof is on those macroeconomists who still want to use models built on these particular unreal assumptions" (Pålsson Syll 2014, p. 13).

1.3.5 A pattern for evolution in Macroeconomics: progressive accumulation vs breaking points

The starting point of Keynes' "General Theory" was the rejection of the neoclassical-marginalist theory[28] (or at least of some of its main assumptions). This hugely influential book has been considered for a long time the 'birth certificate' of macroeconomics as a new, autonomous discipline. The same point of view has been taken to present the arguments in section 1.3.4. However, this interpretation of the origin of macroeconomics is far from being undisputed today.

Simon Wren-Lewis (2016 b and 2018) has pointed out that modern, 'mainstream' macroeconomics does not regard "The General Theory" as its founder text. If one main reference should be identified, it would be found in Lucas and Sargent's "After Keynesian Macroeconomics" (1979), which hailed the beginning of New Classical Macroeconomics revolution.

The New Classical Macroeconomics revolution, Wren-Lewis argued, has not been successful in the long-term with respect to its policy prescriptions: the rejection of fiscal and monetary policies as cycle-stabilizers has not last, first of all because policy making institutions never really 'bought' it; furthermore, the last generation of New Keynesian DSGE models takes into account the need of policy interventions in order to tackle economic shocks.

However, the New Classical revolution has been completely successful from a 'methodological' point of view: microfoundation has become the only way to do macroeconomics 'properly', the only approach that can claim scientific dignity.

It's worth noticing that Wren-Lewis' critic intervention came from an economist far from being biased against microfoundation and its potential. Indeed, he "spent over a decade working with models of this kind" (Wren-Lewis 2016 b, p. 27) just because

[28] Actually, in the very first chapter of the book Keynes referred to the "classical theory" as the target of his criticism. In the tradition of the history of economic thought the classical economists are essentially Smith, Ricardo and Marx. Keynes acknowledged to have become accustomed to label as "the classical school", "perhaps perpetrating a solecism" (Keynes 1936, p. 187), *de facto* all the economists before himself, including Alfred Marshall, Francis Ysidro Edgeworth and Arthur Cecil Pigou.

he thought they could be fruitful. In the paper for the special issue of the *Oxford Review of Economic Policy* (see section 1.3.2) he wrote: “microfoundations modelling is a progressive research programme, and (…) therefore, unlike most heterodox economists, I do not think it should be abandoned” (Wren-Lewis 2018, p. 56). The problem, again, is their ambition to be the *‘*only game in town*’* ever since this programme of research took the form of a ‘revolution’ rather than of a ‘parallel path’ set to help former large-scale econometric models (or structural econometric models, SEMs) to overcome the difficulties they faced[29].

As anticipated, the most important difference between the new breed of DSGE models and the earlier structural models challenged by Lucas’ Critique was to be found in the methodology: for DSGE models, Wren-Lewis explained, “it is essential that aggregate equations can be derived from microeconomic theory, and furthermore the theory behind each equation in the model has to be mutually consistent: what is often described as ‘internal consistency’” (Wren-Lewis 2016 b, p. 26); the method of the old Neoclassical Synthesis is “empirically oriented” and does not regard internal consistency as the main requirement, so that its equations are “often justified by very informal theoretical arguments, and sometimes (particularly when it came to dynamics) no theoretical justification was provided at all” (Wren-Lewis 2016 b, p. 26).

Both methodologies have weaknesses and strengths. The New Classical revolution has focused just on the weaknesses of old SEMs and has deliberately ignored the weaknesses of microfoundation, which “allows clear empirical facts to be put on hold and to be addressed at a later date (some might say just ignored)” (Wren-Lewis 2016 b, p. 28). Such an approach “makes it easier for ideological bias to influence research programs” (Wren-Lewis 2016 b, p. 28). Moreover, for the sake of this “internal consistency”, macroeconomic models tend to set aside all the phenomena and areas that could not find a straightforward integration in the perfect mathematical ‘house of card’ represented by this completely microfounded system:

[29] In their scathing analysis of the models of the Bank of England, Hendry and Muellbauer (2018) endorsed Wren-Lewis regret for the complete abandonment of the SEMs “instead of improving such models by addressing weaknesses” (Hendry and Muellbauer 2018, p. 290). They were referring first of all to the MTMM used by the Bank of England up to 2003. The substitute was, of course, a DSGE model: initially the BEQM and then, since 2011, the COMPASS. Yet the result ended up to be very poor according to these Oxford economists: “If BEQM was a lurch further away from data coherence than MTMM, the introduction in 2011 of the COMPASS could be regarded as another milestone on this road” (Hendry and Muellbauer 2018, p. 305).

the absence of the financial sector in most of the DSGE models prior to the recent crisis has been indicated by Wren-Lewis as a clear example of this attitude.

Between internal and external consistency, that is to say between the purity of a perfect deductive system and the capability of fitting the data and making good economic forecasts, there is a clear trade-off (Wren-Lewis 2016 b). An 'extremist' choice that always leans to the side of the highest theoretical purity does not seem to be the wisest option for a social science that should be able to interpret what is going on in the real world and give useful advice to the policy makers.

Is this trade-off inevitable? Is it possible that one day it will be overcome by an approach both fully microfounded and able to explain the patterns that emerge from the data? Wren-Lewis has not answered explicitly to this question. His pragmatic stance suggested that as far as this trade-off exists it does not make sense to ignore contributions that come from one of two sides. The best option is cooperation:

"There is no reason why both [methodologies] cannot be pursued together. DSGE analysis can attempt to micro-found relationships that appear empirically robust in SEMs, or important from a system perspective in analysis using small analytic models, while these models and SEMs can gradually incorporate advances in theory that come from DSGE analysis" (Wren-Lewis 2016 b, p. 29).

The position evidently echoed the plea made by Blanchard (2016) for a "less imperialistic" approach of the DSGE modelling already seen in section 1.3.1. Indeed, Wren-Lewis has championed a more pluralistic environment for macro modelling, where no hegemonic power overshadows all the other options. His consonance with Blanchard has been explicitly acknowledged: "Blanchard's position is one that I have been publicly advocating for a number of years" (Wren-Lewis 2018, p. 56).

This means that a new 'counter-revolution' against the 'counter-revolution' of the New Classical Macroeconomics – a counter-counter-revolution – is today neither *likely* nor *desirable* for Wren-Lewis.

This very last passage is particularly interesting and requires some clarification. Despite the pretty moderate conclusion, it is possible to identify a 'Keynesian root' in the reasoning behind it.

One of the most famous sentences of "The General Theory" reads that "the ideas of economists and political philosophers, both when they are right and when they are wrong, are more powerful than is commonly understood" (Keynes 1936, p. 332).

Wren-Lewis' position appeared to be consistent with this 'idealistic' and 'anti-materialist' philosophy of history and its implications on the philosophy of economics as a social science. A widespread reconstruction of the rise of the New Classical revolution tends to focus on the situation of the Western economies during the Seventies, when the neo-Keynesian Phillips curve[30] could not explain the simultaneous presence of high inflation and high unemployment. Still, New Classical Macroeconomics failed to provide an alternative and sound explanation of the same inflation phenomenon. The reason for its success was not grounded on a reaction to facts, and on a more plausible accounting for them, but on an ideologically driven project. The story conveys a lesson for today too:

> "Trying to see the NCCR [New Classical Counter Revolution] as being primarily inspired by empirical events fails to understand both the nature of that revolution and also why it was so successful. It may also inspire false hopes among some who believe that the global financial crisis *must* lead to a new revolution in macroeconomic thought and practice" (Wren-Lewis 2016 b, p. 30).

With regard to the *desirability* of a counter-counter-revolution, that's a stance consistent with Wren-Lewis' 'syncretic' approach described previously. Critics of the 'mainstream' should avoid the mistakes made by the New Classical revolutionaries: to replace the dominant method with a 'new dominant' method that completely overthrows the current state of the research and overlooks its indisputable achievements. Evolution in macroeconomics should be led by a progressive accumulation rather than a series of breaking points (Wren-Lewis 2016 b).

Ultimately Wren-Lewis belongs to the same 'reformist bunch' which features Olivier Blanchard and other 'mainstream' economists. Yet his criticism of the unilateralism of microfounded macroeconomics is sometimes so sharp that would have appeared quite extraordinary and 'revolutionary' until a few years ago. And this is actually a significant sign of how far the 'centre' of the debate has shifted in comparison to the pre-crisis era.

[30] When we refer to the 'neo-Keynesian Phillips curve' we mean the relationship between unemployment and inflation which in the economic literature is traditionally associated with the work of the New Zealand economist Alban William Phillips. Actually, the relationship studied by Philipps in his 1958 seminal paper was between unemployment and change in nominal wage rate. What has become known as the Phillips curve – our neo-Keynesian Phillips curve – is the price-level modified curve built by Samuelson and Solow (1960).

1.3.6 The 'Great Return' of fiscal policy: the debate on fiscal multipliers and the Modern Monetary Theory

Wren-Lewis' argument that in the long-run the New Classical Macroeconomics revolution has not been successful in its policy prescriptions is pretty persuasive: notwithstanding the conclusions of the theory, he wrote, policy making institutions never really 'bought' the story of the uselessness of active stabilising intervention. From this point of view, his contention resembles Krugman's position (see section 1.3.3) on the 'instinctive' Keynesianism of the people with apical roles in the American government and central banks during the last financial crisis.

However, the thesis should not be taken to extremes. Apart from the head of the BCE, it is hard to consider the management of the crisis in Europe as an example of 'instinctive' Keynesianism of policy makers. Furthermore, if our purpose is to focus of the 'state of macro' as a theoretical enterprise, we cannot neglect the long period in which fiscal policy has been almost completely dismissed by the leading figures of the profession at least in academia. Its recent return to fashion marks one of the most interesting discontinuities that has been brought about by the crisis and by the real-time analysis of the responses which have been deployed to tackle it.

In 1990 Francesco Giavazzi and Marco Pagano published a seminal study entitled "Can fiscal contraction be expansionary? Tales of two small European countries". It became the primary reference for a long series of subsequent works on the expansionary effects of austerity measures, such as Alesina, Perotti and Tavares 1998, Alesina and Ardagna 1998 and Alesina and Ardagna 2010.

The historical precedents Giavazzi and Pagano drew on were the election of two right-wing governments in Denmark (1982) and Ireland (1987): they slashed government expenditure and yet succeeded in promoting an impressive growth compounded with a stark improvement of public finance. For Giavazzi and Pagano the "alchemy" was due to a variety of factors, included the drop of interest rates linked to a more credible peg of the currencies and the wealth effect that this produced on households' consumption. Furthermore, the Italian economists claimed that in both cases a typical 'Ricardian-equivalence factor' was at work:

"Fiscal consolidation can be read by the private sector as a signal that the share of government consumption in GDP is going to be reduced permanently, so that taxes also will be permanently lower. This would lead households to revise upward the estimate of their human capital (the discounted value of after-tax labour income), and to raise current and planned consumption" (Giavazzi and Pagano, p. 102).

A more original argument was based on a kind of 'substitution mechanism' between public and private goods: when public expenditure is slashed many of the goods and services that were provided by the government are not freely available to the citizens any more. However, many of these services – such as health or education – are of primary importance for the daily life of people and therefore consumers would step in and buy on the market what once was supplied by the state. The outcome would be a simple shift from public to private consumption of several goods, with no adverse effect on aggregate demand and GDP, in particular if credit money is easily accessible to households. The fact that in Ireland a similar experiment in 1982 was followed by a drop by 7% of consumption – and a severe economic recession – was explained by Giavazzi and Pagano with differences in the conditions under which the same policy was adopted, among which a more stringent liquidity constraint prior to the capital movement liberalisation occurred in mid-Eighties.

A broader sample of countries through a more extensive period was considered by Alesina and Ardegna (2010). It is quite striking that, in the middle of the worst recession experienced by Western countries since the Great Depression of the Thirties, Alesina and Ardegna's main concern was about public debt: "The next question governments all over the world will face next year, assuming, as it is likely, that a recovery next year will be underway, is how to stop the growth of debt and return to more 'normal' public finances" (Alesina and Ardegna 2010, p. 35).

Another theoretical pillar of the 'austerity movement' was "Growth in a Time of Debt" (2010) by the American economists Carmen Reinhart and Kenneth Rogoff. Before being discredited by a series of errors contained in the paper – included "coding errors, selective exclusion of available data, and unconventional weighting of summary statistics" (Herdon, Ash and Pollin 2014, p. 257) – this study has been highly influential in shaping the political response to the economic crisis in Europe. In 2010 the then UK Chancellor of Exchequer George Osborne held a speech presenting his strategy of economic policy: "The latest research suggests that once debt reaches more than about 90% of GDP the risks of a large negative impact on long-term growth become highly significant" (Osborne 2010), he said. The notorious threshold had been just set by the study mentioned above, "perhaps the most significant contribution to our understanding of the origins of the crisis" (Osborne 2010). Similar tributes were paid to "Growth in a Time of Debt" by Olli Rehn, then Vice-President of the European Commission and Commissioner for Economic and Monetary Affairs and the Euro: "Public debt in Europe is expected to stabilise only by 2014 and to do so at above 90% of GDP. Serious empirical research has shown that at such high levels, public debt acts as a permanent drag on growth" (Rehn 2013). Wolfgang Schäuble, then the German Minister of Finance and one of the most important figures in the conception of the European economic policy during the euro crisis, joined the choir too: "Recent studies – most prominently Rogoff's and Reinhardt's book 'This Time Is Different' –, have shown that once government debt burdens reach thresholds perceived to be unsustainable more debt will stunt rather than stimulate growth" (Schäuble 2011).

All these works provided further arguments to a 'distrust' for fiscal policy that was already implicit in the dominant paradigm. The latter relied mainly on monetary policy as the main tool to fine-tune the economy, with the strongest emphasis put on structural reforms on the supply side.

Said that, and despite the background that has just been sketched, the exceptional circumstances of the Great Recession have also inspired a renewed attention to the theme of fiscal policy and fiscal multipliers on a different basis. In 2009 the new Obama administration launched the *American Recovery and Reinvestment Act*, a stimulus package of roughly 800 billion dollars[31] which paved the way for an alternative approach. Two competing petitions of economists were published at the time in the United States: one against the stimulus (signed by approximately two hundred economists, the Nobel laureates Edward Prescot, Vernon Smith and James Buchanan included) and one in support of it (signed, again, by approximately two hundred economists, among whom the Nobel Prize winners Kenneth Arrow, Lawrence Klein, Eric Maskin, Daniel McFadden, Paul Samuelson and Robert Solow).

[31] It is worth to notice that Christina Romer, chair of President Obama's Council of Economic Advisers, assumed a fiscal multiplier as large as 1.6 to compute the job gain of the stimulus approved in the first weeks of the new administration (Romer and Bernstein 2009). The theoretical assumption was evidently quite bold at the time, given the dominant consensus on the topic among Romer's academic colleagues. A few years later, the estimate seems quite realistic, especially considering the situation of the US economy in 2009.

A whole new crop of studies has followed. Several literature surveys have been published too, such as Hall (2009), Spilimbergo, Symansky and Shindler (2009), Ramey (2011 b), Boussard, de Castro, Salto (2012), Mineshima, Poplawski-Ribeiro and Weber (2014).

Fiscal multipliers – usually defined as the ratios of the output increase to the government expenditure increase or decrease of tax pressure[32] – have been estimated with different methodologies.

A first group of works was based on classical econometrics models, such as Vector Autoregressions (VARs) or even standard OLS regressions.

OLS estimates have to address a fundamental problem of endogeneity, since the government expenditure is a determinant of total output, but is also influenced by the output and by the corresponding revenues, which often set the main political constraints for public spending. The recourse to instrumental variables could be a way to overcome this problem. An alternative way is to use a reasonably exogenous component of the government expenditure such as military spending as the independent variable and to rely on the pretty smooth growth of the non-military component that is captured by the error term (see, for instance, Hall 2009).

VARs models have been used by Blanchard and Perotti (2002), Perotti (2007), Mountford and Uhlig (2008), Ramey (2011 a), Bachmann and Sims (2011), Beetsma and Giuliodori (2011), Cimadomo and Bénassy-Quéré (2012). Mineshima, Poplawski-Ribeiro and Weber (2014) have calculated that the average value of the government spending fiscal multiplier in the literature which used linear Vector Autoregressive Model is 0.8 (a value that rises to 1 in case of the United States).

Another strand of studies has tried to estimate economic condition-specific, or cycle-specific multipliers. The gist of this approach echoed "earlier Keynesian arguments that government spending is likely to have larger expansionary effects in recessions than in expansions. Intuitively, when the economy has slack,

[32] The definition can vary according to the context. A broader definition is provided, for instance, by Mineshima, Poplawski-Ribero and Weber (2014): "Fiscal multipliers are typically defined as the ratio of a change in output to an exogenous change in the fiscal deficit with respect to their respective baselines" (Mineshima, Poplawski-Ribeiro and Weber 2014, p. 316). In Ilzetzki, Mendoza and Végh (2013) "the definition of the fiscal multiplier is the change in real GDP or other output measure caused by a one-unit increase in a fiscal variable. For example, if a one dollar increase in government consumption causes a 50 cent increase in GDP, then the government consumption multiplier is 0.5" (Ilzetzki, Mendoza and Végh 2013, p. 244).

expansionary government spending shocks are less likely to crowd out private consumption or investment" (Auerbach and Gorodnichenko, p. 2012).

Auerbach and Gorodnichenko (2012) used a regime switching vector autoregression model: over a sample period of quarterly US data (1947-2008) they found a multiplier of about 0.5 in both regimes – recession and expansion – just after the policy shock (which is always considered as a positive change in government purchases). Yet the impact of the stimulus diverged very much over the following quarters "with the response in expansions never rising higher and soon falling below zero, while the response in recessions rises steadily, reaching a value of over 2.5 after 20 quarters" (Auerbach and Gorodnichenko 2012, p. 8). These results were essentially confirmed in a subsequent work built on a bigger number of OECD countries (Auerbach and Gorodnichenko 2013). Several other pieces of research have followed a similar approach and have estimated economic condition-specific fiscal multipliers. Among them: Alfonso, Baxa and Slavik (2011), Batini, Callegari and Melina (2012), Baum and Koester (2011), Baum, Poplawski-Riberio and Weber (2012).

A very similar idea was endorsed even by the International Monetary Fund (2012), which has conducted an analysis on 28 advanced and emerging economies and has found that during the Great Recession fiscal multipliers have been in the range of 0.9 to 1.7. The underestimation of fiscal multipliers in the early stages of the crisis led to fiscal consolidation programmes – especially in Southern European countries – which in turn yielded much worse than expected contractions of GDP and increase in unemployment rates. This was honestly acknowledged by the then chief economist of the IMF Olivier Blanchard, who in 2013 published a paper entitled "Growth forecast errors and fiscal multipliers" (with Daniel Leigh)[33]. Using data from European economies, in 2010 Blanchard and Leigh found a negative correlation between forecasts of fiscal consolidation ("forecast of the change in the general government structural fiscal balance in percentage of potential GDP" as taken from the IMF's World Economic Outlook, Blanchard and Leigh 2013, p. 117) and the forecast errors for real GDP growth: the higher was the fiscal consolidation programme, the higher has been the distance between the actual rate of growth and the forecast rate of growth (with the latter much higher than the former). "A natural

[33] The study was initially published as an IMF Working Paper, although the references at the end of the chapter include its final version, published for the *American Economic Review*.

interpretation" of these results "is that fiscal multipliers were substantially higher than implicitly assumed by forecasters" (Blanchard and Leigh 2013, p. 2012). The liquidity trap in which advanced economies found themselves during the Great Recession has been credited as one of the main factors that explain higher than normal fiscal multipliers.

Some examples of DSGE-derived multipliers can be found in Coenen and Straub (2005), López-Salido and Rabanal (2006), Galí, López-Salido and Vallés (2007) Cogan, Cwik, Taylor and Wieland (2010), Leeper, Traum and Walker (2011), Coenen et al. (2012). Again, different results can be obtained within a DSGE framework if interest rates are set at zero. According to Christiano, Eichenbaum and Robelo (2011), while the fiscal multiplier is around 1 in normal times, it can be as high as 3.7 if the economy is a liquidity trap. Higher estimates of multipliers – again within a DSGE framework – have been obtained in case of binding zero lower bound also by Eggertsson 2006 and Woodford 2011.

To sum up, the extensive literature on the fiscal multipliers that have blossomed in recent years is a clear example of how even 'mainstream' economic research has re-focused its attention after the outbreak of the Great Recession.

According to Mineshima, Poplawski-Ribeiro and Weber (2014)[34] a sort of 'new consensus' on the effectiveness of fiscal policy has emerged from the experience of the Great Recession:

- Government spending has a higher multiplier while tax multiplier is smaller in the short run.
- The United States tends to have larger multipliers than Europe, partly offsetting differences in the automatic stabilizers.
- Spending multipliers tend to be larger when the economy has large output gaps and when monetary policy is accommodative or ineffective (at the zero interest rate bound).
- Although the estimates are fewer, the multipliers for emerging markets and low-income countries tend to be lower than in advanced economies" (Mineshima, Poplawski-Ribeiro and Weber 2014, p. 333).

Outside the 'mainstream', the debate on the so-called Modern Monetary Theory has attracted much attention inside and outside the academia. This approach can be

[34] It is worthwhile to point out that this study - "The size of multipliers" - is included in an official IMF staff book entitled "Post-crisis Fiscal Policy" (Cottarelli, Gerson, Senhadji, eds. 2014). The author of the forefront is the managing director of the IMF, Christine Lagard.

regarded as the theoretical justification for an even more 'radical' use of fiscal policy not only as a cycle stabiliser, but also as a fundamental tool to achieve ambitious social and political goals such as full employment and a sustainable model of growth (sometimes a whole range of goals is incorporated in the proposal of a Green New Deal). At the beginning of 2019 a university handbook of macroeconomics *from the point of view* of the Modern Monetary Theory was released (Michell, Wray and Watts: "Macroeconomics"). There, it is possible to find the following short description of the theory and its principles:

> "The most important conclusion reached by MMT is that the issuer of a currency faces no financial constraints. Put simply, a country that issues its own currency can never run out and can never become insolvent in its own currency. It can make all payments as they come due. For this reason, it makes no sense to compare a sovereign government's finances with those of a household or a firm" (Mitchell, Wray and Watts 2019, p. 13).

The popularity of MMT among the general public is partly due to the political influence of some of its representative on the left of the US Democratic Party. For instance, a leading proponent of MMT, Stephany Kelton, has been chief economist for the Democratic Minority Staff of the US Senate Budget Committee and then economic advisor to Bernie Sanders in the 2016 Democratic Party presidential primaries.

At any rate, although the MMT regards itself as 'version' of post-Keynesian economics, there is no consensus among 'heterodox' economists about the soundness of the theoretical foundations of this strand of research. Thomas Palley, a Post-Keynesian economist too, has been one of the most severe critics of the MMT. According to Palley, the MMT underestimates "the economic costs and exaggerate the capabilities of money financed fiscal policy. MMT's analytic shortcomings render it poor economics. However, its simplistic printing press economics is proving a popular political polemic, countering the equally simplistic and wrong-headed household economics of neoliberal austerity polemic" (Palley 2019, p. 1).

The debate is set to continue, especially in case of a victory of a Democratic candidate in the US presidential elections in 2020.

1.3.7 "Things that probably aren't true" in modern Macroeconomics

Up to now, the chapter has mainly covered the opinions of the economists who have appealed for renewal in the monolithic world of macroeconomics, but at the same time have not advocated an outright shift of methods and models. A completely different approach is adopted by the 'revolutionaries'.

'Heterodox' economics[35] has always existed, even at the peak of the New Classical 'normalisation era'. The novelty of the post-crisis era is threefold: old and new strands of 'heterodox' research have received much more attention than before; 'heterodox' economists have been flanked in their harsh criticism against the 'mainstream' by colleagues who do not always come from a 'heterodox' background (see for instance the case of the Nobel laureate Paul Krugman); calls for a radical change in macroeconomics are spreading even beyond the academia, together with calls for a radical change in economic policy: for many, the populist wave that is threatening Western democracies cannot be defeated without new ideas.

In an article published by the *Financial Times* with the title "Reform the economic system now or populists will do it" (December 18, 2016) the columnist Wolfgang Münchau linked the anti-establishment sentiment that fuels populist movements all over the world to the crisis of authority of the theoretical fabric of the old liberal order: "We should not be surprised that people have become sceptical about experts who peddle theories that result in comically wrong predictions and that do not square with the reality they perceive" (Münchau 2016). Among these theories, it is explicitly mentioned the New Keynesian model, the workhorse of modern macroeconomics. The consequence of a lack of self-criticism within the economics profession could be politically and socially very dangerous. That is why Münchau wrote that "case for a challenge of the macroeconomic policy doctrine is overwhelming" (Münchau 2016).

For the 'revolutionaries' of the economics profession a complete re-building of economic theory is necessary to face this challenge. As Marc Lavoie put it:

[35] Here the expression 'heterodox' economics refers to an archipelago of theories which do not share the fundamental assumptions of the dominant paradigm. The label is somehow ambiguous, as in the heyday of the Keynesian hegemony Milton Friedman could have been defined as a 'heterodox' economist. Still, the popularity of the expression in the current debate is partly due to its 'useful opacity', given the fact that it would be quite tricky to refer all contemporary 'heterodox' economists to a unique school of thought.

"Macroeconomic theory needs to be revised both for the yang and the yin phases. Providing new clothes to the Naked Emperor of mainstream economics won't do; the Emperor needs to be dethroned" (Lavoie 2016).

Lavoie, who is one of the most prominent figures of the post-Keynesian school, provided a whole list of tools and concepts of 'mainstream' economics that have not "survived to the test of time" and "must go away" (Lavoie 2016, "Rethinking macroeconomic theory before the next crisis"). It is indeed a quite long list, but its length is pretty telling of the scale of change that the Canadian economist propounded. It comprises the following elements:

1) Rational expectations.
2) Efficient market hypothesis.
3) Unbiased efficiency hypothesis in financial markets.
4) Perfect assets substitutability assumption.
5) NAIRU (non-accelerating inflation rate of unemployment).
6) Barro's Ricardian equivalence theorem.
7) The idea of expansionary fiscal austerity.

According to Lavoie, all these revered pillars of 'mainstream' economics have been rebutted by empirical evidence in the era of the global financial crisis. In addition, there are many other tenets of 'mainstream' economic theory which are "under threat", in particular in monetary economics: the quantitative theory of money, the causal relationship between excess of reserves and inflation, the "money multiplier story", the usefulness of quantitative easing, the necessity of an independent central bank and of inflation targeting, the Taylor rule (Lavoie 2016).

Lavoie has been so uncompromising in his assessment that very little of the core of modern macroeconomics has been spared. However, several economists with a 'mainstream' background have expressed very similar criticism. In a session in honour of Olivier Blanchard held at the MIT on June the 4th 2016, Justin Wolfers, professor of the University of Michigan and former graduate student of Blanchard himself, presented a list of "things that probably aren't true": rational expectations, DSGE models, consumption Euler equation, Calvo pricing, New Keynesian Philippe curve, Classical dichotomy (Wolfers 2016). It is apparent that Worfers' list is not 'softer' towards the core of contemporary macro than Lavoie's one.

Lavoie did not directly include DSGEs in his list because he mentioned the tools and the theoretical concepts whereby this kind of modelling is conducted; furthermore, he dealt with the New Keynesian model in an earlier section of his 2016 article mainly focused on the concept of hysteresis.

For Olivier Blanchard, the “comeback” of hysteresis is one of the many examples of “propositions that would have been considered anathema in the past” and that now “are being proposed by ‘serious’ economists” (Blanchard 2015). Blanchard himself contributed to the introduction of the idea of hysteresis in the macro debate in the Eighties (Blanchard and Summers 1986, Blanchard 1987), but later the theory would end up to be abandoned by ‘mainstream’ economists.

The consequences of this “comeback” could be very ‘dangerous’ for the dominance of contemporary macro models, namely Dynamic Stochastic General *Equilibrium* models. As Lavoie explained in his article, the *equilibrium* these models refer to is based on the concept of NAIRU (non-accelerating inflation rate of unemployment) or NAICU (non-accelerating inflation capacity utilisation). The introduction of price and wage rigidities has provided the RBS model with a ‘New Keynesian mechanisms’ to explain the deviations from the equilibrium led by demand shocks. It has also allowed the model to justify at least the short-term effectiveness of the monetary policy. However, in the long-run, the system is bound to come back to its equilibrium level (the NAIRU or NAICU), which is defined mainly by supply-side factors. The path the economy has been forced to go through during the ‘transition period’ cannot affect the final outcome.

An alternative vision can be established on the idea that the path ‘matters’ and that the “long-run or final value of a variable depends on the value of the variable in the past” (Setterfield 1995, p.14). Indeed, new papers in recent years (De Long and Summers 2012, Furceri and Mourougane 2012, Ball 2014, Blanchard, Ceretti and Summers 2015, Fatás and Summers 2018) have given new life to the theory of the path-dependence of economic growth. The assumption of a stable long-run equilibrium has been challenged by empirical evidence that shows not only the presence of a GDP gap after a prolonged recession, but even a permanent reduction in the rate of growth. Larry Ball has labelled this change in the ‘slope’ of the trend as “super hysteresis” (Ball 2014).

Lavoie acknowledged that several ‘mainstream’ economists have recognised the path-dependence of economic growth: a new approach towards stabilising economic policy to avoid traumatic downturns of the cycle has followed, at least in some circles. What is still not contemplated by ‘mainstream’ economics is that “the

phenomenon of hysteresis may also apply on the upward side, say because rising government expenditures or a credit boom generate an increase in the so-called natural rate of growth" (Lavoie 2016). Supply-side constraints should be completely rethought once that the productive potential of an economy is explained with the recourse of aggregate demand. A step forward in this direction is represented by the renewed interest for the so-called Kaldor-Verdoorn effect (Verdoorn 1949, Kaldor 1966), which links the growth of productivity to the growth of aggregate demand and size of the market, following a tradition firstly inaugurated by Adam Smith (1776). Among these studies: Alexiadis and Tsagdis 2012, Fazio, Maltese and Piacentino 2013, Millemaci and Ofria 2014 and 2016. Several recent pieces of research have also integrated the same insight into a broader theory of productivity that draws on the pioneering work of Paolo Sylos Labini (1984): Guarini 2007, Corsi and D'Ippoliti 2013, Carnevali, Godin, Lucarelli and Veronese Passarella 2019.
Lavoie conclusions on the topic were pretty explicit and sharp: "there is no such thing as a NAIRU" (Lavoie 2016). Yet the Canadian economist complained that even some of the most innovative scholars of the 'orthodox' school seem to struggle to understand all the theoretical and political implications that this result implies. That is another reason why "the Emperor needs to be dethroned" (Lavoie 2016).

1.3.8 The 'psychological' roots of the "trouble with Macroeconomics"

A very original point of view in the (post-crisis) debate on the 'state of macro' has been put forward by Paul Romer, recipient of the 2018 Nobel Prize in economics.
His article "The trouble with macroeconomics" (2016) had a vast circulation inside and outside the academia. In the *Financial Times'* article quoted in section 1.3.7, Wolfgang Münchau defined it as a "devastating critique" to the profession (Münchau 2016).
At the time Romer had not yet received the Nobel Prize, but he was chief economist of the Work Bank and already one of the most famous and renewed economists in the world.
Despite his position of 'full insider', Romer described the state of his discipline with unprecedented severity: "[in macroeconomics] I have observed more than three decades of intellectual regress" (Romer 2016).

The American economist acknowledged that “in the distribution of commentary about the state of macroeconomics”, his “pessimistic assessment of a regression into pseudoscience lies in the extreme lower tail” (Romer 2016). Nonetheless, he provided a series of reasons why so few economists share this kind of pessimism publicly. These reasons ultimately rest on the conformist attitudes of the academic environment and shed an ominous light on the present and the future of the research.

The scale of Romer’s criticism and the attention that his thesis has drawn justify a detailed analysis of the paper. It will be divided into two parts.

The first one will concern the most theoretical elements of the dispute. The second will deal with the ‘psychological’ or ‘sociological’ approach which Romer has resorted to in his attempt to unveil the ‘unmentionable sins’ of the academic profession.

Macroeconomics started to go astray ever since the Real Business Cycle theory introduced “imaginary shocks”, such as technology shocks[36], to explain fluctuations. New Classical theorists were right when they denounced the problems of identifications that affected Keynesian structural models. However, they were completely wide of the mark when they tried to build an alternative theory. It turned out that this theory was not alternative to Keynesianism but to… facts! Hence the corrosive definitions – “post-real models” – used by Romer to label the fruits of Lucas’ revolution. The recession triggered by the deflationary monetary policy embarked by the Federal Reserve in the USA in the early Eighties is just one example that was used by Romer to make his point: at that time the idea that monetary policy did not matter could be explained only resorting to the power of a dogma or a faith over empirical evidence.

The next generation of models, the Dynamic Stochastic General Equilibrium models, was just an attempt to “put sticky-price lipstick on this RBC pig” (Romer 2016).

The same methodological flaw that Lucas and Sargent (1979) had rightly identified in Keynesian structural models was in fact replicated in the new, microfounded context. Romer’s criticism of the econometrics used in DSGEs partially overlapped

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[36] The vagueness of the concept of technology shocks can be exposed quite effectively through the simple question raised by Joseph Stiglitz in a recent paper: “In agriculture, we know what a negative technology shock means ─ bad weather or a plague of locusts. But what does that mean in a modern industrial economy ─ an epidemic of some disease that resulted in a loss of collective knowledge of how to produce?” (Stiglitz 2018, p. 78).

with Blanchard's one (Blanchard 2016, see section 1.3.1). Yet the American economist went even further: "the prior specified for one parameter can have a decisive influence on the results for others. This means that the econometricians can search for priors on seemingly unimportant parameters to find ones that yield the expected result for the parameter of interest" (Romer 2016). Indeed, several studies showed that a different choice for the priors in the Smet and Wooters' benchmark model (2007) lead to different structural estimates or even to a model that is not identified (Onatski and Williams 2010, Iskrev 2010, Komunjer and Ng 2011).

Calibration implies nothing else than the old identification 'by assumption' that had been criticised in the old generation of Keynesian models. Keynesian macroeconomists tended to say "assume that P is true, then the model is identified" (Romer 2016), without providing any independent evidence to assess the statement. New Classical theorists used math to develop an identification 'by deduction': still "math cannot establish the truth value of a fact" (Romer 2016) and therefore this new way ended up to be an identification 'by assumption' in disguise: "Relying on a micro-foundation lets an author says, 'Assume A, assume B,… blah blah blah… And so we have proven that P is true. Then the model is identified" (Romer 2016).

If the credibility of the identifying assumptions in modern macroeconomics has not improved in comparison with the heyday of the Keynesian theory, the process has become even opaquer. With a pretty effective sense of gravity, Romer concluded his assessment with the very famous quotation of Lucas and Sargent's landmark paper "After Keynesian Macroeconomics" (1979). However, this time the same words ought to be referred to the macro models spawned by the New Classical Revolution – the last generation of DSGE models included:

> "That these predictions were wildly incorrect, and that the doctrine on which they were based is fundamentally flawed, are now simple matters of fact (…) The task that faces contemporary students (…) is that of sorting through the wreckage". (Lucas and Sargent 1979)

In the second half of Romer's article, the attack towards contemporary macroeconomics has been developed via psychological and sociological arguments.

Given the evidence of the flaws and the limits of the theory, in particular after the Great Recession, one could wonder why criticism – radical and harsh criticism – has not been more common. Romer put forwards three answers.

First. The career of an academic economist can be at risk if she parts company with ‘mainstream’ economics. If one wants to publish in top economic journals, she has to stick to what is still considered the ‘only game in town’. This is the wiser choice even for researchers that are not actually persuaded of the soundness of the theory they are going to work with. When Romer wrote this article, he had already left academia and worked for the World Bank. He defined himself as a “practitioner”, not interested in publishing in top journals any longer. That is why he said he had no constraints in telling what he thought (now that he has received the Nobel Prize it is fair to assume his ‘freedom of speech’ is even larger…).

Second. The level of collusion that ties together the leading figures of the field is very high. Romer explicitly made the names of the founding fathers of the New Classical Macroeconomics – Robert Lucas, Ed Prescott and Tom Sargent – as members of an intellectual relationship based on ‘loyalty’ rather than honest exchanges of opinions. He provided some examples of these figures publicly praising one another on topics where the theoretical basis for consensus was actually very fragile; yet the feeling that it is not ‘appropriate’ or ‘polite’ to criticize someone who belongs to your own ‘clan’ appeared to be the only guide to action.

A similar attitude inspired by conformism and uncritical ‘worship’ of authoritative scholars appears to dominate the mindset of the younger generation of economists. This leads to Romer’s third argument:

> “Several economists I know seem to have assimilated a norm that the post-real macroeconomists actively promote – that it is an extremely serious violation of some honour code for anyone to criticize a revered authority figure openly – and that neither facts that are false, nor predictions that are wrong, nor models that make no sense matter enough to worry about” (Romer 2016).

The conformist approach that characterises the economic profession appears to be of the kind one could expect from the believers in a religion rather than the scholars of a (social) science.

Paradoxically, the religious mindset breeds its own opposite: 'nihilism'[37]. Many economists are absolutely aware that contemporary models are structurally flawed and lead to absurd conclusions. But all this does not bother them. With the "post-real economics" we had a theory that was inconsistent with facts; with the last generation of 'nihilist' economists we have a bunch of scholars who "do not care that the macroeconomists do not care about the facts" (Romer 2016).

1.3.9 DSGE vs Stock-Flow Consistent modelling

For Steve Keen, one of the economists quoted by Blanchard in his "Further thoughts on DSGE models" (2016), 'rational expectations' are the real starting point of all strands of 'mainstream' macroeconomics developed after the late Seventies. In a nutshell, the assumption of rational expectations corresponds to the hypothesis that the behaviour of economic agents is led by the knowledge of a fully developed economic model; and, of course, this model is nothing else than the very same theory devised by the Neoclassical authors.

Thanks to rational expectations, DSGE modellers can justify the stability of their models and therefore the validity of the process of linearization of otherwise nonlinear systems. The typical equilibrium solutions that characterise a DSGE model display the pattern of a 'saddle': if we place a small ball on the saddle of a horse, it can follow many different paths under the influence of gravity. Almost all of them will lead the ball to fall out of the saddle. The only one which will not, it is the one that corresponds to the ridge of the horse's back. In other words, all the solutions are unstable except one: the 'saddle path solution' (Rankin 2011). How can the theorists justify that the agents will set the economy just on that path and not on other unnumbered paths that do not lead the system to a stable solution? In fact, via the assumption of rational behaviour by the agents, embodied in the so-called 'transversality condition'.

The linearity of the equations featured in DSGE models is grounded on a controversial process of transformation and implies a problematic separation from a real world that displays nonlinear dynamics. A model built on these conventions

[37] This word is not directly used by Romer in his paper, but it seems the most fit to define the attitude he described.

can "extrapolate existing trends – if they include the main determinants of the economy – but it cannot capture turning points. A linear model is, by definition, linear, and straight lines don't bend" (Keen 2016).

An alternative paradigm is represented by the Stock-Flow Consistent (post-Keynesian) models (SFC models). The origins of the methodology hark back to the works of the American Nobel laureate James Tobin and of the British economist Wynne Godley. A detailed overview of SFC macro modelling – which is by now one of the most accredited approaches within the 'heterodox community' – will be presented in chapter 3. In the context of this chapter, particular attention will be paid to some of the features of SFC models that have contributed to their rising popularity among economists looking for different ways of building macroeconomic models.

As Keen pointed out, SFC models are (mainly) linear too. From this point of view, they cannot be seen as an 'evolution' in comparison to DSGE models. However, their *use* as linear models is different: "In the Neoclassical case, these models are used to make numerical forecasts and therefore they extrapolate existing trends into the future. In the heterodox case, they are used to ask whether existing trends can be sustained" (Keen 2016).

That's the main reason why DSGE modellers have been engulfed by the criticism about their failure in predicting the economic crash of 2008, whereas 'heterodox' economists like Wynne Godley warned far before the financial breakdown that US path of growth was bound to collapse (see more in the subsequent section).

Another of the strengths of the SFC models is based on their set of variables: "Most modern heterodox models are superior to 'mainstream' DSGE ones, simply because most of them include the financial system and monetary stocks and flows in an intrinsic way" (Keen 2016). It is the choice of the 'right' variables that renders SFC more realistic and useful in a world where financial factors should be regarded as 'central'. It is true that after the crisis DSGE modellers have put great efforts in introducing some financial variables (see section 1.3.2). Still, the financial sector tends to be just "another source of 'frictions' that slow down a convergence equilibrium": money and debt are not included "in any intrinsic way" (Keen 2016). These models "certainly don't treat the outstanding stock of private debt as a major factor in the economy" (Keen 2016).

An interesting comparison between SFC and DSGE approaches can be found in a paper of a group of academics and economists of the Bank of England (Burgess, Burrows, Godin, Kinsella and Millard 2016). The authors have built an empirical model of the UK economy alleged to be “the most-complex SFC model so far estimated from national accounting statistics for a real economy” (Nikiforos and Zezza, p. 1224). These scholars considered their modelling a ‘complement’ rather than a ‘substitute’ of the ‘mainstream’ methodologies. However, they underlined the strengths of their choice against the ‘standard’ DSGE model, which “typically had little or no role for financial flows. When the financial crisis struck, these models had little to say about how financial flows had contributed to the crisis and how they might evolve post crisis” (Burgess, Burrows, Godin, Kinsella and Millard 2016, p. 2). By contrast, their model produced a wide picture of “how economic and financial imbalances are likely to evolve over long periods, and whether such evolution is likely to be sustainable for the UK economy” (Burgess, Burrows, Godin, Kinsella and Millard 2016, p. 2).

DSGE modellers have paid much more attention recently to the financial sector. Still, the advantage of the SFC methodology does not lie just on their capability of taking into account the role of money, credit, financial flows and a wide range of assets (with their relative rates of return). It is the continuous feedback between financial asset positions and economic decisions made by the agents that actually improves the realism and the analytical profoundness of SFC models. Expectations are treated in more traditional – but less unrealistic – ways (in Burgess, Burrows, Godin, Kinsella and Millard 2016 a pretty classical ‘adaptive expectations’ equation is used). And behavioural equations do not put a microfounded justification before the aim of capturing the dynamics of real economic systems with an effective and convincing approximation (Burgess, Burrows, Godin, Kinsella and Millard 2016).

Burgess, Burrows, Godin, Kinsella and Millard acknowledged that the SFC methodology is not immune from limits and flaws: the inevitable trade-off between realism and simplicity takes its toll. While DSGEs “produce (at least when linearized) a VAR representation of the endogenous variables that should, in theory, be straightforward to take to the data” (Burgess, Burrows, Godin, Kinsella and Millard 2016, p. 3), working with empirically estimated models in a SFC framework is very far from being simple and easy.

The first problem is given by the structure of the SFC models themselves. The transactions flow matrix – whose role will be fully explained in chapter 3 – is the backbone of the system of equations. It guarantees the consistency of different flows in and out different sectors of the economy. The quadruple entry principle – see chapters 2 and 3 for in-depth analysis – ensures that 'nothing is lost': every sale or purchase has a counterpart in an asset or a liability accumulation in the balance sheets of the agents that are involved in a particular transaction. However, the national accounts published by statistical institutes (the Office for National Statistics in case of the UK model presented in Burgess, Burrows, Godin, Kinsella and Millard 2016) are very detailed and complicated. As far as the modeller wants to keep the number of equations below a certain threshold of 'tractability', she cannot reproduce the level of accuracy of the official national accounts. For instance, the ONS Blue Book – the annual publication of UK National Account statistics – contains around 6500 series referring to the 5 sectors of the Burgess, Burrows, Godin, Kinsella and Millard's model (household, non-financial companies, government, banks, insurance company and pensions funds, rest of the world). By contrast, the model itself features just around 100 series in its transaction flow matrix. A number of 'non-significant' variables are assumed to equal zero: only non-financial companies are 'allowed' to undertake investments; the investments of all the other sectors, which in reality represent 5% of total business investments, are 'cancelled'. That does not prevent the 'synthetic balances' made from the simplified transaction flow matrix to be pretty close to the 'real data' (see, for instance, Chart 5 in Burgess, Burrows, Godin, Kinsella and Millard 2016, p. 16). Yet it is evident that the interaction between the data and the theory is not as clear and direct as it is in a model with just seven variables overall and no problem of 'surplus series', that is to say the DSGE benchmark (Lindé, Smets and Wouters 2016).

Furthermore, a consistency control must be introduced. Not only the 'synthetic balances' have to track effectively the historical evolution of the sectoral financial balances of the National Accounts, but they also have to preserve their internal logic: given the fact that assets of one sector are liabilities of another, their sum must equal zero, regardless of the discarded residuals (the apparently non-significant series set at zero). In other words, the 'translation' of the National Accounts into a manageable transaction flow matrix cannot compromise the overall consistency of the 'synthetic system'. For their UK model Burgess, Burrows, Godin, Kinsella and Millard verified

"that the stock-flow-consistency does indeed hold when we forecast using the model" (Burgess, Burrows, Godin, Kinsella and Millard 2016, p. 18). Still, again, it is evident that the challenges that this process poses to the modeller are really hard.
Despite these issues – and some more others that will be accounted for in the remaining chapters – SFC modelling is clearly set to represent a valid alternative to the dominant paradigm. Its advantages have been summarised by Burgess, Burrows, Godin, Kinsella and Millard as follows:

> "They can be used to analyse the evolution of gross positions of financial assets and liabilities and gross and net financial flows under different assumptions; they allow for feedbacks from financial asset positions to real economic decisions; variables within the models react differently to policies imposed slowly or quickly thus finding different steady states; they allow for an important, and realistic, role for money, credit and banks; they typically (though not necessarily) impose more realistic specifications for expectations and are more realistic than typical DSGE models in terms of the behaviour, and heterogeneity, of agents within the model" (Burgess, Burrows, Godin, Kinsella, Millard 2016, p. 18).

1.3.10 Who predicted the crisis?

As it has been anticipated in the introduction on this chapter (see also sections 1.2.1) the controversy on the failure of 'the economists' to predict the latest financial crisis has spilt over the closed world of academia. The reputation of economists as a whole profession has suffered. Some analysts have directly linked a broader distrust of the public towards 'the experts' to the rise of the populist tide which is threatening the liberal order of Western societies (Münchau 2016). In fact, a portion of this criticism has been perfunctory and wide of the mark. When a discussion on a complex and technical matter such as macroeconomic modelling is transferred into an arena of non-specialists, the risk of manipulations, oversimplification or skewed popularisation driven by political aims is very high.
Said that, it is unquestionable that 'mainstream' economics has for a long time ignored that "things could turn really bad" (Blanchard 2014). Stiglitz has observed that "not only didn't the [DSGE] model fail to predict the crisis, it effectively said that it could not happen. Under the core hypothesis (rational expectation, exogenous shocks), a crisis of that form and magnitude simply couldn't occur" (Stiglitz 2018, p. 76). This had been somehow recognised by the 'father' of all these models, Robert

Lucas, when in 2004 – at the peak of the New Consensus era – he said that "there's a residue of things they [the new theories] don't let us think about. They don't let us think about the U.S. experience in the 1930s or about financial crisis [of the 1980s] and their real consequences in Asia and Latin America. They don't let us think, I don't think, very well about Japan in the 1990s" (Lucas 2004, p.23). As it was pointed out by Marchionatti and Sella (2017) "a fortiori, this judgment applies to the new great crisis. In other words, systemic crises are other-worldly events absent from these models, and their most eminent theorists were aware of it" (Marchionatti and Sella 2017, p. 443).

The same allegation could not be moved to those economists who have warned well in advance against the unsustainability of the model of growth which characterized the years of the Great Moderation.

In 1999 Wynne Godley published a Special Report of the Levy Institute entitled "Seven Unsustainable Processes: medium-term prospects and policies for the United States and the World" (see also Godley and Wray 2000). The starting point was the very 'pink' picture of the US economy produced in 1999 by The Council of Economic Advisers, followed a little later – and even with a more optimistic tone – by the Office of Management and Budget and by the Economic Report of the President. The colours used by Godley in his Report were much darker.

Since 1992 onward, fiscal policy in the US had been quite restrictive and a surplus of the government budget had emerged. In the meanwhile, the deterioration of the trade balance and of the current account did not show any sign of improvement ever since it had turned into deficit in the mid-Eighties. One of the consequences of this prolonged external deficit was the constant rise of the level of the net foreign indebtedness relative to the GDP.

Since the aggregate demand could not rely on the contributions of public expenditure and of net export as drivers of growth, the 'burden' had been taken by the private borrowing. And for the growth of the US economy to be in line with the official forecasts private borrowing had to continue to rise. Godley considered that assumption absolutely unrealistic: "This paper makes no short-term forecast", wrote the British economist in his Report. "Bubbles and booms often continue much longer than anyone can believe possible (…). The perspective taken here is strategic in the sense it is only concerned with developments over the next 5 to 15 years as a whole" (Godley 1999, p. 3).

If we look at what happened in the subsequent years – from the burst of the dot-com bubble and the subsequent (mild) recession, to the Great Recession of 2008 – that analysis appears to be astonishingly prophetic. Godley used a Stock-Flow Consistent model of the US economy developed at the Levy Institute to draw several medium-term scenarios. These were based on different assumptions on the levels of indebtedness of the private sector and the possible behaviour of the stock markets. All outcomes were consistent in predicting a sharp downturn in the growth of the US economy.

Only with 'substitute sources' of aggregate demand in place, the dreadful perspective could have been averted. This would have implied a structural reverse of a fiscal stance based on the 'dogma' of the budget surplus and a significant devaluation of the dollar (of the scale of 20%, in the absence of alternative measures to improve exports).

The dot-com bubble recession could be seen in hindsight as the "first sign of trouble in this unbalanced growth pattern" whose consequences "were avoided at the time by fiscal and monetary intervention, only to postpone the problem and make it more serious" (Zezza 2008, p. 290).

Indeed, the lax monetary policy deployed at the time, compounded with financial innovation like the securitization of subprime mortgages, boosted the boom in the housing market that drove the expansion of American economy for some more years. Still, the group of economists gathered at the Levy Institute stuck to the "unrepentantly Keynesian structure" of their model (Godley, Papadimitriou, Hannsgen and Zezza 2007, p. 1) and kept on warning about the unsustainability of that growth pattern (see for instance Papadimitriou, Chilcote and Zezza 2006). In a report released in November 2007 (Godley, Papadimitriou, Hannsgen and Zezza 2007) the model succeeded in tracking pretty well the actual GDP downturn of the subsequent quarter. In this specific report the medium-term perspective that usually characterized the Levy Institute's models was dropped "because of likely adverse developments in the very short term as a result of the credit crunch that would be ridiculous to ignore" (Godley, Papadimitriou, Hannsgen and Zezza 2007, p. 5). The 'big crash' which 'mainstream' economists have thought to be a "thing of the past that would not happen again" (Blanchard 2014) has finally arrived.

1.3.11 Why the 'outside' matters

In the current debate on the 'state of macro' there is a fact that has perhaps received less attention than it deserved: much of the 'mainstream' macro modelling literature until very recently has been centred, *de facto*, on closed economies. The limitation of the focus on a one-country model could have played a role in the underestimation of a series of "unsustainable processes" – to borrow the expression used by Godley (1999) – behind the hidden fragility of Western economies which finally led to the Great Recession.

This does not mean that open economy topics, such as international trade or international finance, were not studied. Or that open economy DSGEs do not exist[38]. Yet it is fair to say that the research in the two fields has evolved more often along parallel lines rather than via an integrated approach. One of the reasons for the persistent popularity of the old Mundell-Fleming model – as it will be explained in detail in chapter 2 – rests on the lack of very strong alternatives in what has been later produced within the 'mainstream', at least from the point of view of the main conclusions that can be drawn from the model.

It has been the consideration of the huge and increasing negative *external* position of the United States since the beginning of the Nineties that has allowed Godley to understand the profound weakness of the American model of growth of the Great Moderation era (see section 1.3.10), at the same time when many other observers heralded the end of the history of recessions[39].

In Europe, the debate on the origins of the sovereign debt crisis – and on the policy responses to it – has been profoundly compromised by the lack of understanding of the economic dynamics among the European countries of the single currency area. It is common sense that a trade surplus of one country towards another country corresponds to the trade deficit of the latter towards the former. By definition, both countries cannot record a trade surplus, unless a third party joins the system. Far less obvious, apparently, it has been the relationship between the public debts of two areas/countries. Whereas the trade imbalances within the eurozone has been

[38] See Schmitt-Grohe and Uribe "Open economy macroeconomics" (2017) for a handbook treatment of the topic.

[39] In his presidential address delivered at 2003 meeting of the American Economic Association Robert Lucas said: "macroeconomics in this original sense has succeeded: its central problem of depression prevention has been solved, for all practical purposes, and has in fact been solved for many decades" (Lucas 2013, p. 1).

tolerated for very long – still the huge trade surplus of Germany does not seem to bother too much the European institutions – the idea that all the countries could reach a surplus in the government budget *together* has been almost taken for granted by large sectors of the political class (and of their economic advisers) in the continent. The austerity measures implemented, mostly in Sothern Europe, were partly reliant on a series of misconception related to these issues. And even when the relationship between external and government deficit was recognised, it has been often explained via a unique sense of causality: from the government deficit to the trade deficit. Then it was natural that the cure should consist of cuts in government expenditure or tax increases in order to close the twin deficits altogether. Even more so if a fixed exchange rate is in place – a single currency is *de facto* a permanently fixed exchange rate regime – and no depreciation of the currency can bring about any help via the contribution of the net export.

Just at the eve of the financial meltdown (in January 2007) and well before the crisis had taken the shape of a public debt crisis in Europe[40] Godley and Lavoie published a paper entitled: "A simple model of three countries with two currencies: the Eurozone and the USA" (Godley and Lavoie 2007 a). The model simulations forecast pretty well the dynamics of the imbalances within the Eurozone following a shock affecting a generic 'weak' European country, such as an increase in the propensity to import. The appreciation of the dollar that would follow would lead the system to a new stationary state and the current account of the Eurozone would be back to zero. However, *within* the Euro area the 'strong' country would receive a boost from a devalued euro, while the 'weak' country would still run a current account deficit and a government budget deficit. The weak country would hoard a growing level of debt to GDP ratio. If public authorities aimed to find a new equilibrium with balanced current accounts and stable debt to GDP ratios within the eurozone three ways were envisaged: a) Austerity measures in the 'weak' country; b) Expansionary fiscal policy in the 'strong' country; c) Mutualisation of the public debt in the Eurozone.

The European institutions chose the first way and the negative outcomes in terms of lower incomes and productions in *both* the 'weak' and the 'strong' country had

[40] It's not easy to set a starting point for the Euro crisis as a ramification of the US financial crisis of 2007-2008. However, it was in December 2009 that the major rating agencies downgraded Greek government bonds following the announcement of the new government that the figures of the fiscal deficit have been rigged.

been well anticipated by the simulations conducted by Godley and Lavoie with their model. Of course, what followed in terms of the rise of populist and 'eurosceptic' movements in the continent could not have been predicted by the model. However, a better understanding of the complex economic dynamics that characterize the single currency area could have helped in shaping better policy responses during the euro crisis and in preventing some of its most worrying political outcomes.

The acknowledgement of the importance of studying an economy not as a self-contained entity, but as a system profoundly affected by its interchanges with the external world is behind the choice of the present work to focus on open economy models. Furthermore, the acknowledgement of the crucial rule played by the financial system (by the interactions and feedbacks between the 'stocks' on the 'flows' of assets and liabilities) is behind the choice to focus on Stock-Flow Consistent open economy models.

1.4 CONCLUSIONS

This chapter has tried to summarize some of the most critical elements of the recent debate about the 'state of macro'. The attention was concentrated on a selected series of issues in order to offer the reader a 'guide' through the discussion rather than a complete overview of all the contributions related to the topic (being the latter an impossible task, given the constraints of the present work).

The so-called New Consensus dominated 'mainstream' macroeconomics before the outbreak of the financial crisis in 2008. Its theoretical foundations hark back to the end of the Seventies, when the hegemony of the Neoclassical Synthesis ended and the rational expectations revolution was ushered in. About a decade later, with the introduction of frictions and 'staggering prices' mechanisms into the framework of the Real Business Cycle theory, a 'new' New Keynesian strand of models – the Dynamic Stochastic General Equilibrium models – rose to dominance (section 1.2.2). The logic and the structure of the DSGEs have been outlined following the work of Sbordone, Tambalotti, Rao and Walsh 2010, while Lindé, Smets and Wouters 2016 has been taken as the most recent 'benchmark' (section 1.3.2).

After the outbreak of the financial crisis in 2008, criticism towards DSGE modelling has been raised even within the community of scholars which still regards these models as the main pillars of future research. The articles (and the 'posts') of the former chief economist of the IMF, Olivier Blanchard, represented perfect examples of this 'reformist' attitude (section 1.3.1). A brief sketch of how the last generation of DSGE modellers is trying to improve the original framework is contained in section 1.3.2 too. Most of the efforts consist in the introduction of new elements and variables in the models to account for the dynamics in the financial sector and for a certain level of heterogeneity of the agents.

Although the crisis has not overthrown the hegemony of the New Consensus, it is fair to say that its dominance is much less undisputed than before. Eminent scholars such as the Nobel Prize winners Paul Krugman and Joseph Stiglitz have denounced without compromise the shaky assumptions on which the New Consensus has been built and have pointed to alternative, more promising directions of research (section 1.3.3). The reconstruction of their arguments provided the opportunity for a short digression on the original work of John Maynard Keynes and on some 'forgotten' aspects of his theory that can still prove themselves very useful in today's controversy.

The crisis, and the political responses to it on both sides of the Atlantic, have also prompted a revision of the established beliefs on fiscal policy. A tremendous amount of research in recent years has been devoted to measuring the size of fiscal multipliers, which in general turned out to be larger than expected before, in particular in periods of recession (section 1.3.6)

The second part of the chapter dealt with the so-called 'revolutionaries', in other words those scholars who do not think that the current dominant paradigm is improvable and emendable (section 1.3.7). Their criticism targeted the very fundamentals of the economic theory which underpins contemporary DSGE models. Among them: a) Rational expectations; b) The efficient market hypothesis; c) The perfect assets substitutability assumption; e) The NAIRU (non-accelerating inflation rate of unemployment); f) The Barro's Ricardian equivalence theorem; g) The idea of an expansionary fiscal austerity.

Two sections – 1.3.4 and 1.3.5 – covered methodological issues. The first concerned the programme of complete microfoundation of macroeconomics which was at the basis of the Real Business Cycle school and still shapes contemporary 'mainstream' macro modelling. The second discussed the patterns for evolution in macroeconomics; two alternative approaches were identified: 'progressive accumulation', where the knowledge is built with 'gradual steps forward', and 'discontinuous advancement', where the path of the discipline is dotted with breaking points.

Both issues are crucial for the next developments of the research in macroeconomics.

A whole section (1.3.8) was dedicated to the "devastating critique" moved by the Paul Romer, winner of the Nobel Prize in economics in 2018, towards DSGE models and, more generally, towards 'mainstream' contemporary economic theory and its most prominent representatives. This paper received particular attention here due to its originality and its attempt to deal with the 'psychological' and 'sociological' roots of the conformist behaviour that nowadays seems to characterize the profession.

The final part of the chapter presented the first draft of a comparison between DSGEs and Stock-Flow Consistent models (section 1.3.9), which are growing in popularity as a valid alternative to the dominant paradigm for macroeconomic modelling. The SFC models' (relative) success is not unrelated to the recent debate on the poor forecasting performances of 'mainstream' models during the Great Recession. Whereas the 'mainstream' had ended up ignoring that "things could turn really bad" (Blanchard 2014), scholars as Wynne Godley warned several years before the outbreak of the crisis that the US growth pattern was unsustainable. Section 1.3.10 contained a summary of Godley's famous 1999 Special Report on the US economy and a brief description of the work of the economists of the Levy Institute in the run-up of the financial crisis.

Part of the reasons for the failure of 'mainstream' macroeconomics to realise the fragility of the economy in the Great Moderation era was its lack of consideration for external imbalances. Again, the SFC approach has provided essential analyses of the eurozone arrangements, which have proved themselves very solid with the outbreak of the sovereign debt euro crisis (section 1.3.11). Exchange rate regimes and stock of external assets and liabilities play a paramount role in the economic dynamics of modern economies. The recognition of this fact, among other considerations, is behind the choice to focus on open economy models in the following chapters of this thesis.

What has been presented here is just one among very many, equally acceptable, reconstructions of the debate on the ‘state of macro’.

No ‘forecast’ of the exact directions of the future research has been put forward. And no dawn of a new ‘post-Neoclassical’ era has been announced. More modestly, the chapter has tried to account for several, ongoing attempts to overcome the limits of the existing dominant paradigm. The sympathy of the writer towards a more substantial pluralism in (macro)economics has inevitably emerged. Indeed, this is the implicit message that the whole chapter was called to justify. Economics can benefit from a higher degree of ‘competition’ among different schools of thought. Furthermore, given the attention that some topics have understandably drawn from large sectors of public opinion, it is the quality of our democracies that can be boosted by the fair and open presentation of the co-existence of different and alternative approaches.

CHAPTER 2: THE PARADOX OF STABILISING STICKY PRICES IN AN OPEN ECONOMY SFC MODEL

"I would rather be a man of paradoxes than a man of prejudices".
Jean-Jacques Rousseau, Emile or On Education, 1762

2.1 INTRODUCTION

This chapter will deal with some relevant features of the Post-Keynesian Stock-Flow Consistent approach to an open economy.

The OPENFLEX model presented by Godley and Lavoie in their book "Monetary economics" (2007) – which will be analysed in detail in the next chapter – will be taken here as a 'benchmark' in order to compare this methodology with the 'mainstream' open economy theoretical framework.

The elements identified as crucial to understand the differences between the two 'schools of thought' are the following: the assumption of perfect asset substitutability; the way interest rates are set and the forces that drive them; the relative weight of trade flows and financial flows in the determination of the exchange rates; the accounting methodology; the effectiveness of fiscal policy in a flexible exchange rate regime; the pass-through mechanism that transfers a change in exchange rates to prices of tradable goods; the condition for the depreciation of the currency to be effective in rebalancing the current account.

Particular attention will be devoted to the last two elements of the list, since one of the most interesting aspects of the 'standard' SFC open economy model is to provide a framework for a 'general theory', or 'general condition', of the terms of trade. The Marshall-Lerner condition will be re-interpreted as the 'specific' one that can be applied to cases where a complete exchange rate pass-through to import prices occurs. The chapter will include a full-fledged mathematical demonstration of the new 'general condition'. Its formula will turn out to be different from the one endorsed by Godley and Lavoie in the chapter of their book in which the OPENFLEX model was presented[41].

In the second part of the chapter, the consequences of different regimes of pass-through will be analysed via computer simulations. When the model is set with a lower level of pass-through, its prices are 'stickier', that is to say less sensitive to change in exchange rates. One of the most striking results of these tests rests on the fact that stickier prices allow the model to adjust more quickly to negative shocks of its external position than more flexible prices. The strategic behaviour of exporters is indeed a factor which helps the system to achieve a new equilibrium faster and more efficiently. Here is the paradox: exporters try to sterilize the impact of the variation of the exchange rate on the price of their goods in foreign currency, and by doing this they contribute to a more effective impact of the exchange rate in rebalancing the whole system. In fact, while in any pass-through regime[42] the depreciation of the currency helps the economy to close the trade deficit (provided that the condition seen in the first part of the chapter holds), a lower variation of prices keeps down the level of foreign debt piled up after the shock. A lower level of foreign debt means fewer resources drained from the system for the service of the external debt and therefore a current account with a lighter 'historical burden'. The 'stabilizing function' of sticky prices is a pretty uncommon phenomenon in a macroeconomic context, where sticky prices are usually identified as the main obstacle to a rapid readjustment of the system toward a new equilibrium.

The final part of the chapter will focus on the contention that the Marshall-Lerner condition still represents a "useful approximation" (Lavoie 2015, p. 524) to assess if the depreciation of a currency can bring about an improvement of the current account of a country despite the fact that it is not strictly valid in the SFC model (Godley and Lavoie 2007 b, Lavoie and Daigle 2011, Lavoie 2015). The computer simulations will challenge this assumption. Two reasons, in particular, seem to justify the 'rejection' on the approximation:

1) The Marshall-Lerner condition assumes a full-pass through regime. Not only is not this regime realistic given the way modern firms operate, but it is also

[41] In Lavoie 2015 it is possible to find a formula equivalent to the one featured in this chapter, but no demonstration is provided there.

[42] Strictly speaking it would be more correct to say that in *almost* any regime this occurs, as it will become clearer when the full pass-through regime will be analysed via the standard SFC model. Said that, for the moment it is better not to overload the core message with premature detours.

incompatible with the standard SFC open economy model: when a full pass-through regime is included, the model cannot find a stable state solution after the shock anymore and it 'collapses'.

2) It is not very difficult to build theoretical scenarios in which the classical Marshall-Lerner condition does not hold, but the model is absolutely stable and its current account improves following the depreciation of its currency. An example of this situation will be shown.

To consider the approximation 'not acceptable' is far from being a matter of pure theoretical rigour. Indeed, it has important policy implications. Recent empirical studies seem to suggest that the classical Marshal-Lerner condition *does not* hold for the majority of countries. Consequently, policy makers should not expect a benefit to the external position from the depreciation of the currency *if the Marshall-Lerner condition is still valid from a theoretical point of view.* If it is not, there is no need for it to be empirically validated: the depreciation of the currency can improve the current account even when the Marshall-Lerner condition does not hold.

2.2 A COMPARISON BETWEEN THE 'MAINSTREAM' AND THE SFC APPROACH TO OPEN ECONOMY

2.2.1 The choice of the 'benchmark' models

One of the accusations faced by Ben Bernanke with respect to the policies adopted by the FED to tackle the economic crisis after 2008 was of having waged a 'currency war' against the emerging economies. Bernanke has later returned to the topic to put forward a 'structured' and 'systematic' answer to these allegations: this time not as chairman of the FED, but as a scholar dealing with purely theoretical problems. In other words, he has tried to explain the behaviour of the US central bank through arguments based on an explicit and formalised economic model (Bernanke 2016).

This model was essentially a version of the Mundell-Fleming model, and presumably not by chance it was presented during the Mundell-Fleming 2015 lecture. His thesis, in a nutshell, was that the complaints of the US trading partners towards the monetary policy promoted by the FED after the crisis did not have much basis in terms of the impact that this policy could have had on these countries' output, income and growth. The problem could arise when the policy makers of US trading partners had independent and additional exchange-rate objectives. Yet in that case the 'culprit' was not the FED: "Foreign policy makers are constrained primarily by the Mundell-Fleming 'trilemma' – the impossibility of combining free capital flows, independent monetary policy, and exchange rate target – not by US policy" (Bernanke 2016, p. 7).

Despite the long evolution of macroeconomic theory from the 'old times' of the Neoclassical Synthesis, when it comes to the analysis of open economies the departure from the main theoretical assumptions and policy conclusions of the classical Mundell-Fleming model[43] (Mundell 1960, 1961 a and 1961 b and 1963, Fleming 1962) has often been very limited among 'mainstream' economists[44].

As it has been pointed out by several authors (see for instance Isard 1997, Godley and Lavoie 2007 b, Lavoie 2015) the Mundell-Fleming model – in its famous IS-LM-BP version[45] or in one of its 'modern reincarnations' such as the DD-AA model presented by Krugman, Obstfeld, and Melitz (2015) – remains "the 'workhorse' in academic discussions of stabilisation policy for open economy" (Isard 1997, p. 116) and a never-ending source of policy advice. James M. Boughton gave voice to a widespread opinion when he wrote that "the open economy macromodel has, of course, developed well beyond the simple short-run system analysed by Fleming and Mundell forty years ago. The core is nonetheless intact" (Boughton 2003, p. 3).

In his paper "A modern reincarnation of Mundell-Fleming's trilemma" (2018) Joshua Aizenman has reviewed a considerable amount of "research dealing with the relevance of Mundell-Fleming's open economy at the present time" to conclude that "an extended version of the trilemma remains viable and relevant" (Aizenman 2018, p. 2).

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[43] The model is sometimes referred to as the "Fleming-Mundell model". Both expressions seem to be acceptable and correct: "All available evidence (…) suggests that the models of Fleming and Mundell were derived independently and approximately contemporaneously" (Boughton 2003, p. 5). However, in the present work, the expression Mundell-Fleming is preferred. That is because it is Mundell's 1963 contribution, with its graphical representation of the model, that is virtually reproduced in contemporary macroeconomics and international economics handbooks. Moreover, contemporary textbooks tend to report only the assumptions and the policy conclusions of Mundell 1963, overlooking the somehow more 'moderate' position of Fleming 1962.

[44] Similar arguments – in the context of the debate on the 'state of macro' – can be found in section 1.3.11 chapter one.

[45] This is the most common denomination used in contemporary macroeconomics books, such as Delli Gatti and Gallegati "Macroeconomia" (2013). Therefore, it is also the formula used in this work. However, in Mundell 1963 the functions-curves were actually called XX-LL-FF.

The exceptional, persistent popularity of this theory explains why it can represent a good 'benchmark' if one wants to outline the characteristics of the Post-Keynesian Stock-Flow Consistent methodology against a more 'orthodox' approach.

In addition, two further reasons can be put forward:

1) It is true that modern DSGE macro models – that is to say what can be considered 'the' benchmark in contemporary macro modelling – parted company with the theoretical paradigm in which the IS-LM-BP model was developed. As it has been explained in chapter 1, they are essentially based on a series of dynamic maximisations of utility or profit functions combined with a monetary rule for the setting of the interest rate. Their microfounded logic has very little in common with the structural models that characterised the heyday of the Neoclassical Synthesis. By contrast, the Mundell-Fleming model is a development of the old IS-LM model, the father of those structural models.

Yet it is exactly this 'old fashion flavour' that makes the Mundell-Fleming model a better term of comparison for the Post-Keynesian Stock-Flow Consistent approach, which is ultimately a brainchild of the New Haven School and an application of the methodology championed by James Tobin, one of the most prominent representative of the neo-Keynesian tradition[46]. With the Mundell-Fleming model it is possible to avoid the risk of comparing 'apple and oranges' – like it would be the case with a DSGE model – when assumptions, main variables, accounting methodologies, etc. are put side by side.

The gap between contemporary 'DSGE like' models and 'old fashion Mundell-Fleming like' models, at any rate, seems considerable as far as we stay in the rarefied air of the high theory. From a practical point of view, looking at the policy implications of the models, things are pretty different. And this brings to the second additional reason behind the choice of using the Mundell-Fleming model as the 'mainstream' benchmark.

2) The textbook IS-LM-BP model and a 'standard' open DSGE model tend to rely on very similar mechanisms to explain the dynamics of an economy and its relationships with the 'external world'. Philip Arestis (2009) provided a presentation of a typical DSGE open economy model which can be very useful in this

[46] The so-called neo-Keynesian tradition is in fact equivalent to the Neoclassical Synthesis. However, the first expression was used here to underline the link between the Post-Keynesian school and the work of James Tobin: the legacy of Keynes, in its various interpretations, was indeed the common ground on which the SFC approach was built.

context. In that ‘exemplary' model the interest rate was set via a monetary policy rule which encompassed a certain inflation target (equation 5.3). Inflation beyond the target, as it could be assumed after a fiscal stimulus (equation 5.2), would trigger an increase of the interest rate. In turn, the latter would affect the exchange rate via the inflow of capitals attracted in the country by a higher rate of return on bonds (equation 5.4 and 5.6). The exchange rate would appreciate, contributing to the deterioration of the current account and the offsetting of the gains apparently acquired via the fiscal stimulus. As it will be more evident in the following part of the chapter, this process resembles quite closely the dynamics described by the Mundell-Fleming model. Of course, two additional caveats should be born in mind: a) the real outcomes of the model hinge on the parameters of the equations and hence on the weight of a variety of forces which operate simultaneously; b) if the system does not operate close to the full employment (or NAIRU) level – which is, by the way, the long-run equilibrium – the effect of fiscal policy in terms of inflation could be less marked. In this case the interest rate’ movement would be muffled and the effect of fiscal expansion could be sizable. But even this scenario can be ‘translated’ in the language of a ‘re-arranged’ Mundell-Fleming model, via a flat LM curve which allows the IS to move horizontally while keeping the interest rate still.

These overlapping policy implications contribute to the explanation of why the Mundell-Fleming model is still used as a reference and a ‘source of narrative’ for contemporary research.

To sum up, the classical Mundell-Fleming model appears to be an excellent reference to develop a comparison with, notwithstanding the fact this is not ‘the’ open economy theoretical model one can find in top contemporary ‘mainstream’ journals. After all, its counterpart in this comparison is not ‘the’ model for *all* heterodox or even post-Keynesian economists either: “there is no consensus post-Keynesian view on open economy macroeconomics” (Lavoie 2015, p. 2014). However, as the SFC method is attracting more and more attention within the ‘heterodox community’ (and beyond), and as the Godley’s and Godley and Lavoie’s open economy models have *de facto* incorporated some of the main features of the post-Keynesian tradition associated with Harrod’s import multiplier, it does not appear inappropriate to treat these models as the ‘benchmark’ of a post-Keynesian approach to open economies for the sake of a comparison exercise.

Finally, the Mundell-Flaming model is usually said to apply to *small* open economies. This does not represent an obstacle in the comparison exercise with the SFC approach. Indeed, the fact that no such caveats are necessary for the SFC model is revealing of the difference in some of the major assumptions the two benchmark models are built on.

2.2.2 On the assumption of perfect asset substitutability

Post-Keynesians have often opposed perfect capital mobility as a source of financial instability and have not shared the stigma that characterized capital controls among 'mainstream' economists (at least until a few years ago, since even the IMF has recently softened its position on the issue, see IMF 2016 b). Said that, post-Keynesian open economy models do assume free capital flows as a major feature of the contemporary globalized economy. This is not a normative position, but just the recognition of how the financial systems actually work. What post-Keynesians reject is the assumption of perfect asset substitutability. Investors do modify their portfolio choices according to changes in expected rates of return. But this does not mean that they go on buying the asset with the higher return indefinitely. Uncertainty and asset diversification play a significant role in shaping the realistic behaviour of agents in international financial markets described by SFC models.

In the Mundell-Fleming model the so-called BP curve[47] is flat and horizontal because whenever the interest rate of a country is higher or lower the predominant world level a massive capital flow occurs[48]. This flow – an outflow if the interest rate is below the world level, an inflow if the interest rate is above the world level – will not end until the interest rate differential is closed. In the long-run, the interest parity condition always holds, consistently with the teaching of the neoclassical tradition. Short-run fluctuations of the interest rate are possible, as they are triggered by economic shocks or by deliberate fiscal and monetary policies; yet in the long-run interest rates are destined to converge.

It is worth to notice that in the original paper published in 1963, Mundell is somehow prudent about perfect capital mobility: "The assumption of perfect capital

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[47] FF if one wants to use the symbolism from Mundell 1963

[48] Here the small economy hypothesis is assumed to play a role. However, it is the perfect capital substitutability that can be considered the real engine of the whole mechanism.

mobility is not literally valid" (Mundell 1963, p. 485). The statement reflects the institutional context at the time. Mundell was writing in the post-Second World War era which preceded the massive capital liberalisation of the Eighties. Indeed, he added that the assumption captured a feature "towards which international financial relations seem to be heading". He was evidently right. What is more important – and here Mundell's intuition looks more questionable – is that he seemed to completely identify the assumption of capital mobility with the one perfect asset substitutability: "The assumption of perfect capital mobility can be taken to mean that all securities in the system are perfect substitutes" (Mundell 1963, p. 475).

In SFC open economy models the interest rate is usually set by the central bank. A 'post-Keynesian reinterpretation' of the Mundell-Fleming model – as the one developed by Lavoie in his "Post-Keynesian economics. New foundations" (2015) – would therefore result in a flat and horizontal LM curve and in a BP curve with a positive inclination[49]. The positive inclination of the balance of payments curve is given by the simple assumption that if the interest rate is higher, a higher overall income (and consequently import) is compatible with the equilibrium in the balance of payments: the negative impact of a higher income on the current account balance will be offset by the positive impact of the inflow of capitals on the financial account balance. The inflow will cease when investors have reached their desired portfolio composition.

The fact that financial inflows and outflows are limited by the uncertainty of expected rates of return and by the will to avoid an over-exposure towards certain kind of assets (e.g. government bonds of a foreign country) is of foremost importance to understand the dynamics of a SFC open economy model. When the equilibrium in the financial markets is reached – when investors have satisfied the demanded holding of assets *for every given level of expected rate of return* – deficit and surpluses in the current account will directly impact the exchange rates (or the level of international reserves, in case of a fixed exchange rate regime) regardless

[49] It is not by chance that this post-Keynesian BP curve resembles the FF (balance of payment curve) described in Mundell 1960, where perfect capital mobility (which in Mundell's perspective coincides with asset capital substitutability) was not assumed. Both curves are drawn with the interest rate on the vertical axis. The FF curve is then drawn with the level of terms of trade (P) on the horizontal axis, but the principle behind its slope is the same as in the post-Keynesian BP curve: "At high rates of interest the net inflow of capital will be *larger* [my emphasis], or the net outflow will be smaller, than at low rates of interest" (Mundell 1960, p. 230). Note: *larger*, not *infinite*.

any interest rates differential. That is why, as we will see later in more detail, trade flows are the main drivers of 'structural' exchange rates shifts within the post-Keynesian framework. By contrast, in the Mundell-Fleming model trade is almost negligible in determining the exchange rate because the latter is primarily driven by variation of the interest rates, and by the massive capital flow that they spur.

2.2.3 Who control the interest rates? Two different types of 'endogenous money'

The difference between the Mundell-Fleming model and the OPENFLEX model in the way the (short-term and long-term[50]) interest rates are determined was clearly in the background of the dynamic explained in section 2.2.2.

Although the analysis of this chapter will mainly focus on flexible exchange rate regimes, it is important to underline that according to the post-Keynesian approach the power of central banks to set interest rates is not undermined even in a context of fixed exchange rates. This is a quite significant aspect in the comparison of the two 'schools of thought' because it is ultimately grounded on a stark difference in the conception of the money supply.

A practical example can perhaps shed light on the point. A country is experiencing a surplus in the balance of payments and its exchange rate is pegged. In this particular case, the 'narrative' of the Mundell-Fleming model would run as follows: in order to avoid an appreciation of the domestic currency, the central bank will have to buy international reserves and sell domestic currency. This will increase the money supply, which in turn will push down the interest rate. A lower interest rate will deteriorate the financial account and finally the country will reach a new balance of payments equilibrium. The same mechanism operates in case of balance of payments deficit, with an interest rate increase that brings back the system to the equilibrium. This is also the reason why monetary policy is considered entirely ineffective in a fixed exchange rate regime:

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[50] For the sake of simplicity, it has not been distinguished between overnight, short-term and long-term interest rates in this section. Post-Keynesians tend to believe that central banks can control the whole term structure of interest rate. In the Mundell-Fleming model, being the latter a reinterpretation of the IS-LM model in an open economy context – "the" interest rate that affects investment and shapes the IS curve is better to be interpreted as the long-run interest rate. But the ambiguity on this aspect goes back to the "General Theory" of Keynes, where the term interest rate defines "the complex of the various rate of interest and discount corresponding to the different lengths of time" (Keynes 1936, p. 118).

> "A central bank purchase of securities creates excess reserves and puts downward pressure on the interest rate. But a fall in the interest rate is prevented by a capital outflow, and this worsens the balance of payments. To prevent the exchange rate from falling the central bank intervenes in the market, selling foreign exchange and buying domestic money. The process continues until the accumulated foreign exchange deficit is equal to the open market purchase and the money supply is restored to its original level.
> This shows that monetary policy under fixed exchange rates has no sustainable effect on the level of income" (Mundell 1963, p. 479).

The so-called 'rules of the game' at the time of the Gold Standard were assumed to follow precisely these principles. Within this scheme, the central bank completely loses control of monetary policy. According to the famous 'monetary trilemma' only two out of three objectives of the following list can be achieved at the same time: fixed exchange rate, freedom of movement of capitals, control of monetary policy (Obstfeld, Shambaugh and Taylor 2005). Therefore, given the freedom of movement of capitals, the central bank can control the exchange rate only if it gives up the monetary policy and accepts a money supply driven by the balance of payments. Lavoie has even talked of "endogenous money" to define the dynamics described above, although "this endogeneity is quite different from that underlined by post-Keynesian" (Lavoie 2015, p. 464): it is a *supply-led* endogeneity, whereas in the post-Keynesian tradition money is endogenous because is *demand-led*.

The implications of disequilibrium in the balance of payments in a fixed exchange rate regime are completely different in a SFC open economy model. First of all, the central bank is assumed to keep control of the basic interest rate of the system, for instance via lending and deposit facilities which drive the target market overnight rate. Furthermore, discretionary and automatic mechanisms are in place in order to impede a 'passive' modification of the monetary base and the supply of money even when purchases or sales of international reserves could in theory bring about disruptions and affect the entire term structure of interest rates. This is the so-called "compensation" principle or "endogenous sterilisation".

The channels whereby the principle can operate are various. In most of SFC open economy models the sale or purchase of government bonds is the foremost means of compensation. In the steady state the net financial asset accumulation of the private sector is zero: this is at the same time a condition for stationarity of SFC models, the result of the behavioural assumptions of the model and an empirical stylized fact stated by the New Cambridge School for non-crisis period (a detailed explanation of how and why in the New Cambridge open economy framework asset net acquisition converges to zero is contained in Gandolfo 2016, par. 12.4). If private saving is zero it is possible to show via very simple accounting identities[51] that the public sector's lending or borrowing exactly equals the current account. Consequently, when a country is experiencing a deficit or a surplus in government budget balance, it is also experiencing a deficit and a surplus in its external balance. If it is selling or accumulating reserves to peg the interest rates, it is also issuing or withdrawing government bonds to finance the government budget deficit or to invest its surplus. A central bank that wants to set interest rates will have to provide a buffer to these government initiatives.

In case of an external surplus – combined with a government budget surplus – an increase in international reserves held by the central bank will be matched by a decrease of government bonds held by the central bank. The asset position in the balance sheet of the central bank will not be altered and the monetary base – which is in the liability side of the central bank balance sheet – will be allowed to remain unaltered. Likewise, when the government is running a deficit and the central bank is using international reserves to prop up the domestic currency, the liquidity which exits the system via the sales of foreign currency by the central bank is then 'pumped in' via the purchases of government bonds.

Many other mechanisms can operate under the compensation principle. It can happen that the level of assets of the central bank does actually vary with the variation of the level of international reserves. Yet the liability side of the balance sheet is not made just of the reserves held by private banks or currency in circulation. The central bank can intervene, for instance, transferring government deposits from the private banking sector in order to keep constant the monetary base while purchasing foreign assets from the same private banking sectors (this is indeed the method often used by the Bank of Canada to prevent downward pressure

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[51] Gross National Product in an open economy is given by the following formula (where the symbols are respectively the Gross National Product, Consumption, Investment, Public Expenditures, Current Account, Taxes and Saving): $GNP = C + I + G + CA \rightarrow GNP - T = C + I + G + CA - T \rightarrow GNP - T - C - I = G - T + CA \rightarrow S - I = G - T + CA$. Therefore if $S - I = 0 \rightarrow T - G = CA$. Actually, Gandolfo would argue that this "is no longer an identity. It is true that it has been derived from [an] identity, but using the private sector's behaviour assumption" (Gandolfo, p. 256) which is behind the New Cambridge School approach to open economy.

on interest rates while it purchases foreign reserves in order to avoid an appreciation of the Canadian dollar, as explained in Lavoie 2015, cap. 7).

It is true that the consistency of the monetary base does not coincide with the consistency of the money supply given the fact that post-Keynesians do not believe in the 'money multiplier' mechanism. However, two arguments can be put forward at this point: a) When a surplus in the current account occurs, revenues from export could increase private firms' deposits. And the latter are a component of the money supply. Still, these revenues could be used to pay back debts, thus offsetting the tendency of money supply to grow while foreign reserves of the country are increasing (post-Keynesians believe that money supply is endogenous, although demand-led); b) More importantly, the target interest rate set by the central bank is the overnight interest rate of the interbank lending market. It is the monetary base that counts from this point of view because it is the monetary base that needs to be held in check for the target rate to be hit.

2.2.4 Trade vs financial flows

It is now possible to focus on another fundamental difference between the Mundell-Fleming model and the SFC open economy model which was merely touched upon in section 2.2.2: the role played by trade flows in the determination of exchange rates. In the Mundell-Fleming model trade flows are marginal, since the interest rate's differentials mainly drive the exchange rate. In more recent versions of the Mundell-Fleming model, such as the DD-AA model presented by Krugman, Obstfeld and Melitz (2015) the BP curve is even removed since the current account has no influence on the exchange rate in a world where perfect asset substitutability holds and where capital flows for speculative motives overwhelm payments linked to international trade.

The dynamic structure of SFC models – here exemplified via 'benchmark' OPENFLEX model from Godley and Lavoie (2007 b) – offers a less unilateral comprehension of the relationships among capital flows, trade flows and exchange rates.

SFC modellers do not deny that liquidity preferences of asset holders, rates of return on financial assets (included interest rates on government bonds) and expectations on the future level of exchange rates can have a major impact on short-run exchange rates. However, the feedback mechanism that affects the trade balance via the exchange rate can provide a powerful compensation which in the medium-long-run could even offset the initial speculative push. In the real world, it is possible that the long-run 'fundamental movement' will not actually materialise, as other changes will soon modify both the short-run macroeconomic variables and the underlying fundamentals. Nevertheless, the advantage of using an abstract and formal model consists exactly in the possibility to 'see things' that are not immediately evident from the direct observation of data.

Again, a practical example could prove itself useful. Country A is initially in a balanced trade and financial position. Then the interest rate of its long-term government bonds increases. This will trigger an inflow of capitals in country A and the appreciation of its currency. Within the logic of the Mundell-Fleming model the net export position will worsen, moving the IS curve and the overall income down. The interest rate will come back at its original level due to a lower level of money demand. The new equilibrium will be characterized not only by a lower level of income, but also by a stronger domestic currency (that is to say a lower level of the exchange rate if it is measured in 'direct' or 'American' terms: number of domestic units per one unit of foreign currency).

The story would be completely different in the OPENFLEX model. The initial influx of capital will spur an appreciation of the currency. However, once that the agents have satisfied their demand for long term bonds of country A *given a certain level of interest rate*, this influx will cease, even if the interest rate has not come back to its initial value. The assumption of perfect assets substitutability is not part of the model and agents do not accumulate homogenous assets indefinitely. Therefore, in the following periods, the external deficit caused by the initial appreciation of the currency will bring up the exchange rate (depreciation) until this tendency is stopped by a new equilibrium in the current account. The most interesting aspect of the entire process is that the final level of the exchange rate will be higher (meaning a weaker currency) than before the hike in the interest rate: "Indeed, because of additional costs of servicing the now larger external debt, [country A] current account balance will be brought back to zero only if the trade remains positive […]. As a consequence, the new steady state value of [country A] exchange rate is lower than its original steady state value" (Godley and Lavoie 2007 b, p. 487. It is important to remember that it has been initially assumed a trade balance equal to zero).

Within a neoclassical/mainstream approach trade flows can play a more significant role in the very long-run, for instance according to the Purchasing Power Parity (PPP) theory. However, the theory is difficult to reconcile with the Mundell-Fleming framework, even when the assumption of fixed prices is dropped. It is not a coincidence that the support for PPP is not so strong among 'mainstream' economists. When Krugman, Obstfeld and Melitz (2015) raised the question "how well does the PPP theory explain actual data on exchange rates and national price level?", they themselves provided the following "brief answer": "all versions of the PPP theory do badly in explaining the facts" (Krugman, Obstfeld and Melitz 2015, p. 455).

2.2.5 Double vs quadruple-entry principle

Balance of payments accounting in 'mainstream' models follows a "simple rule of double-entry bookkeeping: every international transaction automatically enters the balance of payments twice, once as a credit and once as a debit" (Krugman, Obstfeld and Melitz 2015, p. 455). When, for instance, a US citizen buys a dress from Italy, it is recorded a debit in the US current account, since some money has been spent on buying the item which has been paid to an Italian exporter. On the other hand, US financial account is credited with the same amount of money. Indeed, if the Italian exporter is paid in (cash) dollars and holds the dollars for a future journey in the US (cash is nothing else than a liability of the central bank that issues that currency), it means that the liabilities of US towards Italy have increased. The result turns out to be the same if the Italian exporter deposits the dollars in an American bank: again, the liabilities of the US towards Italy are now higher. If the Italian exporter tries to change dollars for euros with another Italian agent, the acquisition of US assets is simply made by the latter, but the credit position in US financial balance still holds. Finally, if it is an American institution which changes dollars for euros, the level of European assets held by American agents decreases. Lowering the level of lending corresponds *de facto* to increasing the level of borrowing: the positive change in the American financial account is confirmed once again.

This example should help to understand why only non-financial transaction can have an impact on the financial account of a country. Assume now the following situation: the same US citizen does not want to buy an Italian dress anymore;

instead, she wants to buy some stocks of the Italian fashion brand Brunello Cucinelli. In this case, US – and Italy – financial accounts are not modified. The purchase of the stocks implies a debit in the US financial account, which corresponds to the credit created by the increase of the dollar deposit of Mr Cucinelli's family trust in its American bank. Pure financial transactions always end up with a zero net position in the financial account of the countries involved.

In the Mundell-Fleming model – and in a flexible exchange rate regime – the dynamics triggered by a drop of domestic interest rate goes as follows: domestic citizens consider the internal interest rate too low in comparison with the foreign assets' one; the insufficient domestic assets return generates an 'infinite' outflow of capital; the infinite negative financial account which follows drags down the balance of payments below the level of equilibrium and this, in turn, depreciates the currency. The outflow – and the negative position of the balance of payments – does not stop until the level of income increases enough to bring back the interest rate at the original level. At this point the balance of payments is balanced and the exchange rate is stabilized.

At first sight, the narrative reported above looks pretty linear and reasonable. The picture becomes more complicated if the following question is raised: what does an *outflow of capitals* really mean? It means that, for instance, American citizens consider the interest rate of US government bonds too low and they want to buy Italian government bonds. In order to do that, they have to sell dollars and buy euros. Then, with these euros, they can buy Italian government bonds denominated in the European single currency. During this process – assuming it is part of a general trend – it is entirely plausible that dollar depreciates and euro appreciates. Yet the US financial account is far from registering an infinite deficit: for every euro bought in the market, either an asset denominated in dollars has been acquired by a foreign agent (in the form, for instance, of a dollar deposit at an American bank) or an asset denominated in euro has been sold by an American agent (in the form, for instance, of an American bank which uses its deposit in euros at its European correspondent bank to provide the European currency to its American clients). The financial account is always balanced as far as the transactions in question do not involve trade or unilateral transfers. That is why the narrative of the infinite outflow (inflow) of capitals and of the infinite negative (positive) position of the balance of

payments which characterise the Mundell-Fleming model seems to be at odds with the accounting rules that regulate international bookkeeping.
The following statement is taken from the original paper by Mundell (1963), under the section "Policies under flexible exchange rate":

"*Monetary Policy*. Consider the effect of an open market purchase of domestic securities in the context of a flexible exchange rate system. This results in an increase in bank reserves, a multiple expansion of money and credit, and downward pressure on the rate of interest. But the interest rate is prevented from falling by an outflow of capital, which causes a *deficit in the balance of payments* [emphasis added], and a depreciation of the exchange rate" (Mundell 1963, p. 477).

Actually, no *deficit* in the balance of payments can even occur, unless the system is in a fixed exchange regime (and even in this case only within the "less formal usage" of the expression balance of payments, that must refer to the "official settlement balance", or the "level of net central bank financial flows": Krugman, Obstfeld, Melitz, p. 365). In Mundell's original abstract reported above the 'agents of the model' are purchasing foreign assets: therefore, they are trading foreign currency for domestic currency and foreign agents must be buying domestic currency or assets. The inflow offsets the outflow.

SFC open economy models are based on a quadruple-entry principle which will be described in detail in chapter 3. As in the double-entry mechanism, only non-financial transactions can affect the financial account (or the capital account, if one wants to adopt the terminology used in Godley and Lavoie's "Monetary Economics"). However, in the scheme shared by SFC models, there is a way to reconcile the pressure under which the exchange rate can fall with the fact that the financial account needs to be in equilibrium if no non-financial transactions intervene. This consists in taking into consideration the 'notional gap'[52] between the *demand* for foreign assets and the quantity of *owned* foreign assets. The potential for a 'notional gap' is evident from the equations of the model, but never materialises as a real 'infra-period' equilibrium. The distinction between *demand* and *holding* of assets allows the model to incorporate a powerful driver of the exchange rate even when the capital account is assumed to keep being unaffected by merely financial

[52] An in-depth explanation of the concept of 'notional gap' will be provided in chapter 4, when the closure of the OPENFLEX model will be analysed.

transactions. What is labelled as an outflow of capitals in the neoclassical model, in the SFC approach is nothing but a marked increase of *demand* for foreign assets (always denominated in domestic currency). Then the exchange rate must adjust in order to match the demand of foreign assets with their 'capital account equilibrium' quantity.

The same example used above can contribute to the clarification of the concept: when American citizens want to buy much more Italian government bonds due to a rise in the interest rate differential, the demand of Italian bonds[53] exceeds the equilibrium quantity and the dollar depreciates. For the depreciation not to materialise, 'something' must happen 'elsewhere'. For instance, if the demand for Italian goods from American households drops, Italy records a trade deficit. Resources are 'freed' in the US financial account via an increase of the holding of Italian assets by American citizens. For the sake of simplicity, it possible to assume that these resources take the form of cash denominated in euros. The latter can be used to buy Italian government bonds[54] and the downward pressure on the dollar can be tamed, as far as the Italian trade deficit (or the American trade surplus) can supply 'enough euros' to the American households.

Still, for the whole mechanism to work, the 'notional gap' between demand and holding of an asset is not enough. There must be a level of *finite* demand of financial assets which is compatible with the equilibrium of the capital account. For this to exist the model must be characterised by two further elements: the non-substitutability hypothesis (see section 2.2.2) and an accounting technique that allows keeping track of the financial stocks.

The quadruple-entry principle of the SFC model prescribes that every transaction is recorded not only as a flow, that is to say as a (double) item of the balance of payments, but also as a stocks' 'modifier', that is to say as a (double) item which amends the balance sheets of the different sectors of the economy.

Thanks to this rigorous method of accounting, the SFC open economy model does not suffer from the contradictions of the neoclassical model when it comes to dealing with the effects

[53] More precisely this is the demand of Italian bonds from American investor, in the logic of a two-country model shaped as the OPENFLEX.

[54] Nothing changes if we assume international trade is made in dollars: Italian households will buy dollars in the market 'freeing' the euros that are bought by American households who want to buy Italian bonds. Soon the American dollars 'come back' in the US (due to the Italian trade deficit) while the European assets – either in the form of cash or in the form of bonds – are still held by American households.

of the financial transactions on the financial account and, consequently, on the exchange rate.

2.2.6 On the effectiveness of fiscal policy

Given the differences observed so far between the two models, it is not surprising that quite different policy implications follow.

In the Mundell-Fleming model fiscal policy cannot affect the total level of income when a flexible exchange rate regime is assumed. Indeed, the appreciation of the domestic currency associated with expansionary fiscal policy dampens export and undermines the net external demand. The IS curve is back at its starting point and the income of the country is stuck to its initial level. Furthermore, the deterioration of the trade balance generated by a stronger currency contributes to the worsening of the current account, which is also affected by the increase of the debt exposure of residents towards foreigners. The country is overall worse off, since it has not solved the problem of internal balance that has probably moved the government to intervene with an expansionary fiscal policy, while the external balance has been compromised. Using the words of Mundell in one of his original 1963 paper: “Fiscal policy thus completely loses its force as a domestic stabilizer when the exchange rate is allowed to fluctuate and the money supply is held constant” (Mundell 1963, p. 478).

Opposite conclusions characterise the SFC open economy model. Fiscal policy, even in the form of a permanent (non-temporary) intervention, weakens the currency and manages to boost the economy. In the short-run the country can suffer from a deterioration of the trade balance and of the current account, given the fact that import is driven up by a higher level of overall income. Also, a weaker currency widens the trade deficit for a *fixed* level of import and export volumes, as net real export does not change in the very short-run. Yet the persistent depreciation of the exchange rate represents a valid instrument to re-establish the external equilibrium too.

In the SFC model this positive outcome of fiscal policy is due to the fact that the interest rate is not affected by the expansionary measure and the growth of income. It is worthwhile to notice that Mundell reached the same conclusion in 1961 with a model based on the assumption that the central bank controls the interest rate:

"A budget deficit mainly affecting spending on home goods will create an expansion of output equal to that indicated by the Keynesian foreign trade multiplier *plus* an additional amount due to the elimination of the foreign imbalance by the depreciation of the exchange rate. Fiscal policy is therefore more effective in improving employment under a system of flexible exchange rates than under a system of fixed exchange rate" (Mundell a, p. 512-513).

Yet that *was not* the model which later would become famous as *the* Mundell-Fleming model, being the latter mostly based on the 1963 paper. The 1961 paper was more focused on the "mercantilist element in Keynesian policy": that ought to be regarded as "definitely inapplicable" (Mundell 1961 a, p. 509) in a flexible exchange regime only when the money-capital market was left free to adjust via the change in the interest rate. If additional assumptions are introduced – such as "that the central bank, through its open market policy, maintains constant interest rates" (Mundell 1961 a, p. 516) – the Keynesian economic policy tools should be considered still valid.

Fleming himself (1962) described the possibility of a rise of income following an increase in public expenditure in a flexible exchange rate regime if either one of the following two conditions was in place: 1) "the maintenance of a constant rate of interest" (Fleming 1962, p. 370), as in Mundell 1961 (explicitly quoted by Fleming in a note of his paper); 2) "parameters of our models – notably the sensitivity of capital movements to changes in the rate of interest – (…) such that a rise in public expenditure would have resulted, with a fixed exchange rate system[55], in a deterioration in the balance of payments" (Fleming 1962, p. 371), which in turn would trigger a depreciation of the currency. In other words, if capitals are not very mobile (and therefore not attracted by a higher interest rate), the deficit in the current account would trigger a depreciation of the currency which would reinforce the push of the government expenditure. However, Fleming seemed to suggest this is a purely theoretical case. Moreover, it is Mundell 1963 that is virtually reproduced as "the Mundell-Fleming model" in macroeconomics and international economics

[55] Note that Fleming does not speak, rightfully, about a deficit in the balance of payment in a flexible exchange rate regime, which is not possible (see section 2.2.5). In order to give the idea of a supply of domestic currency greater than the demand in the foreign exchange market he speaks about a deficit that *would have resulted*, in case of a fixed exchange rate system. Still, the balance of payment is here defined net of central bank financial flows.

handbooks (see note 43) and therefore it is Mundell 1963 which for the purposes of this inquiry should be assumed as the 'mainstream' benchmark and compared with the standard SFC model.

2.2.7 A 'general theory' of the terms of trade

Although the neoclassical and the SFC models come to opposite conclusions with respect to the effect on the domestic currency of expansionary fiscal policy, they tend to share the same assumption about the relationship between exchange rate and trade balance. Both approaches are built on the expectation that the net external position of a country will improve following a depreciation of the currency.

Evidently, a weaker currency boosts export – domestic products and services are cheaper for foreign customers – and discourages import – foreign goods and services are more expensive for domestic customers. However, even if the level of import in real terms drops, its value in domestic currency could rise. Under certain circumstances, this increase in the value of import could even outstrip the hike in the value of export. That this is not the case in the Mundell-Fleming model is ensured by the famous Marshall-Lerner condition (Robinson 1937, Lerner 1944), which requires the sum of price elasticities of export and imports (in absolute value) being greater than one.

What is less often acknowledged is that there is a 'hidden' condition behind the neat and straightforward Marshall-Lerner 'main' condition:

> "[the M-L condition] seems to be based on the assumption that export prices, expressed in the domestic currency, won't change following a depreciation of the home currency, while import prices will increase in line with the depreciation. In other words, prices are assumed to be always fixed in the currencies of the exporters. This implies that the terms of trade go down by the full amount of the depreciation" (Godley and Lavoie 2007 b, p. 455).

By contrast, the SFC open economy model provides a sort of 'general theory', or 'general condition', of the terms of trade, which encompasses the Marshall-Lerner condition as the specific case in which a complete exchange rate pass-through to import prices occurs.

In the more realistic approach followed by Godley and Lavoie trade prices are given by the following equations (they are taken directly from the OPENFLEX model in

Chapter 12 of Godley and Lavoie 2007 b. The two countries of the model are assumed to be the UK and the US. Therefore, the superscripts with the symbols of the sterling – £ – and the dollar – \$ – denote the country to which a certain variable refers. Bold characters denote natural logarithm):

$$\boldsymbol{p_m^{£}} = v_0 - v_1 * \boldsymbol{xr^{£}} + (1 - v_1)\boldsymbol{p_y^{£}} + v_1\boldsymbol{p_y^{\$}} \quad 0 < v_1 < 1 \quad (OPENFLEX\ 12.21)$$

$$\boldsymbol{p_x^{£}} = u_0 - u_1 * \boldsymbol{xr^{£}} + (1 - u_1)\boldsymbol{p_y^{£}} + u_1\boldsymbol{p_y^{\$}} \quad 0 < u_1 < 1 \quad (OPENFLEX\ 12.22)$$

$\boldsymbol{p_m}$ and $\boldsymbol{p_x}$ are respectively export prices and import prices, $\boldsymbol{p_y}$ is domestic prices[56], $\boldsymbol{xr^{£}}$ is the exchange rate (note that in Godley and Lavoie 2007 b the exchange rate was quoted in indirect terms: foreign currency units per domestic units. More specifically, number of dollars per one pound. Following this approach, the depreciation of the domestic currency implies a *decrease* in the exchange rate).
Setting v_1 and u_1 between 0 and 1 ensures that there is no full pass-through to import prices when the domestic currency of a country depreciates (this is true also with regard to u_1, since UK export prices are US import prices in foreign currency. With a complete pass-through, as it will be clearer later, $u_1$would equal 0).
The first difference of both equations gives the rates of change of both import and export prices (same symbols with a point on the top):

$$\dot{p}_m^{£} = -v_1\dot{xr}^{£} + (1 - v_1)\dot{p}_y^{£} + v_1\dot{p}_y^{\$} \quad 0 < v_1 < 1 \quad 2.1$$

$$\dot{p}_x^{£} = -u_1\dot{xr}^{£} + (1 - u_1)\dot{p}_y^{£} + u_1\dot{p}_y^{\$} \quad 0 < u_1 < 1 \quad 2.2$$

As it is apparent from equation 2.1 a complete pass-through is possible just if, for instance, when the pound depreciates domestic prices increase by the same percentage. Only in this case US exporters can be confident not to lose their market share in the UK even when they charge British consumers for the full price (in dollars) of their products (which implies a higher price in pounds). Despite facing

[56] In the original model p_y is the GDP deflator, but it has been chosen to use the name domestic prices since in chapter 3 this part of the model will be amended with a different measure of domestic prices. At any rate, the amendment will not affect the result of the demonstration of the terms of trade condition that is developed here, which is valid whichever measure of domestic prices is used.

higher prices, British consumers have no alternatives: they keep buying American goods, as domestic products are more expensive too.
The following equations give export and import volumes (again, bold characters denote natural logarithm):

$$\boldsymbol{x}^{£} = \varepsilon_0 - \varepsilon_1\left(\boldsymbol{p}^{\$}_{\boldsymbol{m-1}} - \boldsymbol{p}^{\$}_{\boldsymbol{y-1}}\right) + \varepsilon_2 \boldsymbol{y}^{\$} \quad (OPENFLEX\ 12.25)$$

$$\boldsymbol{im}^{£} = \mu_0 - \mu_1\left(\boldsymbol{p}^{£}_{\boldsymbol{m-1}} - \boldsymbol{p}^{£}_{\boldsymbol{y-1}}\right) + \mu_2 \boldsymbol{y}^{£} \quad (OPENFLEX\ 12.26)$$

These equations, or slightly different versions of them, are pretty standard in the open economy literature. They ultimately rack back to the reduced-form equations firstly put forward – end empirically estimated – by Houthakker and Magee (1969). As it is evident, the equations are nothing but Cobb-Douglas functions. This allows the modeller to assume a constant elasticity of import and export with respect to prices:

$$x^{£} = h\,\left(\frac{p^{\$}_{m-1}}{p^{\$}_{y-1}}\right)^{-\varepsilon_1} {y^{\$}}^{\varepsilon_2} \quad where\ h = e^{\varepsilon_0} \qquad 2.3$$

$$im^{£} = g\,\left(\frac{p^{£}_{m-1}}{p^{£}_{y-1}}\right)^{-\mu_1} {y^{£}}^{\mu_2} \quad where\ g = e^{\mu_0} \qquad 2.4$$

Furthermore, note that:

$$p^{\$}_{x} = p^{£}_{m} xr^{£} \quad (OPENFLEX\ 12.23)$$

$$p^{\$}_{m} = p^{£}_{x} xr^{£} \quad (OPENFLEX\ 12.23)$$

Substituting OPENFLEX 12.23 in 2.3, the following expression is obtained:

$$x^{£} = h\,\left(\frac{p^{£}_{x-1} xr^{£}_{-1}}{p^{\$}_{y-1}}\right)^{-\varepsilon_1} {y^{\$}}^{\varepsilon_2} \quad where\ h = e^{\varepsilon_0} \qquad 2.5$$

The rates of change of import and export are given by taking the first difference of OPENFLEX 12.26 and the logarithm and the first difference of 2.5.

$$\dot{x}^{£} = -\varepsilon_1\left(\dot{p}^{£}_{x-1} + \dot{xr}^{£}_{-1} - \dot{p}^{\$}_{y-1}\right) + \varepsilon_2\dot{y}^{\$} \quad 2.6$$

$$\dot{\imath m}^{£} = -\mu_1\left(\dot{p}^{£}_{m-1} - \dot{p}^{£}_{y-1}\right) + \mu_2\dot{y}^{£} \quad 2.7$$

It is convenient to simplify the equations by getting rid of the one period lag which accounts for the delayed effect on import and export of the changes in prices (in other words, J-curve effects are not considered for now):

$$\dot{x}^{£} = -\varepsilon_1\left(\dot{p}^{£}_{x} + \dot{xr}^{£} - \dot{p}^{\$}_{y}\right) + \varepsilon_2\dot{y}^{\$} \quad 2.8$$

$$\dot{\imath m}^{£} = -\mu_1\left(\dot{p}^{£}_{m} - \dot{p}^{£}_{y}\right) + \mu_2\dot{y}^{£} \quad 2.9$$

Assuming an initial situation characterised by trade balance at zero, it is possible to define $\dot{TB}$ as the (percentage) change in the trade balance over the level of import or export[57]. If, for example, export and import are both initially set at £ 1000, and after one period the value of export has risen to £ 1050 whereas the value of import has increased to £ 1030, the trade balance has improved by £ 20. It is precisely 2% of 1000. And it could have also been calculated as the variation in export value (which is 5% = (1050-1000)/1000) minus the variation of import value (which is 3%).

Therefore, given:

$$X^{£} = x^{£}p^{£}_{x} \quad OPENFLEX\ 12.29$$

$$IM^{£} = im^{£}p^{£}_{m} \quad OPENFLEX\ 12.31$$

[57] Strictly speaking, this is not a rigorous definition of the percentage change in trade balance, which should be given by the formula $\frac{\Delta(X-M)}{X_{-1} - M_{-1}}$. Yet with a rigorous definition its value would always be undefined if one starts from a trade balance that equals to 0. By contrast, this measure of the change in the trade balance is fit for purpose and does not create a problem of undefined results.

and defining $\dot{X}^{£}$ as the variation in export value and $I\dot{M}^{£}$ as the variation in import value, $T\dot{B}$ is given by:

$$T\dot{B} = \dot{X}^{£} - I\dot{M}^{£} = \dot{p}_x^{£} + \dot{x}^{£} - \dot{p}_m^{£} - \dot{\imath m}^{£} \quad 2.10$$

Then each element on the right-hand side of equation 2.10 can be substituted by, respectively, equation 2.2, 2.8, 2.1 and 2.9 (this time in bold characters there are the factors which comprise the exchange rate. It is just useful notation in order to keep track of these factors and does not denote natural logarithm):

$$T\dot{B} = -\boldsymbol{u_1}\dot{\boldsymbol{xr}}^{£} + (1-u_1)\dot{p}_y^{£} + u_1\dot{p}_y^{\$} - \varepsilon_1\left(\dot{p}_x^{£} + \dot{\boldsymbol{xr}}^{£} - \dot{p}_y^{\$}\right) + \varepsilon_2\dot{y}^{\$} - \left[-\boldsymbol{v_1}\dot{\boldsymbol{xr}}^{£} + (1-v_1)\dot{p}_y^{£} + v_1\dot{p}_y^{\$}\right] - \left[-\mu_1\left(\dot{p}_m^{£} - \dot{p}_y^{£}\right) + \mu_2\dot{y}^{£}\right]$$

$$= -\boldsymbol{u_1}\dot{\boldsymbol{xr}}^{£} + (1-u_1)\dot{p}_y^{£} + u_1\dot{p}_y^{\$} - \varepsilon_1\left(\dot{p}_x^{£} + \dot{\boldsymbol{xr}}^{£} - \dot{p}_y^{\$}\right) + \varepsilon_2\dot{y}^{\$} + \boldsymbol{v_1}\dot{\boldsymbol{xr}}^{£} - (1-v_1)\dot{p}_y^{£} - v_1\dot{p}_y^{\$} + \mu_1\left(\dot{p}_m^{£} - \dot{p}_y^{£}\right) - \mu_2\dot{y}^{£}$$

$$= -\boldsymbol{u_1}\dot{\boldsymbol{xr}}^{£} + (1-u_1)\dot{p}_y^{£} + u_1\dot{p}_y^{\$} - \varepsilon_1\left(u_0 - \boldsymbol{u_1}\dot{\boldsymbol{xr}}^{£} + (1-u_1)\dot{p}_y^{£} + u_1\dot{p}_y^{\$} + \dot{\boldsymbol{xr}}^{£} - \dot{p}_y^{\$}\right) + \varepsilon_2\dot{y}^{\$} + \boldsymbol{v_1}\dot{\boldsymbol{xr}}^{£} - (1-v_1)\dot{p}_y^{£} - v_1\dot{p}_y^{\$} + \mu_1\left(v_0 - \boldsymbol{v_1}\dot{\boldsymbol{xr}}^{£} + (1-v_1)\dot{p}_y^{£} + v_1\dot{p}_y^{\$} - \dot{p}_y^{£}\right) - \mu_2\dot{y}^{£} =$$

$$= -\boldsymbol{u_1}\dot{\boldsymbol{xr}}^{£} + (1-u_1)\dot{p}_y^{£} + u_1\dot{p}_y^{\$} - \varepsilon_1\left(u_0 - \boldsymbol{u_1}\dot{\boldsymbol{xr}}^{£} + (1-u_1)\dot{p}_y^{£} + u_1\dot{p}_y^{\$} + \dot{\boldsymbol{xr}}^{£} - \dot{p}_y^{\$}\right) + \varepsilon_2\dot{y}^{\$} + \boldsymbol{v_1}\dot{\boldsymbol{xr}}^{£} - (1-v_1)\dot{p}_y^{£} - v_1\dot{p}_y^{\$} + \mu_1\left(v_0 - \boldsymbol{v_1}\dot{\boldsymbol{xr}}^{£} + (1-v_1)\dot{p}_y^{£} + v_1\dot{p}_y^{\$} - \dot{p}_y^{£}\right) - \mu_2\dot{y}^{£} =$$

$$= -\boldsymbol{u_1}\dot{\boldsymbol{xr}}^{£} + (1-u_1)\dot{p}_y^{£} + u_1\dot{p}_y^{\$} - \varepsilon_1 u_0 + \boldsymbol{\varepsilon_1 u_1}\dot{\boldsymbol{xr}}^{£} - \varepsilon_1(1-u_1)\dot{p}_y^{£} - \varepsilon_1 u_1\dot{p}_y^{\$} - \boldsymbol{\varepsilon_1}\dot{\boldsymbol{xr}}^{£} + \varepsilon_1\dot{p}_y^{\$} + \varepsilon_2\dot{y}^{\$} + \boldsymbol{v_1}\dot{\boldsymbol{xr}}^{£} - (1-v_1)\dot{p}_y^{£} - v_1\dot{p}_y^{\$} + \mu_1 v_0 - \boldsymbol{\mu_1 v_1}\dot{\boldsymbol{xr}}^{£} + \mu_1(1-v_1)\dot{p}_y^{£} + \mu_1 v_1\dot{p}_y^{\$} - \mu_1\dot{p}_y^{£} - \mu_2\dot{y}^{£} =$$

$$\begin{aligned} = -\boldsymbol{u_1}\dot{\boldsymbol{xr}}^{£} + \boldsymbol{\varepsilon_1 u_1}\dot{\boldsymbol{xr}}^{£} + \boldsymbol{v_1}\dot{\boldsymbol{xr}}^{£} - \boldsymbol{\mu_1 v_1}\dot{\boldsymbol{xr}}^{£} - \boldsymbol{\varepsilon_1}\dot{\boldsymbol{xr}}^{£} + (1-u_1)\dot{p}_y^{£} + u_1\dot{p}_y^{\$} - \varepsilon_1 u_0 \\ - \varepsilon_1(1-u_1)\dot{p}_y^{£} - \varepsilon_1 u_1\dot{p}_y^{\$} + \varepsilon_1\dot{p}_y^{\$} + \varepsilon_2\dot{y}^{\$} - (1-v_1)\dot{p}_y^{£} - v_1\dot{p}_y^{\$} + \mu_1 v_0 \\ + \mu_1(1-v_1)\dot{p}_y^{£} + \mu_1 v_1\dot{p}_y^{\$} - \mu_1\dot{p}_y^{£} - \mu_2\dot{y}^{£} \quad 2.11 \end{aligned}$$

The partial derivative of $\dot{TB}$ with respect to the exchange rate is given by:

$$\frac{\partial \dot{TB}}{\partial\ \dot{xr}^{£}} = -u_1 + \varepsilon_1 u_1 + v_1 - \mu_1 v_1 - \varepsilon_1 \quad 2.12$$

In order to have an improvement of the trade balance following a depreciation of the currency, it is necessary to obtain a negative change in the percentage change of trade balance when $\dot{xr}$ increases marginally (note that the exchange rate is still quoted in indirect terms):

$$\frac{\partial \dot{TB}}{\partial\ \dot{xr}} < 0 \ \ if \ -u_1 + \varepsilon_1 u_1 + v_1 - \mu_1 v_1 - \varepsilon_1 < 0 \quad 2.13$$

Therefore, the condition for an improvement of the trade balance following the domestic currency depreciation is:

$$\varepsilon_1(1 - u_1) + \mu_1 v_1 > v_1 - u_1 \quad 2.14$$

The sum of the price elasticities of export and import – weighted for the pass-through coefficients of the exchange rate *on import prices* – must be greater than the difference between the pass-through coefficients of exchange rate on import prices and export prices.

The weights can be referred just to the pass-through coefficient *on import prices* because the expression $(1 - u_1)$ is indeed the pass-through coefficient on import prices of *the other country* (in this case, the US). Remembering that (bold characters denote natural logarithm):

$$\boldsymbol{p}_x^{£} = u_0 - u_1 * \boldsymbol{xr}^{£} + (1 - u_1)\boldsymbol{p}_y^{£} + u_1 \boldsymbol{p}_y^{\$} \quad 0 < u_1 < 1 \quad (OPENFLEX\ 12.22)$$

And that:

$$p_m^{\$} = p_x^{£} xr^{£} \quad (OPENFLEX\ 12.23)$$

It is possible to combine OPENFLEX 12.22 and OPENFLEX 12.23 so to produce:

$$p_m^{\$} = xr^{£} \left(\frac{{p_y^{£}}^{1-u_1} {p_y^{\$}}^{u_1} e^{u_0}}{{xr^{£}}^{u_1}} \right)$$

In turn, the latter expression can be rearranged as follows (bold characters denote natural logarithm):

$$\boldsymbol{p_m^{\$}} = u_0 + (1 - u_1) * \boldsymbol{xr^{£}} + (1 - u_1)\boldsymbol{p_y^{£}} + u_1\boldsymbol{p_y^{\$}} \quad 2.15$$

Therefore $(1 - u_1)$ is the pass-through coefficient of the exchange rate on US *import prices*.

Earlier in this section it has been said that in Godley and Lavoie's open economy model a 'general theory' of the terms of trade is implicitly included. Within that 'general theory' – captured by the condition of equation 2.14 – the complete pass-through hypothesis can be interpreted as a specific, 'extreme' case.
It could be useful in order to clarify the statement to recall the equations of export and import prices:

$$\boldsymbol{p_m^{£}} = v_0 - v_1 * \boldsymbol{xr^{£}} + (1 - v_1)\boldsymbol{p_y^{£}} + v_1\boldsymbol{p_y^{\$}} \quad 0 < v_1 < 1 \quad (OPENFLEX\ 12.21)$$

$$\boldsymbol{p_x^{£}} = u_0 - u_1 * \boldsymbol{xr^{£}} + (1 - u_1)\boldsymbol{p_y^{£}} + u_1\boldsymbol{p_y^{\$}} \quad 0 < u_1 < 1 \quad (OPENFLEX\ 12.22)$$

Again, a complete pass-through means that "prices are assumed to be always fixed in the currencies of the exporters" (Godley and Lavoie 2007 b, p. 455): if sterling depreciates the price (in pounds) of British exports is not modified at all – hence u_1= 0. Likewise, the prices of US export set in dollar will remain at the same level: a full increase in their price in pounds occurs – hence $v_1 = 1$.
If these values of u_1 and v_1 are plugged into condition 1.14 the following case-specific condition results:

$$\varepsilon_1(1 - 0) + \mu_1 * 1 > 1 - 0$$

$$\varepsilon_1 + \mu_1 > 1 \quad 2.16$$

This is precisely the well-known Marshall-Lerner condition, which states that, in order to have an improvement of the trade balance following a depreciation of the currency (and starting from a balanced trade position), the sum[58] of the price (and exchange rate) elasticities of imports and exports should be greater than one. In the second part of this chapter it will be analysed why in the SFC model the complete pass-through must be considered just as a theoretical 'limiting case': not only is it highly unrealistic, but it does not guarantee the stability of the system too.

Finally, some additional observations could be done concerning equation 2.14. The latter is slightly different from the solution provided in Godley and Lavoie's "Monetary Economics", where the authors wrote:

> the sum of "elasticities need be no greater than the elasticity of terms of trade with respect to devaluation. If there was no change at all in the terms of trade following a 10% devaluation [of the dollar] – for instance if both import and export prices in US dollars went up by 6%, not an impossible outcome – the sum of the elasticities need be no greater than positive for the balance of trade to improve" (Godley and Lavoie 2007 b, p. 455).

The statement is equivalent to the following formula, which uses the same symbolism applied up to now:

$$\varepsilon_1 + \mu_1 > v_1 - u_1 \quad 2.17$$

As it has been shown via the long process that led to equation 2.14, condition 2.17 is not sufficient in order to have an improvement of the trade balance after a devaluation of the currency. In Lavoie and Daigle (2011) it is acknowledged that the previous condition is not sufficient. Yet the reason is attributed to "feedback effects": "with feedback effects, things are much more complicated, as the recovery in trade balance following currency depreciation implies larger domestic income, and hence income effects on the trade balance" (Lavoie and Daigle 2011, p. 446).

[58] Here the elasticities are expressed as positive numbers (a minus is put in front of them in the equations of exports and imports). If the elasticities were expressed as negative numbers the Marshall-Lerner condition would imply that the sum of the absolute values of them must be greater than 1.

It is true that feedback effects play a role. Indeed, 2.14 should be considered an approximation which does not take into account feedback effects, since the partial derivative whereby the condition is derived assumes there is no change in income. However, the approximate condition is equation 2.14 and not the one contained in Godley and Lavoie 2007 b or Lavoie and Daigle 2011 (equation 2.17). In subsequent work (Lavoie 2015), Lavoie himself endorsed an equation identical to 2.14, even if no demonstration is provided.

With the presentation of the 'general condition' of the terms of trade the comparison between the neoclassical and the SFC benchmark open economy models is concluded. The following table summarises the main takeaways from sections 2.2.2 to 2.2.7.

Table 2.1: Main features of Benchmark Neoclassical ans SFC open economy model

	Mundell-Fleming /Neoclassical model	SFC Open Economy
Perfect capital mobility	Yes	Yes
Perfect asset substitutability	Yes	No
Interest rates in the short-run	Determined by income and supply of money	Set by Central Bank
Interest rates in the long-run	Interest rates parity	Set by Central Bank
Control of monetary policy in a fixed exchange rates regime	No	Yes
"Endogeneity" of money	Supply-led in fixed exchange rate regime	Demand-led
Compensation mechanism	No	Yes
Influence of trade flows on exchange rate	Negligible	Fundamental

International accounting consistency (non-financial transactions do not affect the financial account)	No	Yes
Effectiveness of fiscal policy in flexible exchange rate regime	No	Yes
Consequence of expansionary fiscal policy on domestic currency	Appreciation	Depreciation
Pass-through of exchange rate variations on import prices	Complete	Partial
Condition for a positive impact of exchange rate depreciation on trade balance	Sum of the price elasticities of imports and exports greater than one	Price elasticities of imports and exports – weighted for the pass-through coefficients of the exchange rate on import prices – greater than the difference between the pass-through coefficients

2.3 CONSEQUENCES OF DIFFERENT REGIMES OF "PASS-THROUGH MECHANISM"

Given the fact that the SFC open economy model by Godley and Lavoie incorporates a 'general theory' of the terms of trade, it can be used to compare the effects of different regimes of pass-through, included the one implicitly assumed by the original Marshall-Lerner condition.

These tests can help in understanding the role played by the behaviour of exporters in the rebalancing mechanisms which characterise a flexible exchange rates system. The tests are conducted via computer simulations and make use of the OPENFLEX model[59] developed by Godley and Lavoie in chapter 12 of "Monetary Economics" (2007). A detailed presentation of the whole model will be provided in chapter 3, when the SFC methodology will be examined in depth, both from a historical and from a theoretical point of view.

2.3.1 Experiment 1: a shock in the propensity to export with different pass-through regimes

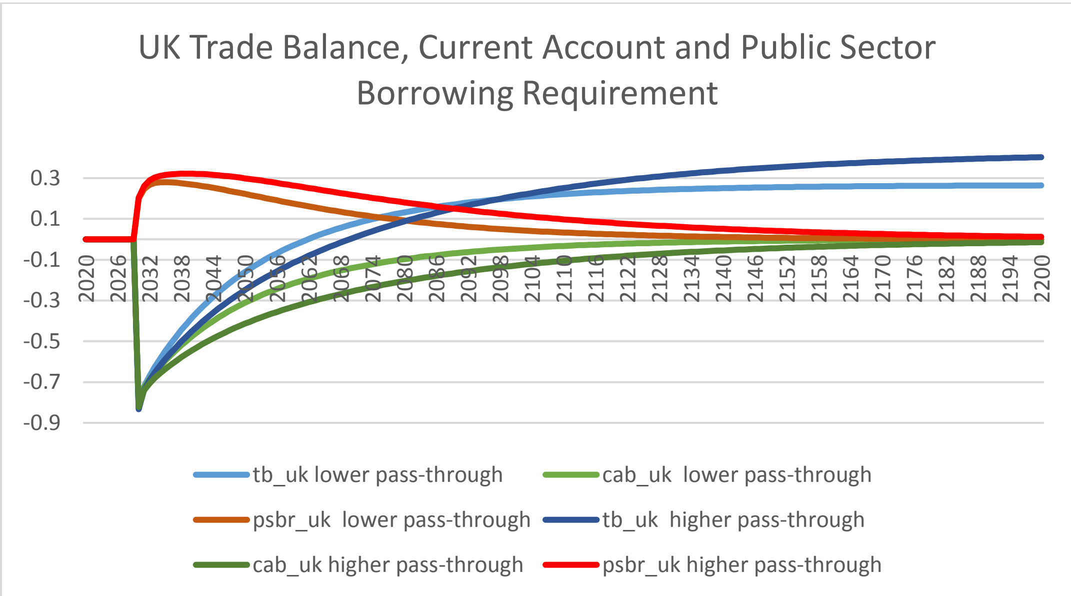
In the first experiment the OPENFLEX model is employed with two slightly different sets of parameters. The first one reproduces the pass-through mechanism with which the simulations in Godley and Lavoie's "Monetary Economics" are conducted. More explicitly: v_1= 0.7 and u_1= 0.5. The second one features a stronger pass-through mechanism: exporters whose domestic currency appreciates do not try too hard to keep their market share in the foreign country; at the same time, exporters whose domestic currency depreciates, do not care too much of gaining extra-profits from the fact that they can charge foreign customers a higher price (in domestic currency) while keeping the same market share. This attitude – which in short can be described as devoid of 'strategic behaviour' – is represented by the following coefficients: v_1= 0.8, u_1= 0.3. Bearing in mind equations OPENFLEX 12.21

[59] In chapter 3 the price structure of the model will be modified. In particular, a new measure of domestic prices will be introduced, which is more consistent with the logic of the import and export equations. However, in this chapter, it has been chosen to stick to the original version of the model. For the topics covered here, it delivers results that are equivalent of the ones obtained with its amended version, both with respect to the theoretical derivation of the new condition of the terms of trade (see note 56) and with respect to the computer simulations. Sticking to the 'original model' makes the comparison between the neoclassical and the SFC approaches easier as it is conducted on well-known benchmark models.

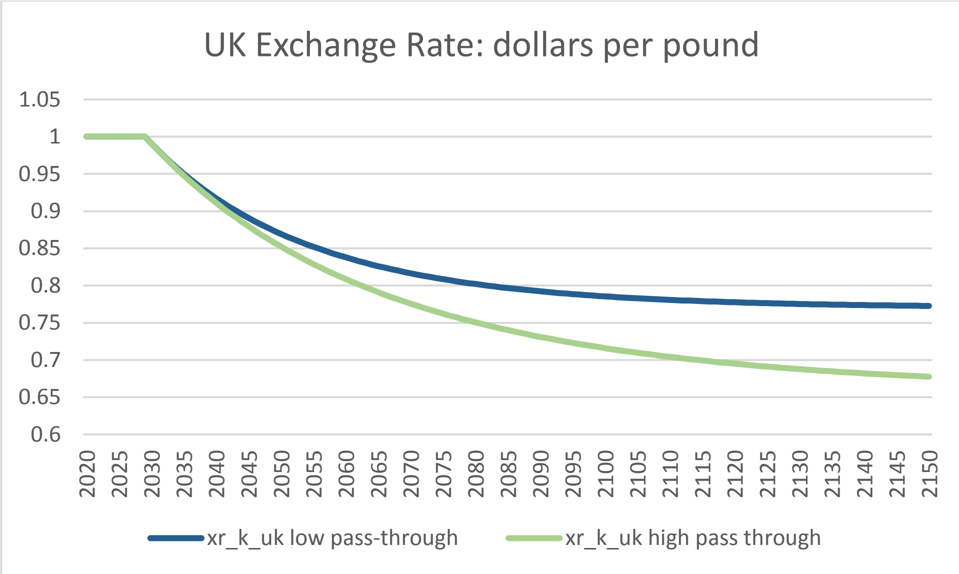
and OPENFLEX 12.22, it is evident that in case of a depreciation of the pound the higher $v_1$is, the higher will be UK import prices (US exporters are not very much concerned about losing customers in the UK); likewise, the lower u_1 is, the lower will be the impact of the fall of the pound on UK export prices expressed in domestic currency (UK exporters let the price of their goods in foreign currency to go down as the foreign currency strengthens).

The two versions of the model are shocked with a drop in the UK propensity to export (ε_0 in equation OPENFLEX 12.25). The results are shown in Graph 2.1 and 2.2.

Graph 2.1: UK Trade Balance, Current Account and Public Sector Borrowing Requirements following a step fall in the UK Exports (OPENFLEX model)



Graph 2.2: UK Exchange Rate following a step fall in the UK Export (OPENFLEX model)



In Graph 2.1 the blue and green lines resemble the famous J-Curve which is shown in every International Economics handbook. These similarities will be examined soon. However, it is essential not to forget that, strictly speaking, the J-Curve describes the behaviour of the current account following a negative shock in the *exchange rate*. Here, the shock involves the propensity to export, and the latter brings about – as an *indirect* effect – a *gradual* depreciation of the currency. In the OPENFLEX model the exchange rate is wholly endogenous and, therefore, it is not possible to shock it directly.

Following the 'original J-Curve narrative', the explanation of the slump in the trade balance and in the current account of both versions of the model – *on top of the share directly determined by the decline in the propensity to export* – would be straightforward: the increase in the value of import is higher than the increase in the value of export; since trade volumes take time to adjust, a weaker currency has an immediate negative effect on the trade balance and consequently on the current account.

Said that, why the drop is roughly equal in the two versions of the model? It could be more intuitive a worse short-run performance of the model with a higher pass-through: first, its import is more expansive in comparison to import of the original model following a depreciation of the currency; second, the increase of export prices is less marked than in the version with lower pass-through (in the latter firms behave more strategically). However, in the periods just after the shock, the depreciation of the currency is so modest that this difference in the structure of the two versions of the model can barely produce visible consequences.

The difference begins to emerge as the depreciation of the currency – initially indiscernible –goes on: trade balance and current account of the original model are more resilient *despite the fact that the gains in competitiveness of the high pass-through model are theoretically stronger* (in the latter, import prices are growing faster and export prices are growing more slowly relative to the original version). The expected, more marked kind-of-J-Curve of the high pass-through version does indeed materialise when one observes that its curves of the trade balance and current account are below the curves of the original model for many periods following the shock. These dynamics are also enhanced by an additional factor: as the current account balance of the high pass-through version struggles to improve, UK public debt held by American households grows, and the unilateral transfers for the service of this debt weigh more and more on UK current account.

Only in the very long-run the great divergence of the depreciation of the currency in the two versions of the model brings about a reversal in the pattern of the trade balance. The model with the weaker currency – the high-pass through regime version (see graph 2.2) – achieves a higher trade surplus (see graph 2.1). This is dictated by the need to serve a higher level of external debt: the trade surplus must be higher to offset higher interest payments if an equilibrium of the current account is to be achieved.

To sum up, the new equilibrium in the high pass-through version requires a higher depreciation of the currency, a higher trade surplus and *it is reached later*.

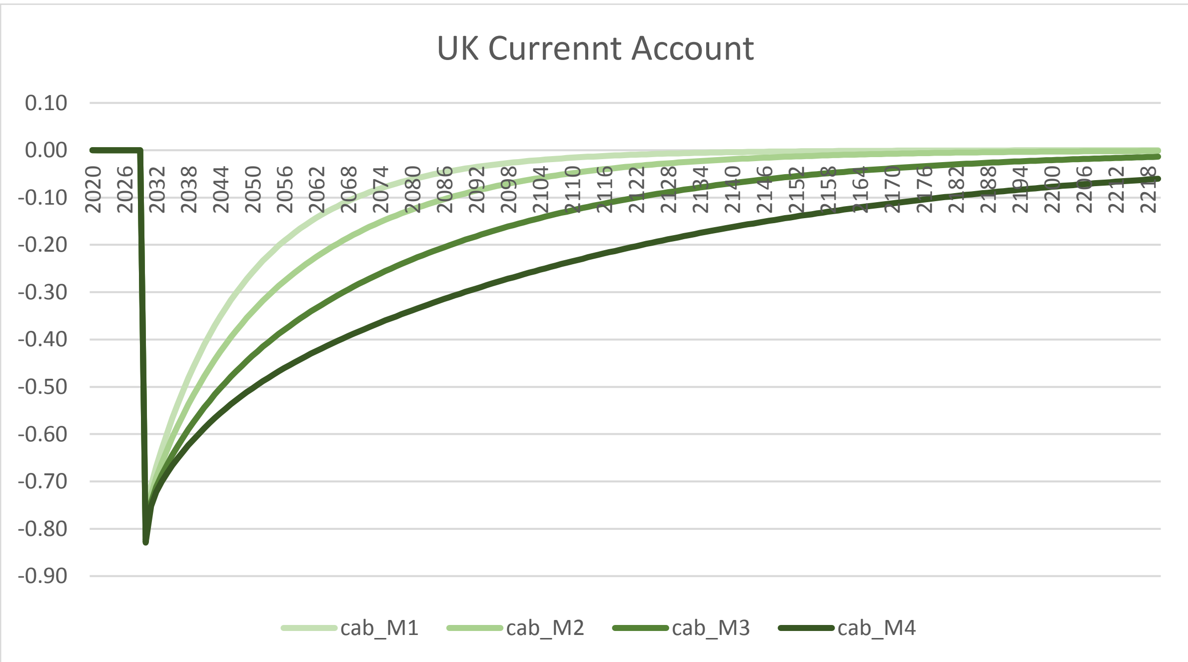
The very last point is of first importance. Again, the result of the simulation defies the initial intuition. If export prices grow more slowly and import prices grow faster in the higher pass-through model, consumers in the deficit country should be quicker to switch to domestic goods and foreign consumers should be more prone to import from the deficit country. This would result in the fact that the trade balance and the current account come back to the equilibrium level *faster* in the high pass-through regime. Yet, the contrary is true. *Less sensitive prices are quicker in bringing about a new external equilibrium* within a flexible exchange rate regime. The strategic behaviour of exporters is indeed a factor which helps the system in achieving a new equilibrium faster and more efficiently. Here is the paradox. Exporters try to sterilise the impact of the change in the exchange rate on the prices in foreign currency of the goods they sell; by doing this, they contribute to a more effective impact of the exchange rate itself in rebalancing the whole system. First of all, they curb the negative impact of the exchange rate and of the new prices on the current trade flows; secondly, their 'damage limitation' brings about long-term positive consequences on the foreign debt and consequently on the unilateral transfers comprised in the current account of the deficit country.

The following graph shows the same OPENFLEX model with 4 different regimes of pass-through in order to highlight how they impact on the speed of the rebalancing process.

Table 2.2: Parameters of import and export prices equations in four different regimes of pass-through

	Model 1	Model 2	Model 3	Model 4
v_1	0.5	0.7	0.85	0.9
u_1	0.5	0.4	0.3	0.2

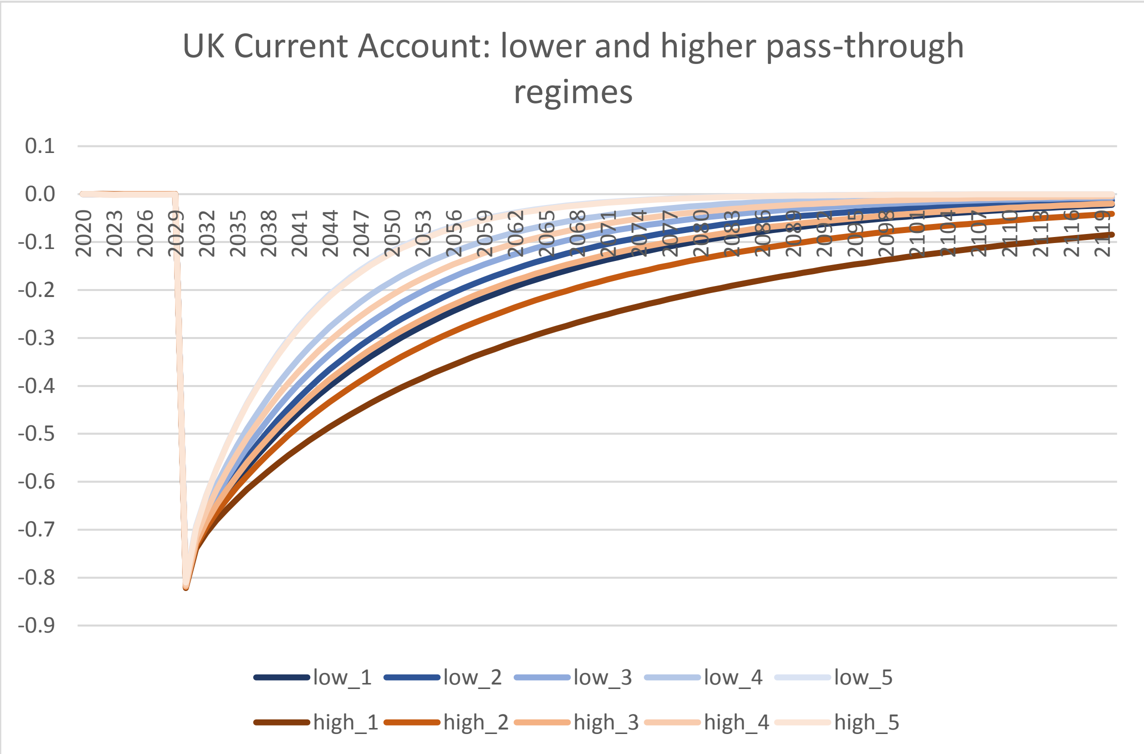
Graph 2.3: UK Current Account following a step fall in the UK exports in four different regimes of pass-through (OPENFLEX model)



Graph 2.3 shows a strong, negative correlation between the level of pass-through and the speed of the adjustment. In the fourth model the current account is still in deficit 200 periods after the shock: with coefficients set so close to the unity (in case of v_1) and to zero (in case of u_1) the model seems to struggle to find a new stable state solution to settle.

It is important to point out that all these results are not dependent on the parameters chosen for the import and export equations. One could suspect that if real import and export were more sensitive to relative prices, the higher pass-through model could indeed rebalance the current account quicker than the original one. That is not the case. A sensitivity test has been conducted with growing values of the parameters ε_1 of equation OPENFLEX 12.25 and μ_1 of equation OPENFLEX 12.26. In every situation, the current account of the original model recovers faster than the one with higher pass-through. Even with *extremely high* values for ε_1 and μ_1 (both at 1.05, a value 50% higher than in the original model) the higher pass-through version does not succeed in performing better from the point of view of the speed of the recovery of the external deficit position. All the numerical results of the sensitivity test are provided in Table A in the Appendix. Graph 2. 4 summarises the conclusions of the sensitivity test: the lines in all the shades of blue represent the original – lower pass-through – OPENFLEX model with growing values of ε_1 and μ_1: the lighter is the colour, the higher are the values of those parameters (up to a maximum of 1.05). The lines in all the shades of red represent the OPENFLEX model with higher pass-through; again, the higher are the values of ε_1 and μ_1, the lighter is the colour. As it is evident, the blue lines are always at the left of the red lines for the corresponding shade of darkness. It means that the rebalancing of the external position is always faster with a lower pass-through.

Graph 2.4: UK Current Account following a step fall in the UK exports in two different regimes of pass-through with a growing level of the parameters of import and export equations (OPENFLEX model)



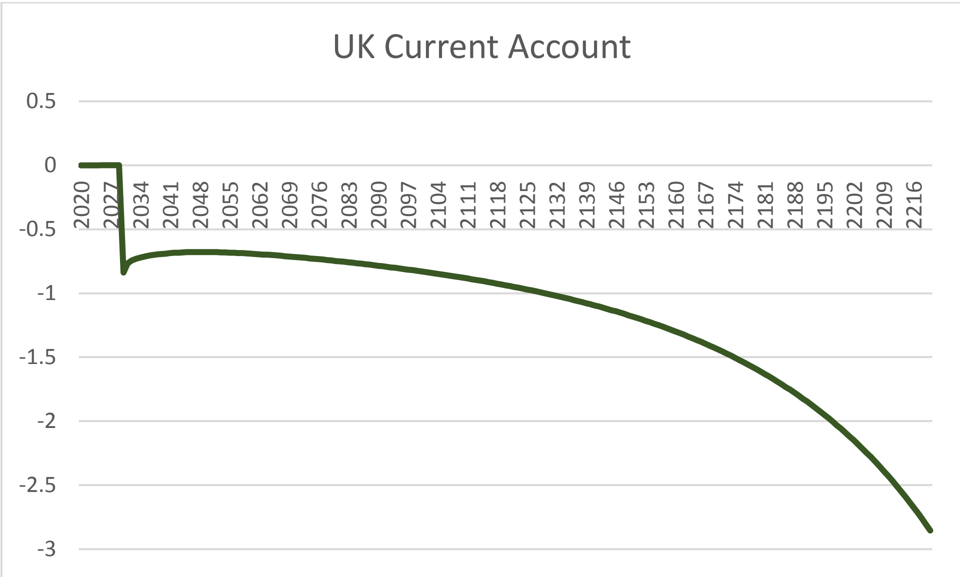
2.3.2 Experiment 2: a shock of propensity to export with a full pass-through model

Experiment 1 has clearly shown that, following a shock in the propensity to export, systems with a higher pass-through regime need more time to reach a new equilibrium of the current account.

In Model 4 of the simulation with four different pass-through regimes (see Table 2.2) the current account is still in deficit 200 periods after the shock (see Graph 2.3). It has already been pointed out that in that case – with such extreme values of v_1 and u_1 – the model seems to struggle to find a new steady state. Finally, if the parameters are set in accordance to a full pass-through mechanism (v_1= 1 and u_1= 0), that is to say consistently with what is implicitly assumed by the original Marshall-Lerner condition, the model is not stable any more.

Graph 2.5 shows the current account curve of the original OPENFLEX model with the ‘Marshall-Lerner condition’s parameters’ after the usual shock in the propensity to export.

Graph 2.5: UK Current Account following a step fall in the UK exports with ‘Marshall-Lerner condition’s parameters’ (OPENFLEX model)



UK current account tends to recover in the first periods after the shock. Then it plunges and there is no ‘hope’ that it can come back to an equilibrium position. What has happened? As far as the depreciation of the currency is not so marked, the gain in competitiveness brought about by the devaluation of the currency itself contributes to the improvement of the external position. However, the external debt is growing and the currency is weaker and weaker. When the currency overcomes a certain threshold (roughly 0.80 dollars per pound), the losses in terms of financial outflows for the service of the debt, and the ‘additional costs’ of import which weigh on the trade balance every time that the currency depreciates further[60], drive the current account more and more in deficit. It becomes impossible to stop the negative spiral and the model collapses.

[60] It is important to bear in mind that import prices affect import volumes with one period lag; therefore, the volume of import every period is proportional to an ‘old’ level of import prices, but the actual level of import prices is the one used to compute the trade balance and the current account (where import and export current *values* matter).

As a full pass-through is not compatible with the stability of the original OPENFLEX model presented by Godley and Lavoie in "Monetary economics" it seems to be fair to say that the Marshall-Lerner condition does not represent a "useful approximation" (Lavoie 2015, p. 524. See also Godley and Lavoie 2007 b and Lavoie and Daigle 2011) in the context of an open economy SFC model.

Naturally, at least three objections could be moved to this conclusion:

1) If the parameters of import and export equations – ε_1 and μ_1 – are set high enough, import and export's volumes become so sensitive to changes in prices that the model stabilises. Evidently it does exist a specific range of (theoretical) parameters compatible with a stable model even in the presence of a full pass-through mechanism. However, when a test is conducted to discover the threshold beyond which the model starts to show a stable behaviour, the values of the parameters ε_1 and μ_1 need to be unrealistically high, with very little or no correspondence in the empirical literature for most of the countries (see next section for some additional notes about the empirical aspects of the issue). More importantly, this also means that in a model based on the 'Marshall-Lerner condition's parameters' for the elasticity of import and export prices with respect to the exchange rate (v_1= 1 and u_1= 0), the sum of the elasticity of import and export volumes with respect to prices ($\varepsilon_1 + \mu_1$) must be far higher than 1[61] for the current account to recover after the shock. This is equivalent to say that if the assumption behind the original Marshal-Lerner condition holds, the Marshal-Lerner condition itself 'does not work' anymore, because it does not identify the right threshold for a positive correlation between the depreciation of a currency and the improvement of the trade balance.

By contrast, the assumption of the 'strategic behaviour' of the agents behind equation 2.14 does not suffer from this dependence from the chosen parameters of the model: even the most extreme case of strategic behaviour (v_1= 0, u_1= 1: export prices are fixed in the currency of the *other* country and therefore import prices in domestic currency are completely rigid) is compatible with the stability of the model

[61] According to the sensitivity test that has been conducted, the sum of elasticities must be at least 1.5 for the model to stabilise.

for any kind of value of ε_1 and μ_1[62]. The assumption of at least a certain extent of strategic behaviour allows the model to incorporate virtually *whichever empirically estimated value*s of the pair ε_1 and μ_1.

From this point of view, only equation 2.14 seems to represent a "useful approximation" for an open economy SFC model.

2) In theory, another way to obtain a stable model featuring the 'Marshall-Lerner condition's parameters' exists: since the problem which creates the unstable spiral is linked with external debt, a much lower level of interest rates should allow – and indeed allows – the model to reach a new steady state even in the presence of a full pass-through mechanism. However, there is a price to pay if one wants to introduce this additional caveat. One of the main characteristics of a *Stock*-Flow Consistent model is in fact lost: that is the effect of historical stocks – in this case the stock of public debt held by American/foreign households – on current flows – in this case the flows of interest payments from the UK to the US. The disturbances brought about by the stocks of wealth and their uneven distribution on a cross-country level do not play anymore the crucial role they do when the level of interest rates is not negligible.

A sensitivity test has been conducted where the level of the interest rates for both countries has been gradually reduced. In the original OPENFLEX model the interest rates are set at 3%. With the version of the model featuring the Marshall-Lerner condition's parameters, it is necessary to go as far as *halving* the level of interest rates (to 1.5%) in order to obtain a stable solution after the usual shock to the propensity to export.

Again, the Marshal-Lerner condition seems to be *incompatible* with a SFC open economy model rather than being a "useful approximation".

3) A third objection can be opposed to the statement that the Marshall-Lerner condition is an unsatisfactory approximation and equation 2.14 should be preferred. Equation 2.14 is an approximation too. It represents the condition which has to hold in order to have an improvement of the *trade balance* following a depreciation of the currency. In a model with unilateral transfers across countries, the external equilibrium is given by a balanced *current account*. In 'normal' circumstances, an

[62] Again, a sensitivity test has been conducted to verify this statement. The test is not shown here, but it can be easily provided upon request. The results come with no surprise, given that with v_1= 0 and u_1= 1 equation 2.14 becomes 0 > -1, which is always true regardless of the value of ε_1 and μ_1.

improvement of the trade balance is sufficient to bring about an improvement of the current account. But that sort of outcome cannot be taken for granted, as the example with full pass-through has just demonstrated: the explosive dynamics of that model following a shock in the propensity to export coexists with an endless increase of the trade balance.

Still, the acknowledgement that equation 2.14 is an approximation does not undermine the claim that it is preferable to the original Marshall-Lerner condition and that the latter is to be abandoned. Exactly because equation 2.14 is already an approximation in the context of the OPENFLEX model[63], it is better not to rely on an 'approximation of an approximation', as the traditional Marshall-Lerner condition would be.

2.4 IS THE MARSHALL-LERNER CONDITION STILL A "GOOD APPROXIMATION"?

2.4.1 A numerical test and its policy implications

Experiment 2 has provided the first argument to challenge the contention that the Marshall-Lerner condition still represents a "useful approximation" of the 'general condition' for an improvement of the trade balance following a depreciation of the currency: a full pass-through is not compatible with the stability of the original OPENFLEX model presented by Godley and Lavoie in "Monetary economics".

An additional argument could be provided if the model proved itself stable – that is to say showed a positive correlation between the depreciation of the currency and improvement of the trade balance of the deficit country – even when the traditional Marshall-Lerner does not hold. This is the topic of experiment 3. In the final part of section 2.4 the policy implications of abandoning the Marshall-Lerner condition will be briefly presented.

[63] Strictly speaking we can consider it a 'double approximation': apart from not considering unilateral transfers, the condition assumes income *as given*, as it has been explained during the demonstration of equation 2.14 and in the comments to equation 2.17.

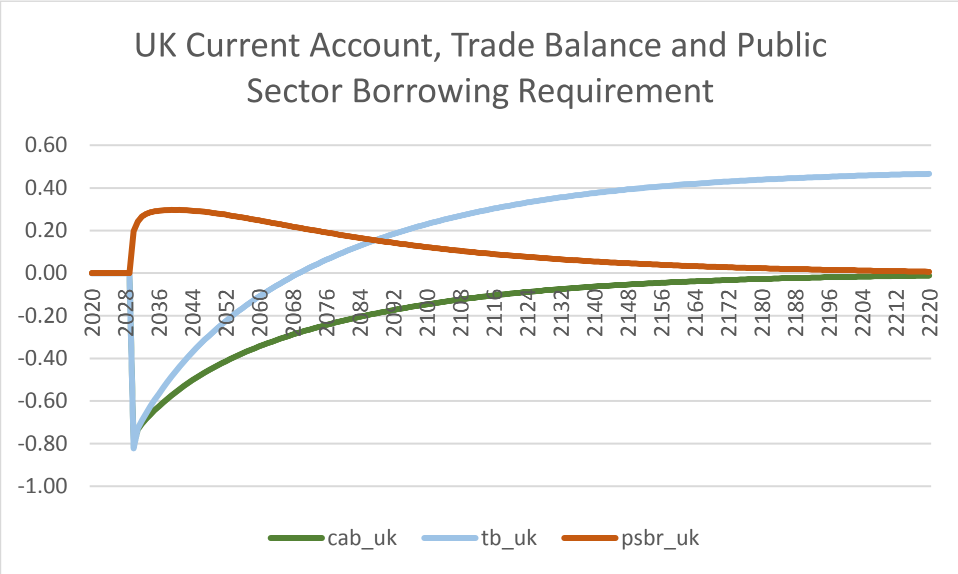
2.4.2 Experiment 3: The shock on a model where the Marshall-Lerner condition does not hold.

The model used for this experiment is still the OPENFLEX from Godley and Lavoie 2007 b. And, again, the shock is represented by a drop in the UK propensity to export (ε_0 in equation OPENFLEX 12.25). However, this time the model is characterised by lower price elasticities of import and export and a slightly more marked strategic behaviour of exporters (ε_1 = 0.49, μ_1= 0.49, v_1= 0.6, u_1= 0.55). If one tried to predict the outcome of the shock via the traditional Marshall-Lerner condition, the logical conclusion would be to say that the model is not stable, since no mechanism drives the system towards a new equilibrium of the current account and of the value of the currency. Indeed, the sum of the price elasticities of import and export is smaller than one:

$$\varepsilon_1 + \mu_1 = 0.49 + 0.49 < 1 \quad 2.18$$

The Marshall-Lerner condition does not hold. If it has to be considered a good approximation of the 'general condition' of the term of trade, a worse and worse situation of the trade balance should be expected as the pound depreciates after the shock.

Graph 2.6: UK Trade Balance, Current Account and Public Sector Borrowing Requirements following a step fall in the UK exports (OPENFLEX model, with low price elasticities of import and export).



Actually, as it is evident from graph 2.6, the model is stable and the trade balance, as well as the current account, constantly improve as far the currency depreciates. All the variables finally settle in a new long-run steady state. Although this is not the result anticipated by the Marshall-Lerner condition, it is an outcome absolutely consistent with the 'general condition' showed in equation 2.14. Indeed:

$$\varepsilon_1(1- u_1) + \mu_1 v_1 = 0.49 * 0.45 + 0.49 * 0.6 = 0.2205 + 0.294 = 0.5145 \quad 2.19$$

And:

$$v_1 - u_1 = 0.6 - 0.55 = 0.05 \quad 2.20$$

Therefore:

$$\varepsilon_1(1- u_1) + \mu_1 v_1 > v_1 - u_1 \quad because \quad 0.5145 > 0.05 \quad 2.21$$

The 'general condition' of equation 2.14 holds, and consequently the model finds a new stable solution via the improvement of trade balance even when the Marshall-Lerner condition does not hold.

The very last conclusion has important implications in terms of policies too. In the paper "Empirical tests of the Marshall-Lerner condition: a literature review" (2013) Bahmani, Harvey and Hegerty have examined the literature which has tested the Marshall-Lerner condition. Out of 216 country-estimates for the price elasticity of import and export, only 130 claimed to have shown the condition was met (60% of the cases). If the studies were further scrutinised via a simple significance test on the sum of the elasticity to be greater than one, the share in which the condition was met decreased to 30% (27 out of the 92 point estimates where the standard errors or t-statistics were available in order to conduct the test). These results were consistent with the original empirical analysis developed by Bahmani, Harvey and Hegerty in the second part of their paper with a set of 29 countries: their model rejected the evidence in favour of the Marshall-Lerner condition too.
The authors summarised as follows the consequences of all this from an economic policy point of view:

"While devaluations are commonly thought to unconditionally help a country's trade balance, the price change must be adequately offset by a change in quantity – the well-known M-L condition. This study surveys the empirical literature that has tested this condition, finding that papers' claims often do not match their statistical results. (…)
As a result, those who draw on previous studies to support certain expected benefits from a currency depreciation should think twice before they rely too heavily on such estimates" (Bahmani, Harvey and Hegerty 2013, p. 434-435).

This sceptical attitude towards the devaluation of the currency as a means to rebalance the external position of a country is definitely warranted as far as the Marshall-Lerner condition does not hold in most of the cases *and as far as the Marshall-Lerner condition is a valid condition for the improvement of the trade balance*. If one accepts that a more 'general condition' should hold (equation 2.14), combined price elasticities of import and export smaller than 1 can be absolutely compatible with a positive effect of the devaluation of the currency on the trade balance. Indeed, in the example presented via experiment 3, the sum of UK price elasticities of import and export is 0.98, and the model showed a positive effect of the devaluation of the pound on the trade balance and on the current account. It is worth to point out that the figure used in the experiment – 0.98 – is pretty close to the sum of the average values of UK price elasticities of import and export in all the empirical studies analysed by Bahmani, Harvey and Hegerty (2013), which is 0.82064[64].

To sum up, the empirical evidence tends to contradict the Marshall-Lerner condition. However, the policy implications of this result find a completely new interpretation under the light of the 'general condition' of equation 2.14. As far as condition 2.14 is valid, the positive effect of the devaluation of the currency on the trade balance cannot be discarded just because the sum of the price elasticities is lower than 1.

2.5 CONCLUSIONS

Chapter 2 has introduced and analysed some of the main characteristics of the 'standard' SFC open economy model with flexible exchange rates, namely the OPENFLEX model presented in Godley and Lavoie 2007 b.

The Mundell-Fleming model has been chosen as the most appropriate benchmark to compare the SFC approach to an open economy with the 'mainstream' approach. The comparison has been developed through sections 2.2.2-2.2.7. Section 2.2.7, in particular, was focused on the non-complete pass-through mechanism (from changes in the exchange rate to changes in import prices) which plays a role of foremost importance in the SFC model: a mathematical demonstration of the condition that should hold to have an improvement of the trade balance following a depreciation of the currency has been provided. While the traditional Marshall-Lerner condition implicitly assumes a full pass-through regime, the more complex - and realistic - equations of import and export prices comprised in the SFC open economy model produce a more elaborate outcome. The formula derived in section

[64] The calculation has been based on Table II of the paper. Then the absolute values of the result have been taken: in by Bahmani, Harvey and Hegerty (2013) elasticities are expressed with the more common negative sign, while in Godley and Lavoie's model they are positive (the negative sign appears directly in the import and export equations).

2.2.7 (equation 2.14) differs from the one suggested in Godley and Lavoie 2007 b, but it is consistent with the one endorsed by Lavoie in subsequent treatment of the topic (see Lavoie 2015).

In the second part of the chapter, the consequences of different regimes of pass-through were tested, included the full pass-through hypothesised by the Marshall-Lerner condition.

In a way that could be considered pretty anti-intuitive, the computer simulations provided evidence that the lower is the pass-through, the higher is the capability of the system to rebalance quickly after a negative shock to the current account. The key to the paradox's explanation is that a higher pass-through mechanism has a greater impact on import and export prices following the depreciation of the currency. The competitiveness of the economy should improve faster in a higher than in a lower pass-through regime and this should boost the former's recovery more than the latter. Yet, the initial negative effect of the gradual depreciation of the currency on the trade balance is deeper in the higher pass-through regime, given the fact that real import and export react with a lag to changes in the exchange rate (but their nominal values adjust in real time!). Furthermore, a model with a lower pass-through is weighed by a lighter burden of foreign debt: interest payments to foreign citizens are lower as a lower level of current account deficit just after the shock has 'attracted' a lower level of capital inflows.

A sensitivity test has been conducted in order to check that these results do not depend on the values of the relevant parameters of the model.

To the limit of the spectrum of cases taken into account, there was the full pass-through model. If the pass-through was complete, the SFC model could not find a new steady state solution after a negative shock to its current account. This outcome challenges the contention that the Marshall-Lerner condition can still be considered a "useful approximation" of the 'general condition' for an improvement of the trade balance following a depreciation of the currency even in a SFC context. Moreover, in the very last part of the chapter it has been shown that it is not difficult to find theoretical scenarios in which the behaviour of the model is absolutely 'normal' (the trade balance and the current account improve after the depreciation of the currency) even if the traditional Marshall-Lerner condition does not hold.

The rejection of the original Marshall-Lerner condition has significant policy implications too. As far as the empirical evidence tends to deny that the original condition is met, it is quite obvious to conclude with Bahmani, Harvey and Hegerty (2013) that policy makers should 'think twice' before they rely on the benefits of currency depreciation to fix a negative external position.

However, if the Marshall-Lerner condition is not a valid condition anymore, there is no need for it to be met to expect a benefit from the devaluation of the currency. The 'new' condition given by equation 2.14 should be considered instead.

APPENDIX: SENSITIVITY TEST EXPERIMENT 1

Table A: UK Current Account following a step fall in the UK exports in two different regimes of pass-through and with different levels of the parameters of import and export equations (OPENFLEX model)

	Lower pass-through					Higher pass-trough				
Import and export equations parameters	$\varepsilon_1 = 0.7$ $\mu_1 = 0.7$	$\varepsilon_1 = 0.75$ $\mu_1 = 0.75$	$\varepsilon_1 = 0.8$ $\mu_1 = 0.8$	$\varepsilon_1 = 0.9$ $\mu_1 = 0.9$	$\varepsilon_1 = 1.05$ $\mu_1 = 1.05$	$\varepsilon_1 = 0.7$ $\mu_1 = 0.7$	$\varepsilon_1 = 0.75$ $\mu_1 = 0.75$	$\varepsilon_1 = 0.8$ $\mu_1 = 0.8$	$\varepsilon_1 = 0.9$ $\mu_1 = 0.9$	$\varepsilon_1 = 1.05$ $\mu_1 = 1.05$
	low_1	low_2	low_3	low_4	low_5	high_1	high_2	high_3	high_4	high_5
2020	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2021	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2022	0.0000	-0.0002	-0.0003	-0.0007	-0.0012	0.0005	0.0003	0.0001	-0.0002	-0.0008
2023	0.0000	-0.0001	-0.0003	-0.0007	-0.0011	0.0001	-0.0001	-0.0003	-0.0007	-0.0014
2024	-0.0001	-0.0002	-0.0004	-0.0007	-0.0011	0.0002	0.0000	-0.0002	-0.0006	-0.0012
2025	-0.0001	-0.0003	-0.0004	-0.0007	-0.0010	0.0002	0.0000	-0.0002	-0.0006	-0.0010
2026	-0.0001	-0.0003	-0.0004	-0.0006	-0.0010	0.0002	0.0000	-0.0002	-0.0005	-0.0009
2027	-0.0001	-0.0003	-0.0004	-0.0006	-0.0009	0.0002	0.0000	-0.0002	-0.0005	-0.0009
2028	-0.0001	-0.0003	-0.0004	-0.0006	-0.0008	0.0002	0.0000	-0.0002	-0.0005	-0.0008
2029	-0.0001	-0.0002	-0.0003	-0.0005	-0.0007	0.0002	0.0000	-0.0002	-0.0004	-0.0007
2030	-0.8129	-0.8118	-0.8107	-0.8084	-0.8049	-0.8217	-0.8201	-0.8185	-0.8152	-0.8102
2031	-0.7251	-0.7204	-0.7157	-0.7065	-0.6927	-0.7397	-0.7334	-0.7272	-0.7149	-0.6966
2032	-0.6870	-0.6784	-0.6699	-0.6530	-0.6283	-0.7065	-0.6951	-0.6839	-0.6618	-0.6296
2033	-0.6542	-0.6420	-0.6301	-0.6066	-0.5727	-0.6803	-0.6642	-0.6484	-0.6176	-0.5736
2034	-0.6241	-0.6087	-0.5936	-0.5644	-0.5226	-0.6571	-0.6365	-0.6165	-0.5780	-0.5239
2035	-0.5959	-0.5776	-0.5597	-0.5254	-0.4772	-0.6357	-0.6110	-0.5871	-0.5416	-0.4790
2036	-0.5693	-0.5483	-0.5280	-0.4892	-0.4357	-0.6156	-0.5870	-0.5595	-0.5078	-0.4380
2037	-0.5442	-0.5207	-0.4982	-0.4556	-0.3977	-0.5966	-0.5642	-0.5335	-0.4763	-0.4005
2038	-0.5203	-0.4947	-0.4702	-0.4244	-0.3630	-0.5785	-0.5427	-0.5089	-0.4468	-0.3662
2039	-0.4977	-0.4701	-0.4439	-0.3953	-0.3312	-0.5612	-0.5222	-0.4856	-0.4193	-0.3348
2040	-0.4762	-0.4469	-0.4191	-0.3682	-0.3022	-0.5448	-0.5027	-0.4636	-0.3935	-0.3060
2041	-0.4558	-0.4249	-0.3959	-0.3431	-0.2756	-0.5290	-0.4842	-0.4428	-0.3694	-0.2796
2042	-0.4364	-0.4041	-0.3740	-0.3197	-0.2513	-0.5140	-0.4665	-0.4230	-0.3468	-0.2555
2043	-0.4180	-0.3844	-0.3534	-0.2979	-0.2292	-0.4996	-0.4496	-0.4043	-0.3257	-0.2334
2044	-0.4005	-0.3658	-0.3340	-0.2776	-0.2089	-0.4858	-0.4335	-0.3865	-0.3060	-0.2132
2045	-0.3838	-0.3482	-0.3157	-0.2587	-0.1904	-0.4726	-0.4182	-0.3696	-0.2875	-0.1947
2046	-0.3679	-0.3315	-0.2985	-0.2412	-0.1735	-0.4599	-0.4035	-0.3536	-0.2702	-0.1778
2047	-0.3528	-0.3157	-0.2823	-0.2249	-0.1581	-0.4477	-0.3895	-0.3383	-0.2539	-0.1624
2048	-0.3383	-0.3008	-0.2670	-0.2097	-0.1441	-0.4360	-0.3761	-0.3238	-0.2387	-0.1482
2049	-0.3246	-0.2866	-0.2527	-0.1955	-0.1312	-0.4247	-0.3632	-0.3101	-0.2245	-0.1353
2050	-0.3115	-0.2731	-0.2391	-0.1824	-0.1195	-0.4138	-0.3509	-0.2970	-0.2112	-0.1235
2051	-0.2990	-0.2603	-0.2263	-0.1701	-0.1088	-0.4033	-0.3391	-0.2845	-0.1987	-0.1127
2052	-0.2870	-0.2482	-0.2143	-0.1587	-0.0991	-0.3932	-0.3278	-0.2726	-0.1869	-0.1029
2053	-0.2756	-0.2367	-0.2029	-0.1481	-0.0902	-0.3834	-0.3169	-0.2613	-0.1759	-0.0939
2054	-0.2647	-0.2258	-0.1922	-0.1382	-0.0821	-0.3739	-0.3065	-0.2505	-0.1656	-0.0857
2055	-0.2543	-0.2154	-0.1821	-0.1290	-0.0748	-0.3648	-0.2965	-0.2402	-0.1560	-0.0782
2056	-0.2443	-0.2056	-0.1725	-0.1204	-0.0680	-0.3560	-0.2868	-0.2304	-0.1469	-0.0713
2057	-0.2348	-0.1962	-0.1635	-0.1124	-0.0619	-0.3474	-0.2776	-0.2211	-0.1384	-0.0650
2058	-0.2257	-0.1873	-0.1550	-0.1050	-0.0563	-0.3391	-0.2687	-0.2121	-0.1304	-0.0593
2059	-0.2170	-0.1788	-0.1469	-0.0981	-0.0513	-0.3311	-0.2601	-0.2036	-0.1229	-0.0541
2060	-0.2086	-0.1708	-0.1393	-0.0916	-0.0466	-0.3233	-0.2518	-0.1954	-0.1158	-0.0494
2061	-0.2006	-0.1631	-0.1321	-0.0856	-0.0424	-0.3157	-0.2439	-0.1877	-0.1092	-0.0450
2062	-0.1930	-0.1558	-0.1254	-0.0800	-0.0386	-0.3083	-0.2362	-0.1802	-0.1030	-0.0410
2063	-0.1856	-0.1489	-0.1189	-0.0748	-0.0351	-0.3012	-0.2288	-0.1731	-0.0971	-0.0374
2064	-0.1786	-0.1422	-0.1129	-0.0699	-0.0319	-0.2942	-0.2217	-0.1663	-0.0916	-0.0341
2065	-0.1718	-0.1360	-0.1071	-0.0653	-0.0290	-0.2875	-0.2148	-0.1597	-0.0864	-0.0311
2066	-0.1654	-0.1300	-0.1017	-0.0611	-0.0264	-0.2809	-0.2082	-0.1535	-0.0816	-0.0284
2067	-0.1591	-0.1242	-0.0965	-0.0571	-0.0240	-0.2745	-0.2018	-0.1475	-0.0770	-0.0259
2068	-0.1532	-0.1188	-0.0917	-0.0535	-0.0218	-0.2683	-0.1956	-0.1418	-0.0727	-0.0236
2069	-0.1475	-0.1136	-0.0870	-0.0500	-0.0198	-0.2622	-0.1896	-0.1363	-0.0686	-0.0215
2070	-0.1420	-0.1086	-0.0827	-0.0468	-0.0180	-0.2563	-0.1838	-0.1310	-0.0648	-0.0196
2071	-0.1367	-0.1039	-0.0785	-0.0438	-0.0164	-0.2506	-0.1782	-0.1260	-0.0612	-0.0178
2072	-0.1316	-0.0994	-0.0746	-0.0410	-0.0149	-0.2449	-0.1728	-0.1212	-0.0578	-0.0163
2073	-0.1268	-0.0951	-0.0709	-0.0384	-0.0135	-0.2395	-0.1676	-0.1165	-0.0547	-0.0148
2074	-0.1221	-0.0910	-0.0674	-0.0359	-0.0123	-0.2341	-0.1625	-0.1121	-0.0516	-0.0135
2075	-0.1176	-0.0871	-0.0640	-0.0337	-0.0111	-0.2289	-0.1576	-0.1078	-0.0488	-0.0123
2076	-0.1133	-0.0833	-0.0609	-0.0315	-0.0101	-0.2238	-0.1529	-0.1037	-0.0461	-0.0112
2077	-0.1091	-0.0797	-0.0579	-0.0295	-0.0092	-0.2189	-0.1483	-0.0998	-0.0436	-0.0102
2078	-0.1051	-0.0763	-0.0550	-0.0277	-0.0083	-0.2140	-0.1439	-0.0960	-0.0413	-0.0093
2079	-0.1013	-0.0731	-0.0523	-0.0259	-0.0076	-0.2093	-0.1396	-0.0924	-0.0390	-0.0085
2080	-0.0976	-0.0700	-0.0498	-0.0243	-0.0069	-0.2047	-0.1354	-0.0889	-0.0369	-0.0077
2081	-0.0941	-0.0670	-0.0473	-0.0228	-0.0062	-0.2002	-0.1314	-0.0856	-0.0349	-0.0070
2082	-0.0906	-0.0641	-0.0450	-0.0213	-0.0057	-0.1958	-0.1275	-0.0824	-0.0330	-0.0064
2083	-0.0873	-0.0614	-0.0428	-0.0200	-0.0051	-0.1915	-0.1237	-0.0793	-0.0313	-0.0058
2084	-0.0842	-0.0588	-0.0407	-0.0188	-0.0047	-0.1873	-0.1200	-0.0763	-0.0296	-0.0053
2085	-0.0811	-0.0563	-0.0388	-0.0176	-0.0042	-0.1832	-0.1165	-0.0735	-0.0280	-0.0048
2086	-0.0782	-0.0539	-0.0369	-0.0165	-0.0038	-0.1792	-0.1130	-0.0707	-0.0265	-0.0044

CHAPTER 3: AN OPEN ECONOMY MODEL WITH ENDOGENOUS PRODUCTIVITY

"Theoretical macro-economic models of one brand or another are very influential.
They guide the architects of econometric forecasting models.
They shape the thinking of policy-makers and their advisers about 'the way the world works'.
They colour the views of journalists, managers, teachers, housewives, politicians, and voters.
Almost everyone thinks about the economy, tries to understand it, and has opinions how to improve its performance.
Anyone who does so uses a model, even if it is vague and informal".
James Tobin, Nobel Memorial Lecture, 8 December 1981

3.1 INTRODUCTION TO "STOCK-FLOW CONSISTENT" MODELLING

3.1.1 On the label "Stock-Flow Consistent"

Although the theoretical roots of the so-called Stock-Flow Consistent models trace back to the dawn of the Keynesian revolution, and the expression 'Stock-Flow consistent' can be found in economic literature throughout the last quarter of the Twentieth century, that very label applied to a specific macro modelling method is far more recent. According to the survey by Nikiforos and Zezza (2017) it was established as a 'brand name' after the publication of Claudio Dos Santos's PhD dissertation at the New School for Social Research (New York, USA) entitled "Three Essays on Stock-Flow Consistent macroeconomic modelling" (Dos Santos 2003).
However, it is meaningful that the primary reference of this school – the book published in 2007 by Wynne Godley and Marc Lavoie – does not even mention the expression 'Stock-Flow Consistent' in its title, which is "Monetary Economics: an integrated approach to credit, money, income, production and wealth".
Indeed, the label is – to some extent – misleading. Strictly speaking, these are not the only class of stock-flow consistent models, since in economics many kinds of different models that comprise this characteristic exist.

A distinctive feature of the 'Godley-style' SFC models is represented by the very accurate accounting framework which provides complete integration of both the real and the financial side of the economy. There is no neoclassical dichotomy: money and financial sector are no longer a 'veil' laid over the real sector; by contrast, they are regarded as fundamental aspects of contemporary economies, which have to be studied to understand the dynamics of the system.

Furthermore, these models are far from simple 'hydraulic' macroeconomic models merely based on accounting identities. The consistency of flows, their interplays with stocks of assets and wealth, and the feedback mechanisms, provide only a 'general constraint' to the model. The constraint is useful in order to shun some nonsensical provisions that sometimes are put forward even by renowned 'mainstream' scholars and practitioners, such as the promotion of trade surplus in a world economy where the trade surpluses of somebody correspond to the trade deficit of somebody else. However, one of the main characteristics of Godley-style SFC models is to be grounded on behavioural equations which are inspired by the Post-Keynesian school of thought.

Consequently, the role of aggregate demand is absolutely central and there are no natural forces that lead the economy to full employment, both in the short and in the long-run. That is why some authors refer to this strand of macro model as "Post-Keynesian Stock-Flow Consistent" (PK-SFC, see for instance another important survey published on this issue in 2015 by Caverzasi and Godin).

To sum up, the name "Stock-Flow Consistent" risks missing the target of conveying the unique characteristics of this approach effectively. However, since it has grown in popularity in recent years and it is widely used among researchers who are devoting their efforts to developing further this approach to macroeconomics, there is no reason to challenge it.

3.1.2 Some history

It is not possible to pinpoint a precise 'date of birth' of the SFC approach. Since his 'theoretical soul' is Keynesian, one would be tempted to think of the work of John Maynard Keynes and the subsequent research of the so-called Cambridge School – which took inspiration not only from Keynes but also from the Polish economist

Michał Kalecki. However, with respect to the SFC methodology, it is perhaps possible to track its origin in something 'less generic'.

Caverzasi and Godin (2015) identify the first root of the new method in the work of Morris A. Copeland (1949), "the father of the flow of funds (for the USA, the Federal Reserve Board's Z.1 release)" (Caverzasi and Godin 2015, p. 161). The flow of funds is a fundamental part of the transaction flow matrix which the SFC models are based on (see section 3.2.2). Its advantage consists in going beyond the information traditionally contained in the national income identity and its main variables (consumption, government expenditure, investment, import, export): indeed, it tries to shed light on what happens once the cycle of production and consumption is 'concluded' and the net saving held by different sectors of the economy must find an employment.

It is the integration between the national income identity and the flow of funds that provides the potential bridge between flows and stocks along with a quadruple accounting principle. If every outflow of a sector (e.g. the wages paid by firms to workers) must find a correspondent inflow in another sector (e.g. the income of the sector 'households'), in the same way the accumulation of wealth that has been generated by the process just described (e.g. money deposit held by the households) must find a correspondence in another sector (e.g. money deposit held as a liability by the banking sector).

Copeland provided a fundamental contribution in term of the information that would be available ever since; what was still lacking was a theory able to link together that information. The latter came from the neo-Keynesian economist James Tobin and the group of work based at Yale University (New Haven, USA; hence the name 'New Haven School' attributed to this research programme). In his Nobel Memorial Lecture (1981) Tobin described with the following words the task of the theory with regard to the flow of funds account: "to bring the columns to life by functions relating sectorial portfolio and saving decisions to relevant variables, and to bring the rows to life as a set of simultaneous market-clearing equations" (Tobin 1982[65], p. 16).

Bringing "the columns to life" meant, for instance, finding a theory which could account for the different allocation of the wealth of households in different assets,

[65] The Lecture was held in 1981, but it was published the following year on the *Journal of Money, Credit and Banking.* That is why there is this apparent discrepancy in the quotations of the years.

according to the liquidity preference of individuals, the rate of return on assets and the expectations of the future value of assets themselves. This is still a fundamental feature of contemporary SFC models, even if the adding-up constraints (or vertical constraints) masterminded by Tobin for the parameters of these functions (Tobin 1969) have been integrated with additional horizontal constraints (Godley 1996) to guarantee logical consistency to the assets' demand functions (more about this later).

Bringing "the rows to life" meant finding the mechanism behind the equality of assets' demand and assets' supply – in other words, the correspondence of assets and liabilities across different sectors of the model. As it appears evident from Tobin's words, markets clearing was the tool whereby this equality was assured. This is no more a characteristic of contemporary Post-Keynesian SFC models, where the equilibrium via price adjustments is applied very rarely even in financial markets. Interest rates on short-term and long-term government bonds, for instance, are usually considered exogenous. In Godley and Lavoie's "Monetary economics" (2007) there is just one case characterized by a pure market mechanism through which demand equals supply via price adjustment: stock market shares (see GROWTH model, cap. 11 of Godley and Lavoie 2007 b).

Apart from these differences between Tobin's original contribution and contemporary SFC models, it is important to underline once again that the New Haven School injected the first theoretical lymph in the 'a-theoretical structure' of the flow of funds matrix.

More precisely, the main theoretical features of the New Haven approach – still part of contemporary SFC modelling – have been explicitly listed by James Tobin in his Nobel Memorial Lecture, which therefore can be regarded as a kind of 'manifesto' of the then 'new' macro modelling strand:

1) "Precision regarding time": SFC models are dynamic models developed through discrete time. It is widely known that Keynes was focused on the short-run; another way to interpret this limitation is by assuming that changes in the main variables are so little that cannot affect the stocks of assets, wealth, capital and government debt significantly. If this assumption is dropped – as it should be for a more realistic representation of modern

economies – time, and evolution of time in discrete succeeding periods, must be taken into consideration.

2) "Tracking of stocks": it is the complementary element of the previous one. Time must play a central role in a dynamic model due to stocks' changes. And when stocks change the whole system is affected by the feedbacks exerted by the 'new' stocks on the flows of the production and consumption mechanism.
3) "Several assets and rates of return" and 4) "modelling of financial and monetary policy operations": the Hicksian IS-LM model, still the centre of the neo-Keynesian tradition at the time of Tobin's Lecture (and to this day the staple of undergraduate macroeconomics textbooks), comprised just two assets: money and "everything else". Even contemporary DSGE models – the last embodiment of 'new-Keynesianism' – ignored financial markets until recently or dealt with them in a very rudimentary way. By contrast, both 'Tobinesque' SFC models and contemporary Post-Keynesian SFC models usually comprise a rich structure of assets and always fully integrate the real and the financial sectors of the economy.
5) Walras' law and adding-up constraint: the latter is the "consistency requirement" of the portfolio equations. Furthermore, given the rigid accounting framework within which SFC models are built, the Walrasian principle assures that one equation of the model is logically implied by all the others and can be dropped (it actually *must* be dropped if one does not want the system of equations to be overdetermined, with more equations than the number of unknowns).

Although being revolutionary, Tobin's approach did not find a great reception within the 'mainstream' neo-Keynesian school at a time when the rational expectations revolution was much more in the limelight.

However, his legacy was collected by the group of economists gathered around the Cambridge Economic Policy Group, led by Wynne Godley. Since the early Seventies, the CEPG was working on models based on accounting identities:

"I remember the damascene moment when, in early 1974 (after playing round with concepts devised in conversation with Nicky Kaldor and Robert Neild), I first apprehended the strategic importance of the accounting identity which says that, measured at current prices, the government's budget deficit less the current account deficit is equal, by definition, to private saving net of investment. Having always thought of the balance of trade as something which could only be analysed in terms of income and price elasticities together with real output movements at home and abroad, it came as a shock to discover that if only one knows what the budget deficit and private net saving are, it follows from that information alone, without any qualification whatever, exactly what the balance of payment must be" (Godley's "Background memories" in "Monetary Economics" 2007, pp. xxxvi-xxxvii).

The quotation from Godley's "Background memories" which open the *Summa* of SFC modelling ("Monetary economics") has been reported in full because it is very illuminating of the principles that first drove the work of that group of researchers. The models that followed (see for instance Godley and Cripps 1983, Coutts, Godley and Gudgin 1985) shared with Tobin's one (Backus, Brainard, Smith and Tobin 1980) the aim to keep track of the evolution of the stocks in the economic system and to account for their feedbacks on the flows. The assonance with the New Haven approach took the form of a direct collaboration when Tobin went to Cambridge in 1984 and instructed Godley's group on the principles of his theory of portfolio asset allocation, which was ever since incorporated in their models.

However, a significant difference divides the New Haven school and the Cambridge school. It lies on the theories that underpin some fundamental behavioural equations behind the accounting structure. It has already been pointed out that contemporary SFC models do not rely on a market clearing mechanism in order to guarantee the equality of assets' demand and supply. More generally, the Post-Keynesian theoretical core which inspires Godley-style contemporary SFC models is far from the neo-Keynesian approach championed by Tobin.

In his "Post-Keynesian economics. New foundations" (2014) Marc Lavoie has summarised very effectively the blend of strands of research which are now encapsulated in contemporary SFC models: they are the product of Post-Keynesian scholars who "have embraced Tobin's approach, incorporating it, however, into a monetary production economy where the supply of money is endogenous and where behavioural equations respond to Kaleckian or Keynesian precepts rather than neoclassical ones" (Lavoie 2015, p. 264).

Godley's work continued in the 1990s when he joined the Levy Economics Institute of Bard College, in the United States. Here, mainly in partnership with the Italian economist Gennaro Zezza, he developed several empirical models used for short-run and medium-run forecasts – initially based on Danish data (Godley and Zezza 1992), then on US data (Godley 1999). These efforts culminated in the building of an empirical model of the US – the so-called "Levy model" (see Caverzasi and Godin 2015 and Nikiforos and Zezza 2017 for a reconstruction of the contributions behind this endeavour) – that fared quite well in the predictions of the 2001 recession in the US, following the burst of the "Dotcom bubble", and of the Great Recession in 2007-2008 (see chapter 1, section 1.3.10). In their survey, Nikiforos and Zezza pointed out that the recognition of the effectiveness of those forecasts, in a time when mainstream models were engulfed by a widespread criticism for their failure in predicting the storm coming, "came from academic economists (e.g. Bezemer 2010), but was also widely shared in the press (Chancellor 2010, Wolf 2012, Schlefer 2013)" (Nikiforos and Zezza 2017, p. 1222).

For purpose of this brief sketch of the theoretical evolution of the SFC methodology, the publication in 2007 of "Monetary Economics" by Godley and Lavoie must be undoubtedly regarded as a landmark: the benchmark and the starting point of the most recent research, which is often a direct development of one of the models encompassed in the book.

The book consists of 12 chapters. The first part deals with models which do not comprise private money created by commercial banks via loans, but only the central bank's money or 'high powered money'. The very first model, the SIM model – from "simplest" – is indeed very simple, with just 10 independent equations and 10 unknowns. This level of simplicity allowed the authors to develop even a graphical representation of the model that resembles the IS-LM model of the undergraduate handbooks of macroeconomics. The chapter is provided with a fully analytical solution, including the demonstration of its stability.

The subsequent models (PC and LP models) add assets to this basic framework to enrich the financial sector and to study the intertwined dynamics of the former with the real sector.

Chapter 6 represents the first attempt to model an open economy (with two regions and then two countries). The exchange rate is fixed and the international debts are settled in gold, that is why the model can "be understood as a representation of the gold standard period" (Godley and Lavoie 2007 b, p. 189[66]). A more advanced model

[66] Since in the SFC literature the main reference to Godley and Lavoie's book is always Godley and Lavoie 2007 b, the present work keeps it to avoid misunderstandings, even if the edition actually used was the one published in 2012. Apart from a summary of the book written by Wynne Godley in May 2010, the two editions are identical, so that every quotation reported in this thesis refers to a page number that is the same in the first and the second edition.

for an open economy is featured in the final chapter of the book (12), where the central banks are endowed with reserves denominated in the other country's currency and both fixed and flexible exchange rates are considered.

Chapter 7 to 9 deal with models that comprise private bank money (BMW model), private bank money, inventories and price decision (DIS and DISINF models).

Chapter 10 summarises the previous work in a sort of 'catch-all' model, which deploys a complete representation of a closed economy within a SFC framework with both public and private money (INSOUT model). In Chapter 11 a slightly simplified version of the INSOUT model is used as a base to build a growing economy model (GROWTH model). Finally, chapter 12 deals with a more advanced open economy (more on this in section 3.1.5).

The importance of this book for the evolution of the research on SFC modelling cannot be overestimated since it represented the peak and the systematisation of the whole 'first generation' of SFC models and the starting point for the 'second generation'.

Indeed, the principles of the methodology are well explained in the first two chapters, where a complete guide for the construction of the matrices on which the SFC are grounded is provided.

These matrices will be explained in detail when an original model will be presented later in this chapter. For now, it perhaps suffices a brief description of their nature and of the logic behind them.

The first is the balance sheet matrix. It encompasses all the assets and liabilities held by the different sectors of the economy. The double column that usually characterises the balance sheets in their standard form is simplified to keep together different sectors: assets and liabilities are put in the same column, assets with a positive sign and liabilities (and net worth) with a negative sign. These stocks enter the equations of the flows (usually with a one period lag) to guarantee the connection between financial and real sectors of the economy.

The flows are captured by the transaction flow matrix, which is a composition of the traditional national income equation and the flow of funds accounting (as it has been explained earlier in this section). The flow of funds provides information about the variations of the stocks of each variable of the financial sector in one period. Yet the variations that are considered here are merely prompted by the net purchases of new assets – or the net issues of new liabilities. The change in the value of a stock generated by an increase (or decrease) in the price of the asset (capital gains or losses) is not part of the flow of funds accounting.

In order to account for these reevaluations a third matrix enters the system: the full-integration matrix. It compounds changes in net assets arising from transactions and changes in net assets arising from revaluations. Therefore, it starts from the values of the net wealth of each sector at the end of the previous period and it calculates the values of the net wealth (capital gains/losses included) at the end of the current period.

Once the system of matrices is completed the modeller can identify the accounting identities that define the main structure of the model and she can set the behavioural equations which determine the values of all the variables not derived on an accounting basis. It is in the construction of this 'behavioural part' of the model that the economic theory is ushered in.

According to Marc Lavoie, Godley was quite confident that the accounting consistency would have limited the choices at the disposal of the researchers so that models grounded on these principles would have given similar medium and long-term results. In fact, as Lavoie put it:

> "things are not so simple. While may be relatively easy to agree on the main structural features of a simplified economy, different economists see the behaviour of firms or banks or even households in many different ways. Despite a possible common structural framework that should constrain the range of possible results, as Godley and Cripps (1983) initially hoped when they proposed a first version of the stock-flow consistent approach, it turns out that different economists will still disagree on behavioural equations and the appropriate closure of the model. Thus the results obtained with these different models will differ, as has been confirmed when new SFC models, with assumption slightly different from those of the earlier ones, produced different trajectories" (Lavoie 2015, pp. 273-274).

Two comments could be added to Lavoie's observation. Notwithstanding this heterogeneity, it is still possible to acknowledge a common 'point of view' which emerges from PK-SFC macro modelling and its policy implications. For instance, given the lack of a 'natural tendency' to full employment, the importance of fiscal policy as an indispensable means of intervention at the disposal of public authorities is widely recognised.

Secondly, thanks to its ability to provide short-run and long-run analysis and to combine real and financial sectors of the economy, the popularity of the SFC approach has risen significantly in recent years. The good performances of SFC models in a time when the Great Recession has shaken the macro modelling fundamentals have contributed to this (relative) success too. Consequently, it is emerging a kind of 'alternative consensus', a common framework to study the dynamics of modern monetary economies where problems of aggregate demand are not overlooked anymore and financial variables are not regarded just as a 'veil' put on the real ones. In other words, the SFC approach is increasingly becoming "an important new way of unifying all heterodox macroeconomists" (Lavoie 2015, p. 264).

3.1.3 Main strands of research within the SFC framework: numerical vs algebraic solution

The fact that SFC methodology has provided a common framework for Post-Keynesian macro modelling does not mean that the research developed in recent years has taken just one direction.

A first important partition can be identified from a methodological point of view. The solutions of the models can be obtained in two ways: numerically and algebraically.

The latter provides a clearer and immediate comprehension of how different variables can affect the short-run and long-run equilibria of the models. It can also offer a useful didactical tool to show the differences – mainly in policy implications – between Post-Keynesian SFC models and 'mainstream' textbook models. For instance, in the so-called PC model ("Government money with portfolio choice", chapter 4, Godley and Lavoie 2007 b) the long-term analytical solution of the debt to income ratio does not feature the exogenous variable 'government expenditure'. Therefore, it shows very directly how the mere reduction of public expenditure may not be an effective way to reduce the debt to income ratio in the long-run.

The drawback of the method based on analytical solutions is that the model in question must be simple enough. Therefore, several realistic features of an economy run the risk of beeing dropped. In Godley and Lavoie's book only the simplest models – such as the PC and the BMW (bank money world) models – present a fully developed analytical solution, with only parameters and exogenous variables in the final formula.

The alternative – and much more employed – way consists in solving the model numerically, with the help of computer simulations. The parameters are established via empirical estimation or via 'calibration', whereby their value is set "using stylised facts or rules of thumb" (Caverzasi and Godin 2015, p. 163).

Estimation involves a series of problems that for a long time have characterised the macro modelling theoretical debate and still represent open issues, as for instance the so-called Lucas' critique (Lucas 1976): estimates of parameters, based on data taken from the past, need to rely on the assumption that the behaviours of the agents do not change following a shock or whichever shift in the dynamics of the economy. Still, these kinds of empirical models are not 'fully empirical models': even if the parameters are found with the use of empirical data, the economy is studied from a purely theoretical starting point, which allows the researcher to insulate the effects of a particular shock better. Indeed, the most common procedure within this area of research – both in 'not fully empirical' models and in calibrated models – consists of the following procedure: 1. The economy is placed in its long-term steady state. This setting helps to 'clear' the environment from the 'noise' of fluctuations that have nothing to do with the shock the modeller wants to study. 2. A shock is introduced, mainly via the change in the value of an exogenous variable or of a parameter, and the behaviour of the other variables of interest is observed, both in the short and in the long-run.

Numerical simulations conducted through the technique mentioned above allow building far more complex and realistic models. Still, there is a trade-off between complexity and a clear understanding of the dynamics of an economy: when the system is made of hundreds of simultaneous equations is not always easy to track the trail of a shock or a stimulus through time. Therefore, it is not always facile to explain 'why' some results turn out from a simulation: a tremendous amount of abstraction can be required in order to account for very indirect – but perhaps very tight – links between two variables.

'Fully empirical models' are dealt with in the next session.

3.1.4 Main strands of research within SFC framework: topics of interest

The SFC approach, as it has been said earlier, is particularly helpful if a modeller wants to integrate the real and the financial sectors of an economy. By contrast, the lack of a satisfying treatment of the financial sector is considered one of the most critical limits of 'mainstream' research based on non-DSGE-like models (see chapter 1).

Therefore, it is not by chance that many studies based on the SFC methodology have been focused on topics related to financial assets, capital gains, portfolio choices and credit rationing. It is an area of research which is usually referred to as "financialization".

A complete summary of all the most recent contributions in this area is beyond the scope of this thesis. However, it is perhaps the case to mention some relevant papers that have shaped the theme of financialization within a SFC approach, such as Skott Ryoo 2008, van Treeck 2009, Veronese Passarella 2012, Morris and Juniper 2012, Sawyer and Veronese Passarella 2015, Botta, Caverzasi and Tori 2015. Chapter 4 will contain a more accurate survey of the works which studied the relationship between financialization and inequality of income and wealth from a SFC perspective. Indeed, this is a topic that in very recent years has gathered more and more attention among scholars.

'Fully empirical models' are also enjoying growing popularity within the SFC community. The expression usually denotes empirically estimated models whose initial values are set to capture the present state of an economy along the actual national accounts' aggregates. These models are used to study future trends and alternative policy scenarios.

The Levy Institute in the USA has been the beacon of this approach initially under the oversight of Godley, then with the fundamental contributions of Gennaro Zezza and Dimitri Papadimitriou. Empirical models have been built on the economy of Denmark (see Godley and Zezza 1992), the USA (Godley 1999, Godley and Zezza 2006, Godley, Papadimitriou, Hannsgen and Zezza 2007, Godley, Papadimitriou and Zezza 2008, Papadimitriou 2009, Papadimitriou, Hannsgen and Zezza 2011, Papadimitriou, Nikiforos, Zezza and Hannsgen 2014. In particular, in Zezza 2008 it is possible to find a brief presentation of the main features of the model used at the Levy Institute for the analyses provided in the above-mentioned reports and papers), and Greece (Papadimitriou, Nikiforos, and Zezza 2013 a, Papadimitriou, Nikiforos and Zezza 2013 b, Papadimitriou, Nikiforos and Zezza 2015). Unfortunately, the policy adopted at the Levy Institute – which is a private American think tank – is not to make the codes or the lists of equations of its models in the public domain. This deprives the community of economists that works on this topic of an invaluable source of historical knowledge.

The SFC model on Ireland developed by Kinsella and Aliti (2012 a, 2012 b and 2013) – the so-called "Limerick model" – has followed another path: whereas the Levy model "assumes fixed parameters estimated using econometrics" the Limerick model "estimates fixed parameters only when necessary (if there is more than one parameter per independent equation) and calibrates the others. This difference is fundamental since the Levy model allows us to predict future variations, while the Limerick model allows us only to conduct simulations on past data", in other words to "simulate changes in policies in the past and see the impact they would have had if implemented" (Caverzasi and Godin 2015, p. 179. Note that Godin has worked with the Limerick model group on the issue of the estimation of SFC models: see Godin, Aliti and Kinsella 2012).

An approach similar to the one adopted by the Limerick group has been applied to build a model of the Austrian economy (Miess and Schmelzer 2016 a and Miess and Schmelzer 2016 b).

According to Zezza and Nikiforos "the most-complex SFC model so far estimated from national accounting statistics for a real economy" (Zezza and Nikifors 2017, p. 1224) is the one built for the United Kingdom economy by Godin, Kinsella and a group of researchers at the Bank of England (see Burgess, Burrows, Godin, Kinsella and Millard 2016).

Other SFC empirical models have been built for Denmark (Kiel 2018), Iceland (Raza, Gudmundsson, Zoega and Randrup Byrialsen 2019), Italy (F. Zezza 2018, Veronese Passarella 2019), Moldova (Le Heron and Yol 2019) and South Africa (Makrelov, Arndt, Davies and Harris 2018).

Recently a special issue of the *European Journal of Economics and Economic Policies: Intervention* (16/1) has focused entirely on empirical SFC models. Among other contributions, it contained two "introductory guides" to SFC empirical models of whole countries: Veronese Passarella (2019) advocated a "universal" method that can be applied to different European countries in order to build models based on

Eurostat time series. His step-by-step guide used *R* and *EViews* as software and was based on the Italian economy's data to provide a practical example. A slightly different approach has been put forward by Gennaro and Francesco Zezza (2019): they argued that a whole country empirical SFC model should be tailored to the country-specific institutional features. One of the most challenging tasks in building this kind of models consists in the simplification and consolidation of the sectoral balance sheets and flow of funds available from the national account statistics (which contain thousands of variables and entries). Zezza and Zezza maintained that the choice on what to "sacrifice" should depend not only on the topic of interest but also on the structural characteristics of the economy of a country. They provided examples related to Greece and Italy.

Another promising frontier of the research related to SFC modelling is represented by the increasing integration and overlapping with the "Agent-Based" methodological approach.

Agent-Based models (ABM) have drawn rising attention for their potential of explanation of macroeconomic variables via the study of the interactions of numerous heterogeneous agents at the micro level. There is no specific theoretical assumption behind the ABMs, although most of the scholars involved in this project do not share a neoclassical background. A paper published in 2016 presented itself as a "benchmark model" for Agent-Based-Stock Flow Consistent macroeconomics (see Caiani, Godin, Caverzasi, Gallegati, Kinsella and Stiglitz 2016. The same work is also mentioned in chapter 1).

Further examples of combination between the SFC methodology and other fields of research within and beyond economics are provided by the application of SFC models to environmental issues. SFC ecological models have been developed to study sustainable economic growth rate (Jackson and Victor 2015), to account for the energy sector (Naqvi 2015 and Berg, Hartley and Richters 2015), to study the effects of green fiscal policies and green finance policies (Dafermos, Nikolaidi and Galanis 2017, Monasterolo and Raberto 2018, Bovari, Giraud and Mc Isaac 2018), to analyse the interaction between climate change and financial stability (Defermos, Nikolaidi and Galanisc 2018). Although Eco-SFC are usually focused on single-area economy, Carnevali, Deleidi, Pariboni and Veronese Passarella (2019 a) have developed a prototype which introduces the ecosystem into a simplified two-country model. A more advanced two-county model is used in Carnevali, Deleidi, Pariboni and Veronese Passarella (2019 b) to analyse the cross-border financial effects of global warming both in a context of flexible exchange rates and in a fixed exchange rates regime.

A broader overview of the application of the SFC approach to international economics is offered in the next section. SFC open economy models are the core of the original contributions contained in this thesis (chapter 2, 3, and 4): that is why this part of the literature review will inevitably require some extra space.

3.1.5 SFC open economy models

Much of the insights of the so-called "first generation" (Nikiforos and Zezza 2017, p. 1221) of open economy SFC models have culminated in the 'summary' provided by the three benchmark models featured in Godley and Lavoie 2007 b:

a) The REG model, a two-region model (chapter 6).

b) The OPEN model, a two-country model with fixed exchange rates, gold as 'international currency' and no foreign assets held by agents: in fact, "a representation of the gold standard period" (Godley and Lavoie 2007 b, p. 189) (chapter 6).

c) The "More Advanced Open Economy Model": a two-country model with four different closures which engenders four different sub-models: OPENFLEX, with flexible exchange rates; OPENFIX, with fixed exchange rates and endogenous foreign reserves; OPENFIXR, with fixed exchange rates and endogenous interest rates; OPENFIXG, with fixed exchange rates and endogenous government expenditure (chapter 12).

The "More Advanced" model, in particular the OPENFLEX version, has provided the starting point for a wide range of several subsequent contributions on this topic.

The basic framework of the OPENFLEX model featured portfolio equations that included the expected change of the exchange rate as one of the factors driving the assets' demand of households. However, its value has been set at zero in order to simplify the structure of the model and no equations have been developed to account for its determinants.

The gap has been filled by Lavoie and Daigle (2011) with a paper that integrated some recent contributions of behavioural finance into the OPENFLEX. Two different 'attitudes' of agents operating in the financial markets were considered: the one of the so-called 'conventionalists', whose expectations are led by a 'conventional' long-term value of the exchange rate; and the one of the 'chartists', who base their expectations of the earlier value of the exchange rate. The 'expectation augmented' open economy model turned out to give results pretty similar to the one without expectations, in term of the direction taken by the main variables following some shocks (e.g. an increase in the propensity to import in one country). However, the introduction of expectations did affect the long-term level of the actual exchange rate and of the trade balance. Furthermore, the economy could be destabilised if the proportion of 'chartist' on the total of traders became dominant. The new model did not exhibit hysteretic proprieties, but it showed a certain level of persistence: when the 'shocked parameter' was set back to its initial value the model with expectations took much more time to recover the initial position than the original one.

Stefanos Ioannou (2018) has used a SFC open economy model to study the impact of the assessments of the Credit Rating Agencies (CRA) on the dynamic of a recessionary shock. The basic framework of his model resembled the REG model of chapter 6 of Godley and Lavoie 2007 b: two countries (Germany and Greece) shared the same currency (euro) issued by a single central bank (the European Central Bank). One of the countries (Greece) was regarded as the 'weak' country and its public expenditure was constrained by its capability of funding itself on the capital markets: in other words, the European Central Bank did not act as a lender of last resort. Sovereign ratings were included in the model as an endogenous variable dependent on GDP cumulated growth and debt to GDP ratio. The rating affected both the liquidity preference of households and the interest rate of long-term bonds issued by the governments. The simulations conducted by Ioannou showed that sovereign ratings make a recessionary shock worse; also, "the CRA's perception of what constitutes a sustainable debt to GDP ratio has self-fulfilling proprieties and may generate additional instability into the system" (Ioannou 2018, p. 153).

Godley and Lavoie's "simple model of three countries with two currencies" (2007 a) has already been presented in chapter 1. The structure of that model was not far from one set up by Mathieu Lequain (2003); however, in Godley and Lavoie's version, the exchange rate between dollar and euro was flexible. It underlined the effects of structural imbalances among the economies of the single currency area when an asymmetric shock hit a generic 'weak' European country.

The lack of adjustment mechanisms in the euro area was also at the centre of a work by Duwicquet, Mazier and Saadaoui (2012). In the first part of the paper, the authors used a FEER approach (Fundamental Equilibrium Exchange Rate) to estimate the exchange rate misalignments within the eurozone over the period 1994-2011. It turned out that the euro was well overvalued for Southern countries such as Spain, Greece and Portugal, and it was undervalued for countries like Germany and Austria. In addition, these misalignments were non-stationary and diverged throughout the analysis. The result reflected the ineffectiveness of the mechanisms of adjustment the eurozone relies on: flexibility of wages and prices tends to be insufficient when it is pursued simultaneously in deeply interconnected countries; on the other hand, fiscal austerity is extremely painful from a political and a social point of view.

These exchange rates misalignments correspond to an 'implicit' money transfer – which was duly computed in the paper – from deficit countries to surplus countries. That is why the European Union should consider an 'explicit' transfer in the opposite direction. Duwicquet, Mazier and Saadaoui tested the reform via a SFC model. An extended version of the model included European public investments funded by Eurobonds. Computer simulations showed that both instruments could play a significant role in tackling asymmetrical shocks and rebalancing the disequilibria that have dogged the single currency project so far.

Mazier and Valdecantos have entertained even more radical solutions for the European Union's dilemmas in a paper published in 2015. They adapted the basic structure of the "More Advanced" model to represent a four-country bloc including the US, Germany (the surplus country/area in the eurozone), Spain (the deficit country/area in the eurozone) and the 'rest of the world'. Four different closures of the model mirrored four different political arrangements: a) A baseline scenario which recreated the situation of the eurozone as it is now, with a single currency and floating exchange rate with the US (and the rest of the world); b) and c) A eurozone with three 'euros' or a return to the European Monetary System, with a 'global euro' used either as international currency or as a mere 'unit of account'; d) A final scenario in which the surplus country has left the eurozone. The fourth scenario ended up to be the most stable: shocks could be absorbed by the system and a new balance could be found without increasing the level of debt to GDP ratio in the weak area of the eurozone. According to Mazier and Valdecantos this solution could be "beneficial for all": "compared to a pure fiscal union or a scenario in which Germany finances the bail-out of the deficit countries" this arrangement "would also save Germany significant fiscal burdens" (Mazier and Valdecantos 2015, p. 108).

Imbalances at a world level have been studied by Mazier and Tiou-Tagba Aliti (2012) in a SFC three-country model. The model featured three blocs: the US, the eurozone and China. It drew on an earlier model developed by Lavoie and Zhao (2010). The authors confirmed the results of Lavoie and Zhao's paper about the negative impact on the eurozone of a strategy of diversification of reserves potentially undertaken by the People's Bank of China in favour of assets denominated in euros. In addition, Mazier and Tiou-Tagba Aliti underlined the contribution of a semi-fixed dollar-yuan parity[67] in keeping huge imbalances in the balance of payments of these three macro-regions of the world. They showed how a 'real' floating exchange rate between the dollar and the Chinese currency could reduce the current account deficit and surplus in the US and in China, respectively. The authors recognized the political impracticability of this solution, given the limited liberalisation of the Chinese monetary and financial system. Therefore, they tested the outcome of less 'extreme' arrangements, with an exchange rate 'managed' by Chinese authorities. Two sub-models were provided in order to represent two different ways of intervention: the first one was characterized by an 'adaptive' exchange rate that adjusted more slowly than a perfectly flexible exchange rate; the second one introduced a target level of reserves denominated in dollars or of current account surplus for the Chinese authorities. In both cases, the results were consistent with a pure floating exchange rate mechanism in terms of imbalances reduction. Similar results were achieved with an extended model which took into account prices and wages too.

Zezza and Valdecantos (2015) have focused their attention on world imbalances too. They have first developed a model with four blocks – the US, the eurozone, China and the 'rest of the world'. Its aim was to capture the state of the art of the international monetary system, characterized by persistent disequilibria in the

[67] At the time of the paper China's exchange rate arrangement was ranked in the group of "crawl-like arrangements" (a sort of 'dirty' and moving peg) by the *Annual Report on Exchange Arrangement and Exchange Restrictions* of the International Monetary Fund. The latest report (2016 a) moved China's system from the "crawl-like" to the "other managed arrangements" group.

current account balances: on one side the huge US deficit, on the other side the surpluses of many export-led economies like Germany and China[68].

Several economists and officials in financial institutions and organizations have called for a reform of the current arrangements, which are the product of the collapse of the Bretton Woods order and are based on the accumulation of an enormous foreign debt by the United States. After having built a SFC "US dollar model", which represented the post-Bretton Wood order, Zezza and Valdecantos have used a SFC "bancor" model to study the original proposal by John Maynard Keynes for a post-Second World War international monetary system (the Bretton Woods final agreement did not follow his proposal, since the American plan masterminded by Henry Dexter White prevailed). Keynes' idea was based on the introduction of a new 'international currency', the bancor, to be used as means of payment and international reserve; furthermore, an international clearing union should have kept records of deficits and surpluses in the current accounts of the countries. Zezza and Valdecantos' model demonstrated via computer simulations how world imbalances could be eliminated thanks to a series of mechanisms that are at the heart of Keynes' plan: a) surplus countries would be forced to contribute to the adjustment if compelled to pay an interest on their reserves in bancors; b) interest payments on positive reserves could be transferred to deficit countries in order to promote development projects; c) although all the national currencies would be pegged to the bancor, discrete and 'exceptional' depreciations of the currencies would be allowed to accelerate the pace of the adjustment when needed. The effects of Keynes' plan on the European Monetary Union have been tested also by Mazier and Valdecantos (2019), who have developed their previous four-country SFC model (Mazier and Valdecantos 2015) for this purpose. Their simulation experiments suggested that "the implementation of Keynes' ideas may conduct European countries to a stronger and more sustainable growth cycle" (Mazier and Valdecantos 2019, p. 8).

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[68] Although in recent years the Chinese current account surplus has reduced significantly, when the model was firstly set up the Chinese surplus was still very large.

3.2 TOWARD A MODEL WITH ENDOGENOUS PRODUCTIVITY

3.2.1 Why endogenous productivity in an open economy SFC model

The New York Times has recently ranked productivity among the big economic "challenges of our age" (Neil Irwin, May the 26th 2017).

"Productivity puzzles" was also the title of a speech given by Andrew Haldane, chief economist of the Bank of England, at the London School of Economics on May 2017. Haldane borrowed an expression already used in several academic papers (Barnett, Broadbent, Franklin and Miller 2014; Bryson, Forth and Askenazy 2014; Weale 2014), to introduce "a tale of productivity disappointment, in forecasting and in performance" that "has been extensively debated and analysed over recent years" (Haldane 2017). Even the President of the European Central Bank, Mario Draghi, has often pointed to productivity as the 'culprit' of the unbalances between deficit and surplus countries which are absolutely crucial in explaining the dynamics of the European sovereign debt crisis (Draghi 2013 and 2014).

Actually, countless examples could be given of the growing attention towards productivity and its determinants that have involved institutions, policy makers and academic scholars in recent years.

In the same context, a revival of empirical studies about the so-called Verdoorn-Kaldor law (Verdoorn 1949, 1980, Kaldor 1961, 1978) has occurred. In a nutshell, the law links productivity with aggregate demand and scale of production (see for instance the studies by Alexiadis and Tsagdis 2010, Fazio, Maltese and Piacentino 2013, Millemaci and Ofria 2014, Magacho and McCombie 2017).

The main idea behind this approach dates back to the founder father of political economy, Adam Smith. The division of labour was at the very centre of the analysis of the "Wealth of Nations" (1776). Productivity – or the "powers of labour", if one wants to recall the original expression used by Smith – was considered the outcome of a more and more sophisticated division of labour and specialisation. Yet the precondition for this process of specialisation to take place was the actual possibility of selling the growing quantities of *homogenous* goods that would be produced:

ultimately, the "extent of the market" could be identified as the real determinant of the powers of labour:

> "As it is the power of exchanging that gives occasion to the division of labour, so the extent of this division must always be limited by the extent of that power, or, in other words, by the extent of the market. When the market is very small, no person can have any encouragement to dedicate himself entirely to one employment, for want of the power to exchange all that surplus part of the produce of his own labour, which is over and above his own consumption, for such parts of the produce of other men's labour as he has occasion for". (Smith 1776, p. 121)

The debate on productivity has also been encouraged by a parallel controversy on the policy responses to the Great Recession and on the austerity measures that have been implemented in Europe following the sovereign debt crisis.

For many policy makers – especially in central-northern Europe – the best way to rebalance economies affected by government and external deficits was to cut public expenditure and increase taxes. In their vision, economic growth should rely on improvements in productivity, which would make the production system more competitive. Higher levels of productivity could be achieved via the 'liberalisation' of labour markets and the corrective power of competition among workers that would follow.

On the other side of the argument there have been scholars who have pointed out that the disappointing trajectory of productivity in many advanced countries could be the *product* of struggling economies rather than the *cause* of the crisis and the *vindication* of austerity measures. The growing attention towards ideas like the aforementioned Verdoorn-Kaldor law is perfectly in line with this alternative vision. Paolo Sylos Labini's equation of productivity (Sylos Labini 1984 and 1995) and the abundant research related to it also belong to the same trend. Sylos tried to integrate the principle of the Varnoorn-Kaldor's law with technological innovation and cost of labour; in recent years several empirical studies have provided new evidence to his theory (see, for instance, Guarini 2007, Guarini 2014, Corsi and D'Ippoliti 2013, Carnevali, Godin, Lucarelli and Veronese Passarella 2019).

The idea of 'endogenous productivity', namely the idea that the productivity is at the same time a trigger and a *product* of economic development, is a concept that cannot be confined just in a particular school of economic thought.

In the aftermath of the Second World War, growth models developed within the so-called neoclassical synthesis were dominated by the idea of exogenous technological progress. In the Solow-Swan approach (Solow 1956 and Swan 1956) the convergence towards the (per capita income) steady state of the economy was explained by factors such as the initial endowment of capital, the rate of saving and the rate of growth of the population. The possibility for the economy to reach higher and higher levels of per capita income relied on technological progress, which could shift the (Cobb-Douglas) production function upwards allowing the system to achieve higher and higher levels of 'provisional steady states'. Within this framework, technological progress was assumed as an 'unexplained' exogenous variable: it could affect the model, but it could not *be affected* by the economic variables encompassed in the model.

Neoclassical theory parted company with this way of modelling technological progress when it started to 'endogenise' technical changes in the new generation of endogenous growth models: increasing return to scale can be the outcome of externalities linked with capital accumulation (Romer 1986) and with the investments in research and development and in education that accompany the process of economic growth (Lucas 1988 and Romer 1990).

However – as explained by Magacho and McCombie in a recent paper about the empirical evidence of Verdoorn's law – even in the new scheme "productivity growth is ultimately constrained by the growth of the supply side and, in these models, the latter is determined exogenously" (Magacho and McCombie 2017, p. 2; see also Dutt 2006 and McCombie 2002).

An alternative 'tradition' which has looked at the evolution of productivity as an essential feature of the process of economic growth can be identified from a Keynesian-Kaldorian perspective.

The starting point of what has been subsequently labelled as the Verdoorn-Kaldor's law was an article written by the Dutch economist Petrus J. Verdoorn and published in 1949 in the Italian journal *L'Industria* (the original title was: "Fattori che regolano lo sviluppo della produttività del lavoro" – "Factors which determine the development of labour productivity"[69]). Between 1945 and 1947 Verdoorn had been the director of the Labour Market Unit of the Central Planning Bureau in

[69] My translation from Italian.

Netherland. From 1947 and 1949 he was part of the team of economists and statisticians of the Research and Planning Division of the Economic Commission for Europe in Geneva, a team which was led by Nicholas Kaldor. The article on *L'Industria* was part of a wide range of works which tried to address problems related to economic reconstruction and development in the period following the end of the Second World War. One of the main issues in long-term economic planning – as Verdoorn wrote in that article – was "to estimate the future level of labour productivity. Until this value remains unknown, it is not possible to estimate the relationship which exists between the estimates of the production and the estimates of employment"[70] (Verdoorn 1949). Verdoorn's answer to this problem was to use statistical data of the period 1870-1930 (available for a series of industrial countries such as United Kingdom, United States, Germany, Italy, Japan) to estimate the elasticity of labour productivity with respect to industrial production. The average value found was 0.45 (in a log-log equation, see more on this in section 3.2.5). The Dutch economist explained the relationship via the "increased level of labour specialisation that is prompted by a higher level of industrial production"; at the same time "the expansion of the production creates the opportunity of further rationalisation via the effect of increased mechanisation"[71] (Verdoorn 1949). As it is evident, the argument was very similar to the one proposed by Smith in the quotation reported previously in this section.

It is true that – as Anthony Philip Thirlwall pointed out – "nowadays, most economists like to think of the Verdoorn relationship in more 'dynamic' terms related to the extent to which capital accumulation is induced by output growth and technical progress is embodied in capital (as well as 'learning by doing')" (in McCombie, Pugno and Soro, eds 2002, p. X). Yet, not only Verdoorn's main intuition remain still valid, but also the empirical estimation of the coefficient he proposed in his 1949 article (around 0.5) has been substantially confirmed via several different econometric techniques in a very large number of successive empirical studies on data across countries, across regions within a single country, across branches of industries within a single country, across branches of industries across countries, across branches of industries across regions. The volume Productivity growth and economic performance. Essays on Verdoorn's law (McCombie, Pugno and Soro, eds.

[70] My translation from Italian.
[71] My translation from Italian.

2002, which collects the acts of the conference organised in Genoa for the 50th anniversary of the publication of the original paper "Fattori che regolano lo sviluppo della produttivita' del lavoro") features a list of the empirical studies published between 1949 and 1999 (with just few lines of description for each of them): it is enough to know that it occupies 18 pages to have an idea of the abundance of research on this topic.

One of the main challenges in these econometric estimations has been to avoid the problem of bias due endogeneity caused by the 'reverse causality' between the dependent and the independent variables: the growth of output affects productivity, in line with the Verdoorn's law; but as far as higher levels of productivity boost output, instrumental variables should be found in order to 'insulate' the independent variable from this 'economic feedback' and obtain unbiased estimates of the law (two-stage least square estimation). Other problems have arisen from the fact that employment drops less rapidly than output during a recession – workers are not always easy to be sacked and firms fear the loss of know-how – and it consequently increases more slowly than output during a boom. It is therefore important to distinguish the so-called Okun's law (Okun 1962) from the authentic Verdoorn's effect; this can be done employing lags in the variables and by taking into account the intensity of use of capital.

Despite the long-lasting popularity of the Verdoorn's law and the blossoming literature it generated, few economists noticed that contribution just after the publication of the original article. Undoubtedly, the fact that it was written in Italian for an Italian journal did not help its international circulation. We owe to Kaldor – who had worked with Verdoorn at the Research and Planning Division of the Economic Commission for Europe in Geneva – the 're-discovery' of this relationship. In his famous inaugural lecture held in Cambridge on November the 2nd 1966 and entitled "Causes of the Slow Rate of Economic Growth of the United Kingdom" (reprinted in Kaldor 1978), Kaldor set the Verdoorn law at the centre of his diagnosis of British economic malaise. From this moment onwards the law, rebranded as Verdoorn-Kaldor law or Kaldor's 'second law', gathered increasing attention in the debate about productivity and economic growth.

Nowadays, in a time when concerns about sluggish British productivity and the perspectives of British economy outside the European Union dominate the political debate in the United Kingdom and beyond, it could be very interest to give 'new life' to Verdoorn's law in a broader macro modelling context.

Stock-Flow Consistent models developed so far have mainly assumed productivity as constant (or as characterised by a fixed, exogenous rate of growth: see, for instance, the growth model prototype in chapter 11 of Godley and Lavoie 2007 b). The present work tries to fill this gap with the conviction that on the one hand a realistic representation of an open economy cannot overlook a proper scrutiny of productivity and its effects on the competitiveness of a country; on the other hand, the 'glorious' relationship discovered by Verdoorn could 'benefit' from being part of a broader 'network' of equations with the aim of offering an effective account of the dynamics of a modern, open, economic system.

3.2.2 The matrices of the OPENPROD model

The OPENPROD model that will be presented in this chapter is a development of the "More Advanced open economy model" described in Godley and Lavoie 2007 b (Chapter 12). The latter constitutes the "centre of gravity of the open economy SFC literature" (Nikiforos and Zezza 2017, p. 1220).

When Marc Lavoie himself held a lecture at the University of Leeds about Stock-Flow Consistent modelling in May 2017[72] his main recommendation was: "Simplify, simplify, simplify!". Bearing in mind this advice, the changes in the model required by the analysis of the new topic have been focused on a limited number of equations rather than on its assets' structure. Therefore, the new model can easily rely on the matrices of the original OPENFLEX model (although a new full-integration Matrix – which it is not featured in Godley and Lavoie's book – will be introduced in order to account for the capital gains/loss that may affect the assets recorded in the balance sheet matrix).

The OPENFLEX model consists of a system of two countries. Godley and Lavoie named them as the United States and the United Kingdom. The same denomination will be kept here too. Even if in a theoretical model it is not important which is the 'second country', the model is built on the assumption that one of the two countries

[72] "Everything comes from somewhere and goes somewhere: the SFC approach", May the 18th, University of Leeds, organised by Rosa Canelli, Emilio Carnevali and Marco Veronese Passarella and funded by the University of Leeds and White Rose Social Science Doctoral Training Centre.

is the issuer of the currency that is commonly used as international means of payment: therefore the central bank of this country has no need to hold assets denominated in a foreign currency. The dollar presents nowadays characteristics pretty similar to an international means of payments and central banks all over the world hold reserves of assets denominated in dollars. Hence it seems entirely appropriate to label one of the countries as the US.

In this simplified economy, goods are produced without fixed capital and there are no inventories. The equivalence between the supply and demand of goods is guaranteed via a so-called "quantity adjustment mechanism" (Godley and Lavoie 2007 b, p. 65): the driver of the level of production is the aggregate demand and firms can satisfy whichever level of demand coming from the consumers. In other words, there are no supply constraints.

Each country comprises three sectors: households, firms and government (the latter including the central bank). Given the fact that there are no capital goods or inventories, firms do not need to borrow and there is no bank sector and credit money (that is why – as it will be shown very soon – the column of firms in the balance sheet matrix is empty: firms hold no assets or liabilities).

The governments finance their budget deficits issuing short-term obligations (bills), which yield interest and whose price is fixed at one unit of the country's currency (a price that does not change during the duration of a bill's life, which is assumed to be one period).

Households of each country hold bills denominated both in their own currency and in the foreign currency. By contrast, they keep only cash in domestic currency.

The description of the assets held by each sector is better provided with the help of the balance sheet matrix which follows.

Table 3.1: OPENPROD balance sheet matrix

	UK Households	UK Firms	UK Government	UK C. B.		US Households	US Firms	US Government	US C. B.	Sum
	all in £				Ex. rate	all in \$				
Money	$+H^{£}$			$-H^{£}$		$+H^{\$}$			$-H^{\$}$	0
£ Bills	$+B_{£}^{£}$			$+B_{cb£}^{£}$	$xr^{£}$	$+B_{\$}^{£}\, xr^{£}$				0
\$ Bills	$+B_{£}^{\$}\, xr^{\$}$		$-B^{£}$	$+B_{cb£}^{\$}\, xr^{\$}$	$xr^{£}$	$+B_{\$}^{\$}$		$-B^{\$}$	$+B_{cb\$}^{\$}$	0
Gold				$+or^{£} p_g^{£}$	$xr^{£}$				$+or^{\$} p_g^{\$}$	$\mathbf{\Sigma} or\ p_g^{£}$
Balance	$-V^{£}$		$-NW_g^{£}$	$-NW_{cb}^{£}$	$xr^{£}$	$-V^{\$}$		$-NW_g^{£}$	0	$-\mathbf{\Sigma} or\ p_g^{\$}$
Sum	0		0	0	$xr^{£}$	0		0	0	0

The left-hand side of the table represents the United Kingdom and all assets are recorded in pounds. The right-hand side represents the US and all assets are recorded in dollars. Since the assets of an agent correspond to the liabilities of another, and their sum has to equal zero, there must be a method whereby this calculation is made regardless of the difference in the currencies. This is provided by the column in the centre, which features the exchange rate ($xr^{£}$): how many dollars can be bought with one pound (quotations of exchange rates in Godley and Lavoie's models are always in indirect, or 'European', terms).

The superscript of a variable always denotes the country which issued the asset (i.e. $ for US and £ for the UK). The subscript, the country where the asset is held.

Assets are always denominated in the currency of the country which issued them. That is why, for instance, in the column of UK households it is necessary to convert bills issued by the US government but held by British savers via the exchange rate. The only exception to this rule is given by the demand of assets, which is denominated in the currency of the country of the agent that expresses that demand. However, in the balance sheet matrix only 'actually held' assets are recorded. Therefore, this exception does not apply here and needs to be remembered only when the behavioural equations of the system will be ushered in.

UK's central bank holds bills denominated in dollars as international reserves. In a pure flexible exchange rate regime, this asset does not play any role. However, Godley and Lavoie's "More Advanced Open Economy Model" considers several possible 'closures' and it can be very easily adapted to a fixed exchange rate model: in this case negative or positive positions in the balance of payment can be offset, for instance, by fluctuations in the international reserves at the central bank of the 'second country' (see OPENFIX model).

Since the UK holds reserves denominated in dollars and since the price of gold – that is kept by both central banks as a 'residual' of the gold standard era – is assumed constant but set in dollars, UK's central bank can record capital gains/losses. Consequently, at the end of its column there is the measure of its net worth (with the negative sign required by the accounting rules adopted by the SFC methodology, see Godley and Lavoie 2007 b, Chapter 2). By contrast, US' central bank does not hold any bill denominated in pounds and the price of gold is set in its domestic currency: the bank's liabilities exactly offset its assets and the net worth is zero.

The overall net worth of the economy equals the only element that is not a financial asset, or "a claim of someone against someone else" (Godley and Lavoie 2007 b, p. 32): the total amount of gold reserves. That is why, except for the line of gold reserves (and, obviously, of the line of net worth/balance of the whole system), each row and each column of the matrix yields a zero result in the sum of all its elements. The transaction flow matrix is presented in Table 3.2.

Table 3.2: OPENPROD transactions-flow matrix

	UK House.	UK Firms	UK Gov.	UK C.B.		US House.	US Firms	US Gov.	US C. B.	Sum
	all in £				Exch. rate	all in \$				
Consumption	$-C^{\pounds}$	$+C^{\pounds}$				$-C^{\$}$	$+C^{\$}$			0
Gov. Expend.		$+G^{\pounds}$	$-G^{\pounds}$				$+G^{\$}$	$-G^{\$}$		0
Trade		$-IM^{\pounds}$			$xr^{\pounds}$		$-IM^{\$}$			0
		$+X^{\pounds}$			$xr^{\pounds}$		$+X^{\$}$			0
GDP/Income	$+Y^{\pounds}$	$-Y^{\pounds}$				$+Y^{\pounds}$	$-Y^{\$}$			0
Taxes	$-T^{\pounds}$		$+T^{\pounds}$			$-T^{\$}$		$+T^{\$}$		0
Interes paym.	$+r^{\pounds}B^{\pounds}_{\pounds}$		$-r^{\pounds}B^{\pounds}$	$+r^{\pounds}B^{\pounds}_{cb\pounds}$	$xr^{\pounds}$	$+r^{\$}B^{\$}_{\$}\,xr^{\$}$				0
	$+r^{\$}B^{\$}_{\$}xr^{\$}$			$+r^{\$}B^{\$}_{cb\pounds}xr^{\$}$	$xr^{\pounds}$	$+r^{\$}B^{\$}_{\$}$		$-r^{\$}B^{\$}$	$+r^{\$}B^{\$}_{cb\$}$	0
CB profits			$+F^{\pounds}_{cb}$	$-F^{\pounds}_{cb}$				$+F^{\$}_{cb}$	$-F^{\$}_{cb}$	0
Flows of funds (changes in assets)										
Money	$-\Delta H^{\pounds}$			$+\Delta H^{\pounds}$		$-\Delta H^{\$}$			$-\Delta H^{\$}$	0
£ Bills	$-\Delta B^{\pounds}_{\pounds}$		$+\Delta B^{\pounds}$	$-\Delta B^{\pounds}_{cb\pounds}$	$xr^{\pounds}$	$-\Delta B^{\pounds}_{\$}\,xr^{\pounds}$				0
\$ Bills	$-\Delta B^{\$}_{\pounds}\,xr^{\$}$			$-\Delta B^{\$}_{cb\pounds}\,xr^{\$}$	$xr^{\pounds}$	$-\Delta B^{\$}_{\$}$		$+\Delta B^{\$}$	$-\Delta B^{\$}_{cb\$}$	0
Gold				$-\Delta or^{\pounds}p^{\pounds}_{g}$	$xr^{\pounds}$				$-\Delta or^{\$}p^{\$}_{g}$	0
Sum	0	0	0	0		0		0	0	0

Again, on the left-hand side flows are measured in pounds and on the right-hand side in dollars. It is essential to point out that import is included only in the column of the firms and not in the households' one. Far from being grounded on the assumption that firms import intermediate goods while households buy only domestic goods, this 'accounting constraint' can be interpreted as suggested by Godley and Lavoie[73]: "Remembering that most goods are purchased in shops, one can say that all imported transit through firms of the North [UK, in our case], which act as intermediaries, purchasing these goods from the firms of the South [the US, in our case], and then selling them to the Northern [British, in our case] household consumers" (Godley and Lavoie, p. 173).

This point will be crucial in the discussion of the equations of the price of domestic goods and the overall price of domestic sales that will be introduced later. For the moment it is enough to bear in mind that domestic sales encompass goods produced abroad and sold in the domestic market, whereas domestic goods are goods produced internally whose price is not calculated in the OPENFLEX model but will be at the centre of the amendments developed via the OPENPROD model.

Table 3.3 features the full-integration matrix for the OPENFLEX and the OPENPROD models. In Godley and Lavoie 2007 b no equivalent matrix was included. And actually, its reconstruction poses some challenging dilemmas.

What follows is just a hypothesis on how the matrix could be built. The proposed method goes beyond the rules adopted in previous Godley-Lavoie's models. Yet it is worth to make an attempt, given the fact that capital gains play a significant role in the OPENFLEX model[74]

Gold is the only element of the 'world economy' that in this model does not represent a claim of someone against someone else. This must be the net wealth of the system. Since the overall quantity of gold in the system is constant, net real wealth must be constant. Still, the sum of all the changes in net assets arising from revaluations due to a change in the exchange rate does not equal zero. For instance, if the pound

[73] This explanation is actually put forward in chapter 6 of Godley and Lavoie 2007 b, and it originally referred to a two-region economy (North and South of the REG model). However, the same narrative can be perfectly applied to the "More Advanced" model.

[74] For instance, in the OPENFLEX model Godley and Lavoie chose to take into account households' capital gains in the consumption function without any lag. Households' income included in the consumption function did not comprise this element in all previous models: capital gains only affected the level of consumption through the wealth channel (and with one lag).

depreciates, a capital gain for dollar-denominated assets holders in the UK and a capital loss for sterling-denominated assets holders in the US must be recorded. The negative and the positive gains can offset each other and the result would be zero. However, there is no need that everything adds up.

Let us put aside the gold and assume that the overall public debt issued by the US government is worth $ 100. UK households hold $ 30 of US bills and US households hold the remaining $ 70. US families do not hold any bill denominated in pounds. The exchange rate of the pound is initially equal to 1 (1 pound = 1 dollar). It means UK household hold £ 30 of US bills. Then, let us imagine the sterling depreciates and 1 pound is worth 0.5 dollars. This means that the same US bills held by the UK families are now worth £ 60. They enjoyed a capital gain of £ 30. By contrast, US households do not record any gain or loss. It seems that the overall wealth of the system has grown by a certain amount if someone recorded a gain and nobody a loss. Yet the overall wealth of the system is still zero: if the wealth of UK and US families is converted in dollars, it is still $ 100, and the US public debt is still $ 100. In fact, a virtual loss can be identified just if the value *in pounds* of US public debt is considered: it was £ 100 and now is £ 200; furthermore, the wealth of US families was worth £ 70 and now is £ 140. There is no need to take into account these 'additional' losses and gains since the assets are denominated in the same currency of the country where the holders live.

To sum up, it is possible to record a capital gain even if the overall wealth of the system has not changed. This is the meaning of the black line that has been drawn over the last cell of the last column of the full-integration matrix. In every other model presented in Godley and Lavoie's book, the sum of all the elements in the last column equals the overall wealth of the system. Here it does not. A considerable depreciation of the pound[75] can imply significant 'net' capital gains. However, the overall wealth measured in dollars will remain the same: the last row of the matrix will equal the total value of the gold held by the two central banks like in the year before. If no gold was held by the central banks in the model, the overall wealth would have remained at zero, just as in the example above with a public debt of $ 100.

[75] It is important to bear in mind that dollar-denominated assets are held by both UK citizens and UK's central bank, while sterling denominated assets are held just by US citizens: US' central bank does not hold sterling-denominated assets.

An alternative and more rigorous – but far less clear – method to build the full-integration matrix could be to compute a ‘double’ first line of the net wealth inherited from the previous period: the first time with the ‘old’ exchange rate and the second time with the ‘new' one. The line with the ‘new’ one would record the virtual loss suffered by the wealth denominated in pounds in case of the depreciation of the sterling, thus offsetting the capital gain enjoyed by British holders of dollar-denominated assets.

Table 3.3: OPENPROD full-integration matrix

		UK House.	UK Firms	UK Gov.	UK C.B.		US House.	US Firms	US Gov.	US C. B.	Sum
	Net worth, end of previous period	$V_{-1}^{£}$	0	$NW_{g-1}^{£}$	$NW_{cb-1}^{£}$	$xr_{-1}^{£}$	$V_{-1}^{\$}$	0		$NW_{cb-1}^{\$}$	$\boldsymbol{\Sigma} or\ p_g^{£}$
Change in net assets arising from transactions	Change in Cash	$+\Delta H^{£}$			$-\Delta H^{£}$		$+\Delta H^{\$}$			$-\Delta H^{\$}$	0
	Change in £ Bills	$+\Delta B_{£}^{£}$		$-\Delta B^{£}$	$+\Delta B_{cb£}^{£}$	$xr^{£}$	$+\Delta B_{\$}^{£}\ xr^{£}$				0
	Change in \$ Bills	$+\Delta B_{£}^{\$}\ xr^{\$}$			$+\Delta B_{cb£}^{\$}\ xr^{\$}$	$xr^{£}$	$+\Delta B_{\$}^{\$}$		$+\Delta B^{\$}$	$+\Delta B_{cb\$}^{\$}$	0
	Change in gold reserves				$+\Delta or^{£} p_g^{£}$	$xr^{£}$				$+\Delta or^{\$} p_g^{\$}$	0
Change in net assets arising from revaluation	Capital gains in £ Bills						$+B_{\$-1}^{£}\ \Delta xr^{£}$				
	Capital gains in \$ Bills	$+B_{£-1}^{\$}\ \Delta xr^{\$}$			$+B_{cb£-1}^{\$} \Delta xr^{\$}$	$xr^{£}$					
	Capital gain in gold				$+or^{£} p_g^{\$}\ \Delta xr^{\$}$	$xr^{£}$					
	Net worth, end of the period	$V^{£}$	0	$NW_g^{£}$	$NW_{cb}^{£}$	$xr^{£}$	$V^{\$}$	0		$NW_{cb}^{\$}$	$\boldsymbol{\Sigma} or\ p_g^{£}$

3.2.3 The equations of the OPENPROD: some preliminary amendments to the OPENFLEX model

The OPENFLEX model is the flexible exchange rate variant of Godley and Lavoie's "More Advanced open economy model" (Godley and Lavoie 2007 b). The other three versions – as already seen in section 3.1.5 – are characterised by a fixed exchange rate closure with endogenous foreign reserves; a fixed exchange rate closure with endogenous interest rate; and a fixed exchange rate closure with endogenous government expenditure.

Before addressing the core ideas behind the OPENPROD model, it is necessary to put forward some little amendments to the benchmark[76]. In the OPENFLEX the measure of real income featured in the consumption function is not the (expected) real regular disposable income (like in all the previous models of the book: see, for instance, equations 10.26, 10.29 and 10.30 in the INSOUT model – chapter 10, Godley and Lavoie 2007 b) but the (expected) real disposable income "in line with the Haig-Simons definition of disposable income" (Godley and Lavoie 2007 b, p. 455. See also Haig 1921 and Simons 1938).

The Haig-Simons disposable income in nominal term (YD_{hs}) is defined as consumption (C) plus the change in wealth (ΔV: all the explanations of the symbols used in the following equations are provided in the appendix of the chapter):

$$YD_{hs} = C + \Delta V \quad (3.1)$$

The change in wealth is defined as:

$$\Delta V = YD_r - C + CG \quad (3.2)$$

[76] The code of the model and of the computer simulations shown in the book can be found here: http://gennariozezza.it/software/eviews/gl2006.php. This is a 'translation' in *Eviews* made by Gennaro Zezza of the original code written by Godley in *Modler*. "Zezza's code" was 'officially endorsed' by Godley and Lavoie in the preface of their book. It has been used as the base of OPENPROD model too. However, some typos have been corrected. Equations OPENFLEX 12.1 and 12.4 (regular nominal disposable income in the UK and US) refer in fact to the Haig-Simons nominal income since capital gains are added. This implies that the equations of Haig-Simons nominal income (OPENFLEX 12.2 and 12.5) end up to be wrong, because they take into account capital gains twice. At any rate, the simulations conducted via Zezza's code are not affected by these typos because he used the variable of regular nominal disposable income in all the other equations where Haig-Simons nominal income was required. Furthermore, Zezza chose to use current relative prices in equation OPENFLEX 12.25 (instead of prices with one lag). No justification was provided for the choice. In this chapter, the original formula of the book (OPENFLEX 12.25 with lags) was reinstated to compare the OPENPROD model with the original OPENFLEX model.

Where YD_r is regular disposable income and CG are capital gains/losses. Therefore Haig-Simons disposable income in nominal term is defined as nominal disposable income plus capital gains:

$$YD_{hs} = YD_r + CG \quad (3.3)$$

To transform this value in real terms – and to respect the accounting principles of the SFC methodology[77] – "an inflation-accounted definition of household's disposable income" (Godley and Lavoie 2007 b, p. 293) is required. Not only should the nominal income be deflated by the level of prices, but it should also be adjusted by the loss of value (properly deflated) of the historical stock of wealth generated by the inflationary process.

All this leads to the following formula for the Haig-Simons income in real terms as defined in chapter 10 of Godley and Lavoie (2007 b), where the capital gains were given by the change in the price of bonds (Δp_{bL}) held by the households (p is the general price level, π the level of inflation and BL_{h-1} the units of long-term bonds):

$$yd_{hs} = \frac{YD_r}{p} - \pi \frac{V_{-1}}{p} + \Delta p_{bL} \frac{BL_{h-1}}{p} \quad (INSOUT\ 10.27)$$

In the OPENFLEX model the same logic should be applied[78]. Therefore, the measure of the wealth inherited from the previous period should be expressed in nominal terms. Here are the formulas of Haig-Simons income comprised in the OPENPROD model (being p_{ds} the 'domestic' price level)

$$yd_{hs}^{£} = \frac{YD_r^{£}}{p_{ds}^{£}} - \Delta p_{ds}^{£} \frac{V_{-1}^{£}}{p_{ds}^{£}} + \frac{\Delta xr^{\$} B_{£s-1}^{\$}}{p_{ds}^{£}} = \frac{YD_{hs}^{£}}{p_{ds}^{£}} - \Delta p_{ds}^{£} \frac{V_{-1}^{£}}{p_{ds}^{£}} \quad (3.4)$$

[77] See Godley and Lavoie 2007 b, p. 323, for more information on how to deflate income variables in line with the stock-consistency principles.

[78] The only difference is given by the fact that there the capital gains are represented by the appreciation/depreciation of the foreign currency: remember that households keep part of their wealth in bills denominated in foreign currency.

$$yd_{hs}^{\$} = \frac{YD_{r}^{\$}}{p_{ds}^{\$}} - \Delta p_{ds}^{\$} \frac{V_{-1}^{\$}}{p_{ds}^{\$}} + \frac{\Delta xr^{£} B_{\$s-1}^{£}}{p_{ds}^{\$}} = \frac{YD_{hs}^{\$}}{p_{ds}^{\$}} - \Delta p_{ds}^{\$} \frac{V_{-1}^{\$}}{p_{ds}^{\$}} \quad (3.5)$$

By contrast, in the formula of the Haig-Simons income included in the original OPENFLEX model the wealth of the household is expressed in real terms:

$$yd_{hs}^{£} = \frac{YD_{hs}^{£}}{p_{ds}^{£}} - v_{-1}^{£} \frac{\Delta p_{ds}^{£}}{p_{ds}^{£}} \quad (OPENFLEX\ 12.35)$$

$$yd_{hs}^{\$} = \frac{YD_{hs}^{\$}}{p_{ds}^{\$}} - v_{-1}^{\$} \frac{\Delta p_{ds}^{\$}}{p_{ds}^{\$}} \quad (OPENFLEX\ 12.36)$$

The second amendment to the benchmark is related to assets' demand and supply. Equations OPENFLEX 12.67, 12.68, 12.69A, 12.70, 12.71 and 12.72A of the original model describe the demand of assets by British and American households along with Tobin's principles of portfolio choice. However, one equation for each group (US and UK) is dropped to guarantee the accounting consistency of the model and to consider the fact that mistakes in expectations can occur: as it was the case in previous Godley and Lavoie's models, expectations' errors "are fully absorbed by fluctuation in money balances" (Godley and Lavoie 2007 b, p. 143).
Consequently, the residual variables should not be the demand for money (H_d) – as in the original OPENFLEX model (see equations OPENFLEX 12.79 and 12.72 in the book) – but the *actual holding of money*. This hypothesis is validated by equations OPENFLEX 12.77 and 12.80, which match the supply of money (H_s) with households' money holding (H_h). Without this amendment, the model *would not close*, and it *would not run,* since there would not be any equation determining H_h.
The 'official code' of the model (see note 76) featured a different solution: equations OPENFLEX 12.77 and 12.80 are modified so that on the right-hand side the demand for money appeared.
In the OPENPROD model it has been preferred to scrap the variable H_d to make more transparent the 'residual nature' of the balance of money.

Now the benchmark model would have 82 equations and 82 unknowns[79] and it would be a fully closed system. Below, the equations of the OPENFLEX models that have been just discussed and their amended versions in the OPENPROD model:

$$H_d^{£} = V^{£} - B_{£d}^{£} - B_{£d}^{\$} \quad (OPENFLEX\ 12.69)$$

$$H_d^{\$} = V^{\$} - B_{\$d}^{\$} - B_{\$d}^{£} \quad (OPENFLEX\ 12.72)$$

$$H_h^{£} = V^{£} - B_{£s}^{£} - B_{£s}^{\$} xr^{\$} \quad (3.6)$$

$$H_h^{\$} = V^{\$} - B_{\$s}^{\$} - B_{\$s}^{£} xr^{£} \quad (3.7)$$

Note that the demand for money is not the only variable that has been substituted in equations 3.6 and 3.7. On the right-hand side of the equations, the actual holding of assets (B_s) is comprised (in place of their demand, B_d). The change is not going to affect the final results, as in the model "central banks will always exchange cash for bills and vice versa" that "is equivalent to saying that the supply of all assets to the private sector of each country passively matches demand" (Godley and Lavoie 2007 b, p. 460). However, the residual nature of the money balance can be grasped more easily when the money held by households results from the amount of the overall stock of wealth minus the amount of assets *actually purchased* (not just demanded!). Of course, equations 3.6 and 3.7 must include the exchange rates too: foreign bills actually held are denominated in the currency of the country which issued the bills. By contrast, bills demanded are always denominated in the currency of the country of the agent which expresses that demand[80].

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[79] According to the equations' numbering in the book, the model should have 91 equations. Yet there are some gaps in the numbering (equations OPENFLEX 12.73 and 12.74 do not exist); furthermore, some equations have just a 'definition function' such as the ones for the expected changes in the exchange rates, which are assumed to be zero to simplify the model (equations OPENFLEX 12.75 and 12.76 are consequently dropped in the simulations presented in http://gennariozezza.it/software/eviews/gl2006.php). Equation OPENFLEX 12.91FL merely defines the reserves denominated in dollars held by the UK central bank as a constant: it is better to classify it as an exogenous variable (as the 'official code' does). Equations OPENFLEX 12.9, 12.10, 12.63A and 12.64A refer to the same unknowns respectively of equations 12.53, 12.54, 12.7 and 12.8: they must be dropped. After the new calculation, the total of equations ends up to be 82 (=91-9).

[80] This is an example of the exception in the accounting rules that was anticipated in section 3.2.2.

3.2.4 The equations of the OPENPROD: productivity as an endogenous variable

The next step will be characterised by a much more substantial modification of the benchmark model. The main aim will be to take into account the productivity as an 'endogenous' variable of the system and to study the consequences of this change on the dynamics of the economy.

Intuitively it is not difficult to argue that a higher level of productivity – given a specific value of the exchange rate – will allow a country to produce with lower costs; the prices of its 'homemade' goods will be lower and the country will be more competitive. Its trade balance will improve.

The problem with the OPENFLEX model is that it does not incorporate a proper measure of the 'original price level' of 'homemade' goods, which can be regarded as a major indicator of the competitiveness of a country.

In order to develop further this point, it is necessary to recall some fundamental equations of the original OPENFLEX model. Six of them will be at the centre of the new amendments: trade prices of the United Kingdom (OPENFLEX 12.21 and 12.22. Note that trade prices of the US follow by symmetry: see equations OPENFLEX 12.23 and 12.24 of the original model in the book); trade flows, measured at constant prices (OPENFLEX 12.25 and 12.26); and price level of sales (OPENFLEX 12.45 and 12.46).

$$\boldsymbol{p_m^{£}} = v_0 - v_1 * \boldsymbol{xr^{£}} + (1 - v_1)\boldsymbol{p_y^{£}} + v_1\boldsymbol{p_y^{\$}} \quad 0 < v_1 < 1 \quad (OPENFLEX\ 12.21)$$

$$\boldsymbol{p_x^{£}} = u_0 - u_1 * \boldsymbol{xr^{£}} + (1 - u_1)\boldsymbol{p_y^{£}} + u_1\boldsymbol{p_y^{\$}} \quad 0 < u_1 < 1 \quad (OPENFLEX\ 12.22)$$

$$\boldsymbol{x^{£}} = \varepsilon_0 - \varepsilon_1\left(\boldsymbol{p_{m-1}^{\$}} - \boldsymbol{p_{y-1}^{\$}}\right) + \varepsilon_2\boldsymbol{y^{\$}} \quad (OPENFLEX\ 12.25)$$

$$\boldsymbol{im^{£}} = \mu_0 - \mu_1\left(\boldsymbol{p_{m-1}^{£}} - \boldsymbol{p_{y-1}^{£}}\right) + \mu_2\boldsymbol{y^{£}} \quad (OPENFLEX\ 12.26)$$

$$p_s^{£} = \frac{(1 + \varphi^{£}) * (W^{£}N^{£} + IM^{£})}{s^{£}} \quad (OPENFLEX\ 12.45)$$

$$p_s^{\$} = \frac{\left(1+\varphi^{\$}\right) * (W^{\$}N^{\$} + IM^{\$})}{s^{\$}} \qquad (OPENFLEX\ 12.46)$$

Apart from the variables and parameters already met in chapter 2, p_s is the average price of all sales in a country; N is the employment level; W is the wage rate; φ is the mark-up on unit costs; s is the total volume of sales in a country[81]. Once again, bold characters denote natural logarithm.

Equations OPENFLEX 12.45 and 12.46 express the prices of all the sales that are 'recorded' in a country. These sales include goods that are produced in the country and sold in the country, goods that are imported from abroad and sold in the country and goods that are produced in the country but are sold abroad ($s = c + g + x$: see equations OPENFLEX 12.41 and 12.42 in the book).

It seems that a form of 'weighted average' is required if one wants to compute a unique measure of the price level of this heterogeneous group of goods. And this appears to be the way whereby equations OPENFLEX 12.45 and 12.46 have been conceived, even if the authors have provided no explanation of their origin except for a short reference to the "price level of sales, p_s" as "determined as a mark-up, φ, on unit costs" (Godley and Lavoie 2007 b, p. 457).

In an attempt to reconstruct the original reasoning of the authors a new variable will be introduced: the price level of the goods 'made in Britain' or 'made in USA' ($p_{madeUK}^{£}$; from now on, only the equations of the UK will be shown since the US' ones follow by symmetry). This variable will reveal itself crucial in the further development of the OPENPROD model:

$$p_{madeUK}^{£} = (1+\varphi^{£})UC^{£} = (1+\varphi^{£})\frac{W^{£}N^{£}}{y^{£}} = (1+\varphi^{£})\frac{W^{£}N^{£}}{s^{£} - im^{\$}} \qquad (3.8)$$

The measure of prices of imported goods (from the US into the UK) is provided by equation OPENFLEX 12.21 (see above), but it is also equal, by definition, to the nominal value of import divided by its real value.

[81] A complete list of the symbols of the variables of the OPENPROD model, which keeps the same notation for the variables in common with the OPENFLEX model, is provided in the appendix of the chapter.

It is not difficult now to build a weighted average of all sales by merely summing up the price of made in Britain goods (multiplied by the share of made in Britain goods on the total of sales) and the price of imported goods (multiplied by the share of imported goods on the total of sales):

$$p_s^{£} = p_{madeUK}^{£} * \frac{s^{£} - im^{£}}{s^{£}} + p_m^{£} * \frac{im^{£}}{s^{£}} = (1 + \varphi^{£}) \frac{W^{£}N^{£}}{s^{£} - im^{\$}} * \frac{s^{£} - im^{£}}{s^{£}} + \frac{IM^{£}}{im^{£}} * \frac{im^{£}}{s^{£}}$$

$$= \frac{(1 + \varphi^{£}) * W^{£}N^{£} + IM^{£}}{s^{£}} \quad (3.9)$$

Equation 3.9 is almost identical to the one proposed by Godley and Lavoie in OPENFLEX 12.45 (the only difference consists in the fact that the latter seems to suggest that the mark-up should be applied to imported goods too: British importers of goods from the US try to charge an 'additional' mark-up, given the fact that an 'original' mark-up ought to be already charged by American producers. However, this interpretation implies that the price level of imported goods, $p_m^{£}$, should not be considered as a 'definitive price'. But *it is*, as it emerges clearly from equation such as OPENFLEX 12.31: $IM^{£} = im^{£}p_m^{£}$).

No matter which formulation one initially prefers (either equation 3.9 or OPENFLEX 12.45), none of them takes into account that the made in Britain goods are not sold abroad at their original price. As it is evident from equation OPENFLEX 12.22, export prices are affected by several factors such as the exchange rate or the domestic inflation of the country (US) which is importing (from the UK). That is why export should be considered separately in the equation of sales' prices, with its own price level multiplied by the share of exported goods on the total of sales. If all the different prices – of export, of import and of the goods made in Britain for the domestic market – were considered, the following equation of sales' prices would result:

$$p_s^{£} = p_{madeUK}^{£} * \frac{s^{£} - im^{£} - x^{£}}{s^{£}} + p_m^{£} * \frac{im^{£}}{s^{£}} + p_x^{£} * \frac{x^{£}}{s^{£}} \quad (3.10)$$

Equation 3.10 seems to provide a better representation of the price level of all the sales than OPENFLEX 12.45.

In addition, during this process it has been explicitly derived the equation of the 'original' price level of the 'homemade' products (equation 3.8): not only is it useful to determine the price level of all sales, but it appears to be a more effective indicator of the homemade products' inflation than the deflator of the GDP. The latter is the variable used by Godley and Lavoie as a measure of changes in domestic prices. For instance, in the equation of UK import (OPENFLEX 12.21) if $p_y^£$ increases, American exporters can increase the price they charge their products: indeed, since British goods are less competitive, American merchandise would retain approximately its share of the market even with higher prices[82]. Still, if this is the story one wants to tell, a better measure of domestic inflation is the price of made in Britain goods ($p_{madeUK}^£$). The GDP deflator is obtained by dividing nominal GDP (nominal export included) by real GDP (real export included). Since it takes into account exported goods and their prices – which are affected, for instance, by the exchange rate – it is not a measure of the absolute and 'original' competitiveness of the economy as accurate as the 'original price' of made in Britain goods is. When the deflator of GDP is used in OPENFLEX 12.21 and 12.22, the impact of the exchange rate is actually inputted *two times*, and the parameters of the equations run the risk of losing any empirical and even any logical link with what they are supposed to represent.

The same reasoning could be applied to equations OPENFLEX 12.25 and 12.26. For example, in OPENFLEX 12.25 UK exports are affected by the difference between the price level of American import and the domestic price inflation of the US (both variables are in logarithm). The higher is the difference, the lower is the competitiveness of British products and, consequently, the lower is the level of British export. However, domestic prices in the US are much better captured for this purpose by the price level of goods made in USA and sold in the US ($p_{madeUS}^\$$) rather

[82] Since v_1 is assumed to be between 0 and 1, in OPENFLEX 12.21 the increase of import prices will not be as high as the increase of domestic inflation. Therefore, given OPENFLEX 12.26, in the subsequent period UK import would be higher in real terms and the share of the UK market held by US firms would be larger too (*assuming a given level of the exchange rate*). However, the drop in the pound triggered by this adjustment implies that the outcome on US real exports will depend on the parameters of the model. To simplify all this, in the text above it has been stated that "American merchandise would retain approximately its share of the market even with higher prices": it means that regardless the parameters of the model, American firms can, *generally speaking*, afford a hike in the price level of their export when UK goods become more expensive.

than the price level of goods made in USA and sold in the US *and abroad* ($p_y^\$$). The prices of US export are affected by many factors not directly related with the cost of production in the US, and therefore the deflator of US GDP is not the best possible indicator of the 'original' competitiveness of American merchandise.

For all these reasons the OPENPROD model gets rid of the deflators of GDP (equations OPENFLEX 12.57 and 12.58 are dropped) and in their place it uses the price level of the made in USA and made in Britain goods ($p_{madeUS}^£$ and $p_{madeUK}^£$). Therefore, equations OPENFLEX 12.21, 12.22, 12.25 and 12.26 are replaced by the following:

$$\boldsymbol{p_m^£} = v_0 - v_1 * \boldsymbol{xr^£} + (1 - v_1)\boldsymbol{p_{madeUK}^£} + v_1\boldsymbol{p_{madeUS}^\$} \quad 0 < v_1 < 1 \quad (3.11)$$

$$\boldsymbol{p_x^£} = u_0 - u_1 * \boldsymbol{xr^£} + (1 - u_1)\boldsymbol{p_{madeUK}^£} + u_1\boldsymbol{p_{madeUS}^\$} \quad 0 < u_1 < 1 \quad (3.12)$$

$$\boldsymbol{x^£} = \varepsilon_0 - \varepsilon_1(\boldsymbol{p_{m-1}^\$} - \boldsymbol{p_{madeUS-1}^\$}) + \varepsilon_2\boldsymbol{y^\$} \quad (3.13)$$

$$\boldsymbol{im^£} = \mu_0 - \mu_1(\boldsymbol{p_{m-1}^£} - \boldsymbol{p_{madeUK-1}^£}) + \mu_2\boldsymbol{y^£} \quad (3.14)$$

Equations 3.11, 3.12 and 3.13 feature a variable ($p_{madeUS}^\$$) defined by an equation which has not been explicitly shown yet. However, it is just the American counterpart of the price level of made in Britain goods already seen with equation 3.8:

$$p_{madeUS}^\$ = (1 + \varphi^\$)UC^\$ = (1 + \varphi^\$)\frac{W^\$N^\$}{y^\$} = (1 + \varphi^\$)\frac{W^\$N^\$}{s^\$ - im^\$} \quad (3.15)$$

The same principle applies to equation 3.10. Therefore:

$$p_s^\$ = p_{madeUS}^\$\frac{s^\$ - im^\$ - x^\$}{s^\$} + p_m^\$\frac{im^\$}{s^\$} + p_x^\$\frac{x^\$}{s^\$} \quad (3.16)$$

The parameters of equations 3.11-3.14 in the OPENPROD model are set in accordance with condition 2.14 described in chapter 2[83], so that the trade balance would improve following a devaluation of the currency.
Now that it has been identified a price variable ($p^{£}_{madeUK}$) directly affected by changes in costs of production, but not by changes in the exchange rate[84], the problem of productivity can be addressed too. Indeed, now it is possible to study how a change in productivity can influence the 'basic competitiveness' of a country which depends on the 'real' conditions of production and not on the value of the domestic currency.
In the OPENPROD model the productivity is an endogenous variable of the system and it is determined via the Verdoorn-Kaldor law (see section 3.2.1).
The model provides two different equations of productivity, respectively for the UK and the US:

$$pr^{£} = prbase + sm * y^{£} \quad (3.17)$$

$$pr^{\$} = prbase + sm * y^{\$} \quad (3.18)$$

sm is the so-called Smith parameter, which set the sensitivity of productivity with respect to real GDP, being the latter a measure of the size of the economy; *prbase* is a constant.
These equations – which set the real output as the 'right-hand side' variable and the productivity as the 'left-hand side variable' – capture the primary causal relationship between y and pr as the theorists of Kaldor-Verdoorn's law hypothesise it. However, since they are part of a system of simultaneous equations that determines at the same time the value of output in an open economy, the reverse causality phenomenon is also accounted for by the model. In empirical works that have tried to estimate the parameter sm the presence of a reverse causality must be addressed in order to avoid the problem of endogeneity, namely

[83] $\varepsilon_1(1 - u_1) + \mu_1 v_1 > v_1 - u_1$. More precisely, the actual values of the parameters of the model used for the simulations in the second part of this chapter are: 0.7*(1 – 0.5) + 0.7*0.7 > 0.7 – 0.5. This implies 0.84 > 0.2: the condition holds.
[84] In spite of its more complex price structure, the OPENPROD model retains some of the simplifying assumptions of the OPENFLEX model: the production is carried out by labour alone with no fixed or working capital and no intermediate costs of production. Therefore, the exchange rate can affect the price of imported goods, but the latter cannot affect the cost of production.

the bias of the estimators due to errors terms whose mean is not zero (see section 3.2.1). The solution is often offered by the use of instrumental variables that 'substitute' the dependent variable and 'protect' it from the influence of the independent variable within a two-way causal relationship.

In the OPENPROD model this bidirectional causality is at work in 'real time': equation 3.17 and equation 3.18 capture the primary relationship. Then the value of productivity affects the level of internal prices via equations 3.8 and 3.15. They contain the variable N which expresses the level of employment; N itself is given by equations OPENFLEX 12.65 and OPENFLEX 12.66, that simply define the level of employment as the real output divided by productivity. Thus, it is possible to summarise the cycle of the reverse causality encompassed in the model as follows: output affects productivity via equations 3.17 and 3.18. At the same time, when a higher level of output prompts a higher level of productivity, the costs for every unit of product fall. If the mark-up is fixed – given by the expressions $(1 + \varphi^{£})$ and $(1 + \varphi^{\$})$, respectively in equations 3.8 and 3.15 – the drop of unit costs implies a decrease of the price level of 'homemade goods' and therefore an improvement of the competitiveness of a country. The consequent rise of export closes the circle because export is one of the determinants of real output together with consumption and public expenditure. This is the theoretical 'reconstruction' of the forces behind endogenous productivity as determined in the OPENPROD model. At any rate, it cannot be ignored that in a system of over 80 equations every theoretical 'long chain' of causal relationships must 'coexist' with what happens to all the other variables of the equations, which cannot be assumed as *equal*. Only with the help of computer simulations further light on this issue can be shed.

3.2.5 Computer simulations with the OPENPROD model: experiment 1

In the following sections, the main characteristics of the OPENPROD model will be analysed via computer simulations.

As the purpose of this research is mainly theoretical, the values of the parameters and exogenous variables that OPENPROD shares with OPENFLEX are borrowed from the original model.

With regard to the parameters of the 'completely new' equations introduced in the OPENDPROD model – *sm* and *prbase* – they have been set respectively at 0.0055 and 0.750442905 (same values for the UK and US). These values return an initial level of productivity (1.286110) which is pretty close to the constant used in the original OPENFLEX model (1.3333). However, far from being purely a arbitrary parameter, *sm* roughly reflects the empirical evidence[85] on the 'Smith effect' that can be found in the most recent literature (Magacho and McCombie 2017, Carnevali, Godin, Lucarelli and Veronese Passarella 2019). In addition, as it has been already said in section 3.2.1, recent estimates of the Smith parameter are substantially equivalent to the first estimate made by Verdoorn, who wrote that a change in the volume of production by 10% tends to be followed by an average increase of the productivity of nearly 4.5% (Verdoorn 1949). This is the same effect that the simulations with the OPENPROD model will show: on average, the ratio of the change in productivity on the change in GDP will be 0.41.

All the experiments have been conducted starting from the stationary state of the OPENPROD model, which by the way is very similar to the 'original stationary state' reached by the OPENFLEX model (for instance real GDP of the UK in 1952 is 97.39180 in the OPENFLEX model and is 97.40507 in the OPENPROD). This will simplify – when needed – the comparison between the behaviour of the two models. The expression 'stationary state' has been used instead of 'steady state' because both the OPENPROD model and OPENFLEX omit growth: once a stable condition has been reached the values of the stocks do not change. In models where economic growth is taken into account the ratios of the values of the stocks remain constant, but the values themselves change.

It is essential to set the model in its stationary state. Otherwise, it would not be possible to distinguish the effect of a particular shock from the 'background fluctuations' which are leading the variables towards the stationary state.

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[85] It is crucial to bear in mind that when the literature on the Verdoorn-Kaldor law refers to what it is usually called the 'Smith parameter' the implicit formula in the background is a log-log equation with the variables expressed as rates of change. By contrast, the equations of productivity in the OPENPROD model are in level and their variables are not the rates of change. That is why, despite the parameter *sm* appears different, the outcome in terms of the relationship between change in output and change in productivity in the OPENPROD model is absolutely consistent with the results contained in the empirical literature.

It has been chosen to represent productivity via linear equations to treat this amendment of the original model in the simplest possible way.

The complete list of variables, parameters and initial values of stocks of the OPENPROD model is provided in the appendix at the end of the chapter.

The first experiment consists in a step fall in UK exports[86]. Let's recall equation 3.13:

$$\boldsymbol{x}^{£} = \varepsilon_0 - \varepsilon_1\left(\boldsymbol{p}^{\$}_{\boldsymbol{m-1}} - \boldsymbol{p}^{\$}_{\boldsymbol{madeUS-1}}\right) + \varepsilon_2 \boldsymbol{y}^{\$} \quad (3.13)$$

Total real UK export is given by three factors: GDP (in logarithm) of the other country (US), the price level of US import relative to the price level of American homemade goods (in logarithm), plus a constant: ε_0. The latter is a concise measure of British propensity to export. Factors like the costs of production are already encompassed in the price level of made in Britain goods – which affects British export prices and consequently US import prices; therefore, ε_0 can be considered as a 'residual variable' that captures all the other characteristics of an economic system responsible for its strength or weakness in the international markets: e.g. the reputation of its brands, the quality of its products, etc.

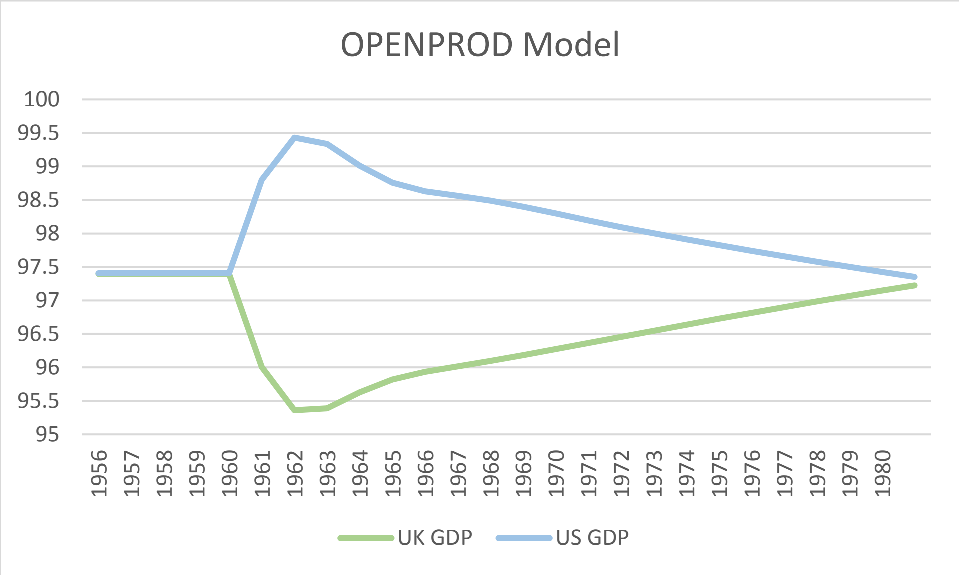
ε_0 is initially set at -2.1 in the OPENPROD model (as in the original OPENFLEX model). Then experiment 1 simulates the scenario in which the United Kingdom suffers a drop in its propensity to export: since 1960 onward ε_0 becomes -2.2.

Graph 3.1 shows UK and US GDP following the shock. As it is evident, while British GDP plunges, a symmetrical gain is experienced by the US total income. Indeed, a lower level of UK export means an equivalent decrease of US import: American consumers redirect their consumption patterns towards made in USA goods and this boosts the American economy.

What is striking in graph 3.1 graph is the steepness of the British economy downturn (and consequently of the American boom).

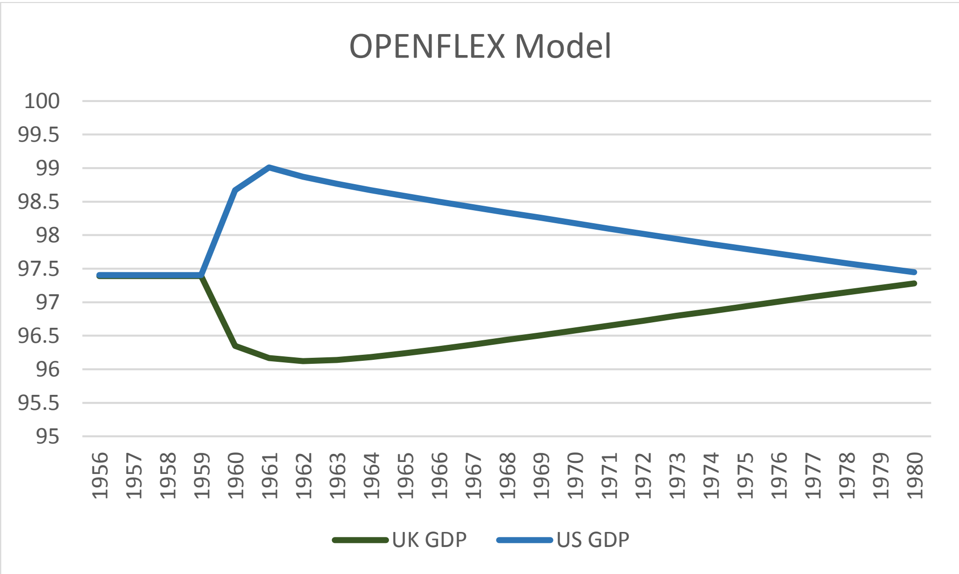
[86] For the sake of comparison, it has been chosen the same first shock studied by Godley and Lavoie in the section of their book devoted to the open economy model with flexible exchange rate: 12.7, p. 478.

Graph 3.1: US and UK GDP following a step fall in the UK export (OPENPROD model)



If an identical shock is triggered in the OPENFLEX model the effect on the GDP of the two countries is far less marked.

Graph 3.2: US and UK GDP following a step fall in the UK exports (OPENFLEX model)



In graph 3.2 UK GDP never goes beneath 96 and US GDP barely overcomes 99.
The reason for the discrepancy between the models lies in the role played by the endogenous productivity, which widens the scale of the fluctuation in the OPENPROD model. When the UK propensity to export drops, British economy

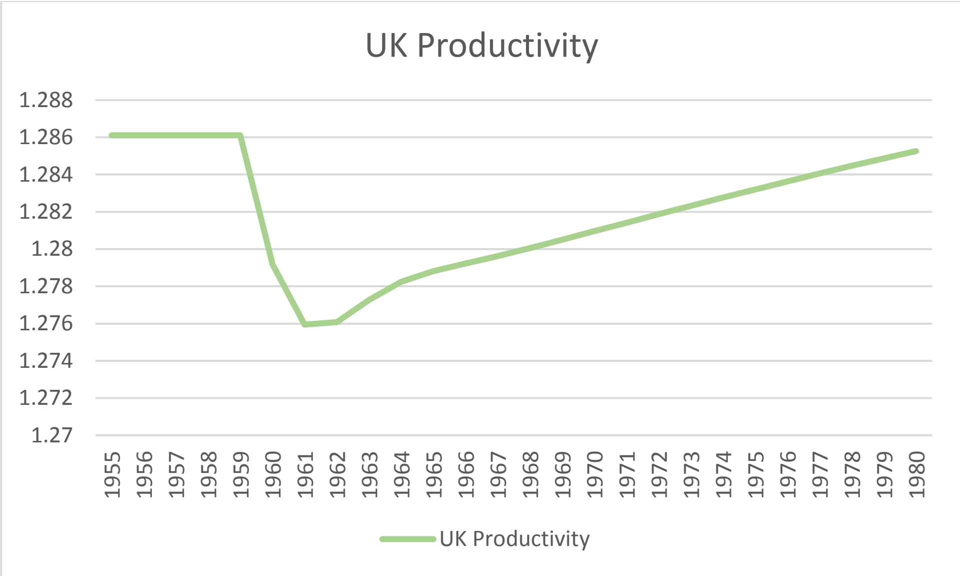
shrinks. The productivity of workers decreases (Smith effect) and costs of production[87] increase (more workers are required for a given level of output). This results in higher prices for made in Britain goods and higher prices for UK exports. While in the OPENFLEX model British exports rebound quickly and stem the recession thanks to the fall in the value of the pound, in the OPENPROD model the positive effect of the devaluation of the currency on US import prices is partially offset by the increase in the 'basic price' of UK 'homemade' goods due to this loss of productivity. UK export is also undermined by the decrease in the price level of American goods which is linked to the productivity gains enjoyed by the US.

In the meantime, UK import decreases due to the increase in import prices caused by the devaluation of the pound. However, since the 'basic prices' of US goods are decreasing too, the drop in UK export outpaces the drop in UK import, notwithstanding the dip in UK GDP, which should help to reduce import. UK trade balance and current account balance record a wide deficit position.

In addition, higher inflation of domestic prices in the UK undermines real disposable income and real wealth of households, despite capital gains associated with the devaluation of the currency: as a result, UK overall consumption dips in the periods following the shock.

[87] In equation 3.8 [$p^{£}_{madeUK} = (1+\varphi^{£})UC^{£} = (1+\varphi^{£})\frac{W^{£}N^{£}}{y^{£}} = (1+\varphi^{£})\frac{W^{£}N^{£}}{s^{£}-im^{\$}}$] the total costs of production is given by wages (assumed constant) multiplied by the number of workers. In turn, the latter is given by equation OPENFLEX 12.65 [$N^{£} = \frac{y^{£}}{pr^{£}}$]. Therefore, when productivity decreases the number of workers per unit of product increases.

Graph 3.3: Productivity in the UK following a step fall in the UK exports (OPENPROD model)

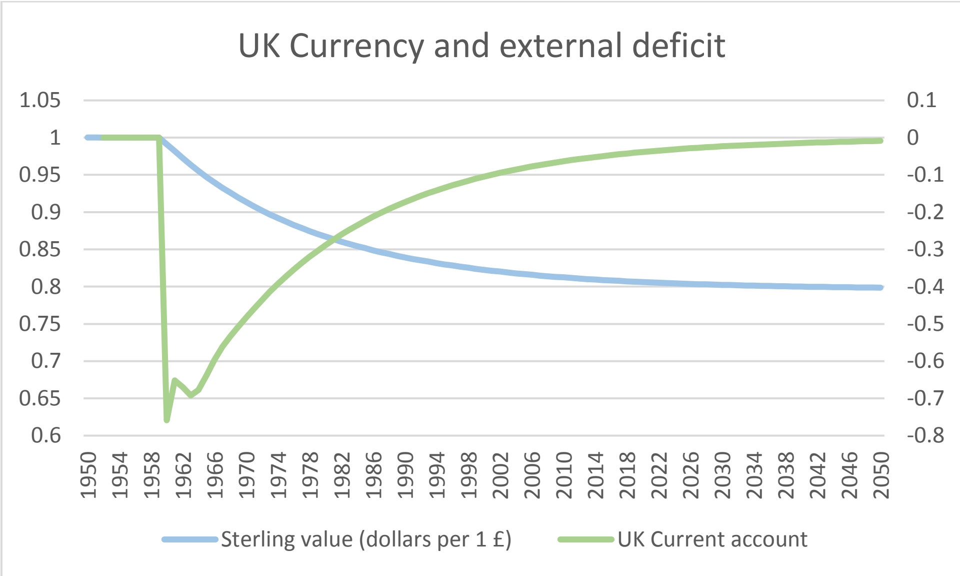


Graph 3.4: Prices of made in Britain goods and UK domestic prices following a step fall in the UK exports (OPENPROD model)

Graph 3.4 shows the trajectory of the price level of made in Britain goods and the domestic price level, which encompasses imported goods too. The first index soars just after the shock when the productivity falls (see graph 3.3 for the productivity drop). At the same time, domestic prices grow because homemade good represent a large share of the total volume of sales (nearly 88%). Yet, after the first periods,

the trails of evolution of the two indexes split: the prices of goods made in Britain start to decrease, due to the constant improvement of productivity ushered in by the recovery of the economy; by contrast, domestic prices settle at a higher level, due to the constant increase in import prices caused by the ongoing devaluation of the pound. Indeed, as it is showed in graph 3.5, the devaluation of the British currency continues until the deficit in British current account comes back to zero.

Graph 3.5: UK currency (left axis) and UK current account (right axis) following a step fall in the UK exports (OPENPROD model)



With regard to the devaluation of the pound, it is worth to notice that the stationary state of the British currency after the shock is 0.79. It is slightly higher than it was after an identical shock in the OPENFLEX model. This is due to the fact that the recovery of the British economy after the drop in its propensity to export is initially prompted by a weaker currency, but then gather steam thanks to higher and higher levels of productivity.

To sum up, experiment 1 has shown that a system with endogenous productivity is far more flexible but also far more unstable than a system with exogenous productivity.

The pace of the recovery after the shock is indeed faster in the OPENPROD model than in the OPENFLEX model: both economies achieve the pre-shock level of GDP after around 20 periods, with the OPENPROD model starting from a lower level of production just after the shock.

However, the system with endogenous productivity is far more unstable. When an exogenous shock hits the economy, the effects of the shock are magnified by the fact that the recession affects productivity and the latter deepens the recession. This result is less trivial then it appears at first sight. In fact, alternative scenarios could in theory be envisaged based on alternative 'theoretical causal chains'. The following sequence gives an example: lower productivity means higher 'homemade goods' prices, which mean larger current account deficits, which mean steeper depreciation of the currency. This, in turn, means greater capital gains and therefore greater (Haig-Simons) disposable income, wealth and consumption. Only via computer simulations is possible to put together the multiple forces at play in the model and verify which are the prevailing ones, as far as the results are not dependent on a particular set of *ad hoc* parameters. That is why the results of experiment 1 presented above have been checked against different parameters which imply a higher propensity to consume out of Haig-Simons disposable income and wealth, higher price elasticity of import and export and higher pass-through from exchange rate to import and export prices. In all these cases, the negative impact of the shock is higher in the model with endogenous productivity than in the original OPENFLEX model (see the appendix at the end of the chapter).

The outcome shown by OPENPROD model can have significant consequences on the debate on how public institutions should react to an external shock similar to the one described in experiment 1. In the next sections, the topic will be analysed with the use of two slightly different versions of the OPENPROD model.

3.2.6 Computer simulations with the OPENPROD model: experiment 2

In the scenario described by experiment 1 the drop of propensity to export (ε_0) generates a severe recession in the UK (GDP slumps by over 2% two periods after the shock). An even more dramatic crisis can be observed in case of a fixed exchange rate between the two countries. The recovery in experiment 1 is activated and pushed forward by two factors: the devaluation of the pound, which helps export to recover, restricts UK import and sustains British incomes with capital gains on American securities denominated in dollars and held by UK households; and the growing level of productivity following the first bounce of recovery prompted by the devaluation. This virtuous circle cannot take place in a context of fixed exchange rates. Some other mechanisms must lead the system to a stable solution where the current account balance is back to zero (as no country is assumed to have an infinite amount of international reserves, no country can run a current account deficit forever[88]).

Austerity measures can be one of the responses deployed by the deficit country's institutions to tackle this kind of balance of payment crisis. And from a historical point of view, this has actually been one of the major tools used by British governments to deal with the problem in the 'Bretton Woods era'.

For instance, the Labour government led by Harold Wilson in the Sixties tried to rebalance the British current account deficit with increases in taxes and temporary import surcharge. Yet eventually, on November the 18th 1967, it had to resort to the devaluation of the pound: the scale of the adjustment needed to rebalance the external position of the country turned out to be far greater than expected. The sacrifices in terms of GDP would have been too high to be imposed, especially by a Labour government[89].

Experiment 2 will help to shed light on this issue. The OPENPROD model has been adapted to a system with fixed exchange rates, following the closure of the OPENFIXG model[90] presented in chapter 12 of Godley and Lavoie 2007 b. This closure assumes that the UK government funds itself just with bills it is able to sell in capital markets (UK central bank does not operate as a lender of last resort). In

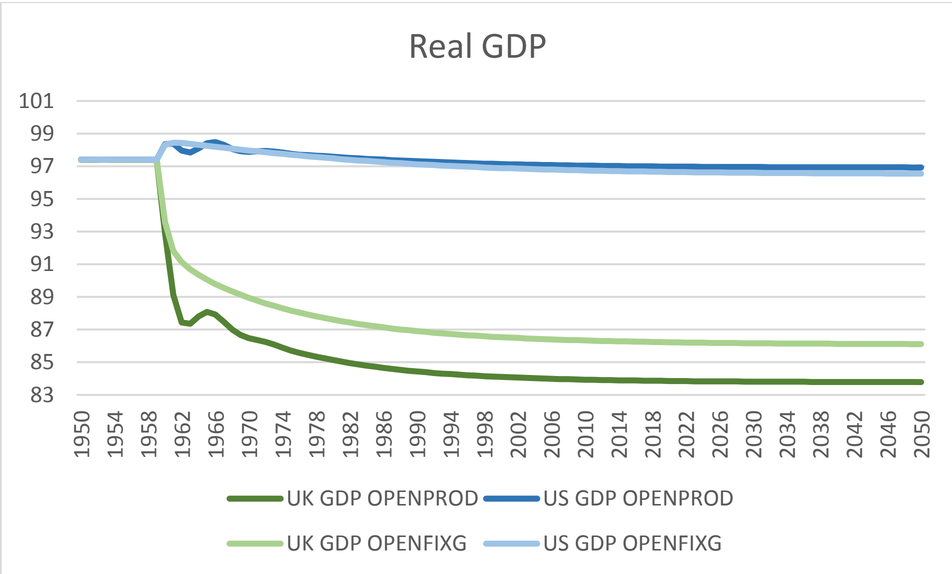
[88] Naturally, an inflow of capitals from abroad can offset the deficit in the current account. However, that cannot be considered a 'structural' solution, in particular if one gets rid of the assumption of perfect asset substitutability. The exceptional role of the dollar as a global reserve currency, and the related privilege enjoyed by the United States in managing their current account deficit, is not considered here.

[89] The gap between 'economic' and 'political' (or even 'moral') sustainability of a policy is often ignored in economic papers, but it is a fundamental element to explain the dynamics of economies in the real world. It is therefore worth to remember that when Wynne Godley published his famous report "Seven sustainable processes" (1999) on the US economy he concluded the paper with some policy considerations; they referred, among other things, to the massive deficit of current account faced by the US and the possible "ways in which the net export demand can be increased". He wrote: "of the four alternatives, we rule out the second – progressive deflation and resulting high unemployment – on moral ground" (Godley 1999, p. 17).

[90] The version used here differs from the 'official code' code as equation 12.11, which features the profits of the UK central bank, should include the exogenous level of British bills held by the central bank and not the endogenous demand of these bills by the central bank. Thus equation 12.84, which features the endogenous demand of UK bills by UK central bank, has been cancelled. It is also worth to point out that, unfortunately, in Godley and Lavoie's book the presentation of this closure of the model contained two misleading typos: equation OPENFIXG 12.93 G should refer to UK bills held by UK central bank (not to US bills held by UK central bank). Furthermore, international reserves are not strictly fixed, even if a mechanism assures they do not move very far from their initial value.

case of a shock similar to the one presented in experiment 1, UK private wealth slumps due to consumption overcoming income. A lower level of UK bills is demanded by UK households. US households may buy more UK bills, but they cannot offset the disinvestment of UK private sector insofar as the propensity to buy foreign bills is lower than the propensity to buy domestic bills. Therefore, the British government's real expenditure decreases. This helps to rebalance the current account deficit, but the result comes with a high price: a much lower level of GDP both in the short and in the long-run.

Graph 3.6: US and UK GDP following a step fall in the UK exports (OPENPROD and OPENFIXG model)



Graph 3.6 allows comparing the behaviour of the OPENPROD and the OPENFIXG model following a drop in UK propensity to export since 1960 onward (like in experiment 1, ε_0 is lowered by 0.1 and set at -2.2).

The consequences of the crisis are much graver in the model with endogenous productivity[91]. Not only is the dip in the GDP figures much steeper, but even the long-

[91]In the OPENPROD model it is possible to observe a little recovery of UK GDP just after the slump, followed again by a continuous decrease towards the stationary level. This behaviour does not change the interpretation of the effects of endogenous productivity on a system with fixed exchange rates and endogenous government expenditure. Indeed, there is a symmetric oscillating movement in the production of the US and the UK. The US benefits from the collapse of UK propensity to export and from the increase in productivity which tames inflationary pressures. However, the US is hit by the ongoing crisis of the UK economy too. In turn, the UK is helped by US export when the US economy grows, but every improvement of the British economy is curtailed by the cuts in government expenditure as far as British current account

run stationary state is at a lower level. The simulation confirms that if the effects of a recession on productivity are taken into account, the sacrifice in terms of GDP which a country has to undergo if it wants to rebalance its external position is much higher than expected given a model with exogenous and fixed productivity. This could help to explain why, for instance, the Labour government in the Sixties had to give up the strategy of an adjustment conducted via austerity measures and resorted to a devaluation of the pound. At the end of the decade, British current account was back in surplus.

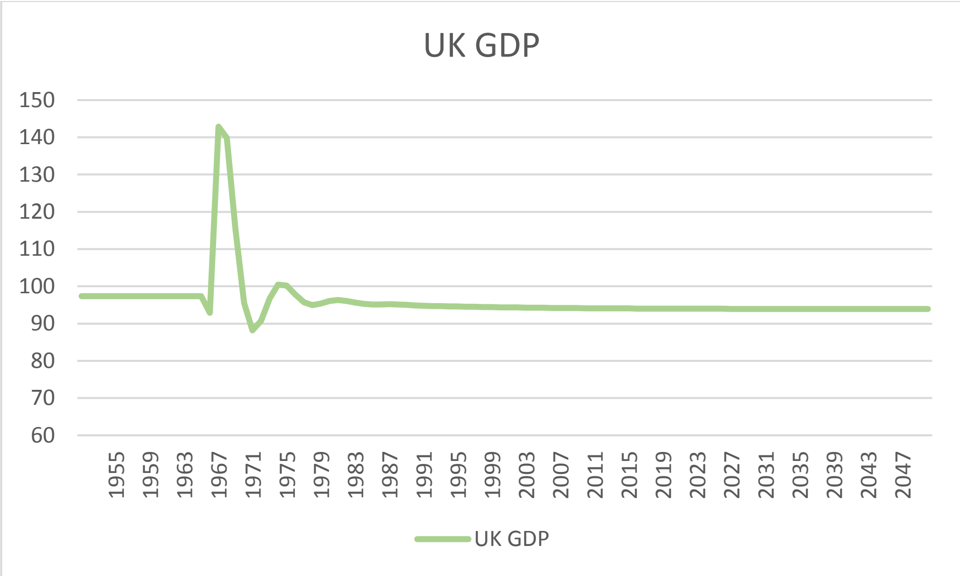
The following graph shows the consequences of a devaluation of the currency the year after the shock in UK exports[92]. In 1967 the pound is devalued by 14% against the US dollar, exactly the same amount of the 'actual' devaluation announced by Wilson with his famous "pound in your pocket" speech. Indeed, the size of the change in the exchange rate has been chosen just to provide a 'historical narrative' to the experiment. However, it is necessary to bear in mind that the initial values of the variables of the model *do not* represent real historical values. Furthermore, it is evident that the parameters of the original version of the OPENFIXR model tend to overestimate the effect of capital gains on consumption: this leads to unrealistic values of the GDP immediately after the devaluation of the currency[93]. Said that, the simulation can help to grasp what Wilson's government tried to achieve via its intervention on the value of the currency.

remains in deficit. The complicated interactions of all these factors create these fluctuating movements that are soon flattened by the strength of the long-term trend.

[92] This time the shock is triggered in 1966

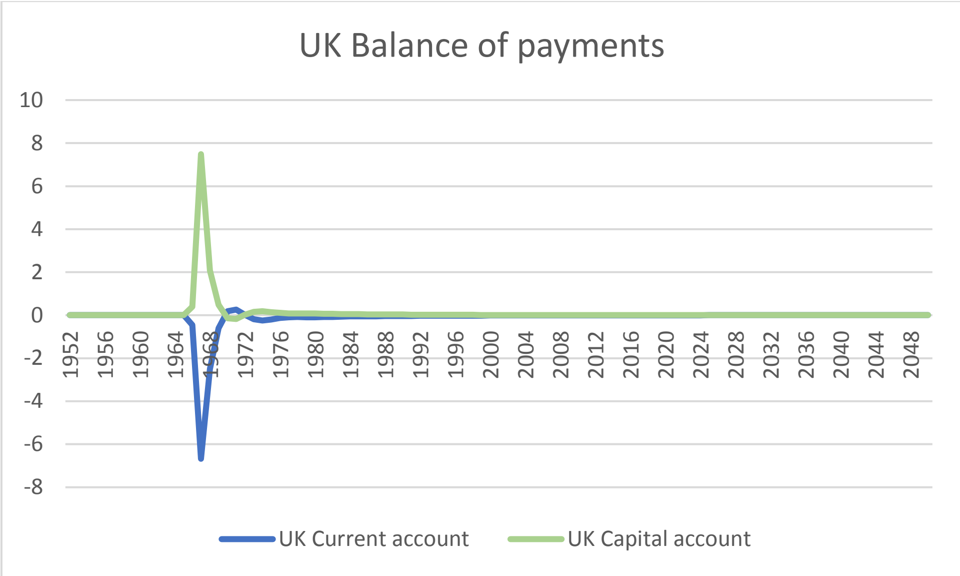
[93] It is worth to notice that picture 12.4B of Godley and Lavoie's book has the wrong values on the vertical axes. The real values are far higher and as unrealistic as the one that results from the simulation with the OPENPROD model shown above.

Graph 3.7: UK GDP following a step fall in the UK exports in 1966 and the devaluation of the pound in 1967



Graph 3.7 shows how the devaluation of the pound brings about the adjustment of the economy that was earlier (graph 3.5) provided by austerity measures. Thanks to a weaker currency, British current account improves very quickly after the initial shock, as it is shown in graph 3.8.

Graph 3.8: UK Balance of payments[94] following a step fall in the UK exports in 1966 and a devaluation of the pound in 1967



The same reasoning can be applied to the recent crisis in the European Union, which is a *de facto* fixed exchange regime area. European institutions have tried to mend the internal imbalances which characterized the eurozone via the imposition of austerity measures to Southern deficit countries. The social costs of this operation in terms of lower income and a higher level of unemployment have been much greater than expected.

Better mechanisms can be envisaged, as far as there is the political will to implement them. One option could be the 'mutualisation' of the public debts within the eurozone. Alternatively, a change of attitude towards trade surpluses is needed: surplus countries should take their part of responsibility in fixing the imbalances. Countries like Germany should be open to deploying expansionary fiscal policies to boost the internal aggregate demand of the eurozone and rebalance the current account of weaker countries. The point is that Southern countries should not be requested to solve the problem all by themselves, since they bear the burden of a

[94] In Godley and Lavoie's terminology the capital account (KABOSA) features all the international transactions involving financial assets (included the ones conducted by central banks, which define the official settlements account). Thus the capital account corresponds to what is usually called financial account in most of the international economics textbook. This account has not to be mistaken for the capital account which defines international movements which involve "nonmarket activities or represent the acquisition or disposal of non-produced, non-financial, and possible intangible assets (such as copyright and trademarks)" (Krugman, Obstfeld and Melitz 2015, p. 359)

much stronger currency than they would have had if they had not joined the euro. By contrast, countries like Germany benefit from a currency far weaker than it would have had.

3.2.7 Computer simulations with the OPENPROD model: experiment 3

Within a flexible exchange rate regime, the recession suffered by the UK after the shock is deeper in the OPENPROD than in the OPENFLEX model (experiment 1). However, both scenarios/models display a long period – roughly 20 years in the simulations – in which the GDP remains under its pre-crisis level. The slowness of the recovery in the OPENFLEX is due to the fact that it has to rely entirely on the effects of the depreciation of the currency on the trade balance. In the OPENPROD model the improvement of productivity accompanies and speeds up the recovery, yet the initial depth of the trough represents a heavy burden for the British economy for many years after the shock. Different parameters of the models in the equations defining the terms of trade would alter the time necessary to come back to the pre-crisis levels, but still the economy would face the consequences of the recession and the uncertainty due to rebalancing mechanisms entirely based on market forces.

Experiment 3 will test if some forms of economic policy can be effective in dealing with this kind of situations in the context of the OPENPROD model.

The model will include three additional equations. For the sake of simplicity, the amendments will involve just equations referring to the UK, as the latter will be the country hit by the shock which will have to react adopting counter-cyclical policies.

Equations 3.19 defines UK productivity. In comparison to equation 3.17 it features an additional variable: the productivity dividend of public investment in R&D (*pp*). In turn, *pp* is given by equation 3.20, which comprises as an independent variable the public expenditure on R&D (*prs*).

Public expenditure on R&D carries out a double function. On the one hand, it helps to boost productivity along with a typical pattern of industrial policy. On the other hand, it represents a net increase of total public expenditure which affects the economy via the traditional Keynesian multiplier. For this reason, *prs* is also included in equation 3.21, which ‘endogenizes’ real government expenditure as a sum of a basic level (*baseg*) and an industrial policy component.

Overall, the following three new equations will be introduced in the OPENPROD model:

$$pr^{£} = prbase + sm * y^{£} + pp^{£} \quad (3.19)$$

$$pp^{£} = crs^{£} * prs^{£} \quad (3.20)$$

$$g^{£} = gbase^{£} + prs^{£} \quad (3.21)$$

The parameter $crs^{£}$ is set at 0.013. It implies that an increase of 0.3 pounds in government expenditure on R&D (+1.8% on the total level of real expenditure, given the initial values of the model) prompts a productivity increase of 0.3%. The reason for the choice of this particular value is twofold: on the one hand it is consistent with some empirical evidence[95]; on the other hand, it brings about plausible values for the other variables when a shock hits the model. $gbase^{£}$ is the exogenous and 'generic' public expenditure.

As usual, the system is shocked in 1960 with a fall in UK propensity to export: ε_0 drops from -2.1 to -2.2. However, this time, the UK government reacts with a countercyclical policy.

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[95] In the simplified world of the OPENPROD model, where no capital is taken into account, it is pretty tricky to mechanically introduce parameters that have been estimated in economic literature using real data and complex production functions. However, in Guellec and Van Pottelsberghe de la Potterie 2004 – a study conducted on 16 major OECD countries with data from 1980 to 1998 – the variables of the regression are sufficiently aggregated to provide some useful insights for the purpose of the OPENPROD model too. The elasticity of (total factors) productivity with respect to public expenditure on R&D is estimated at around 0.17. Therefore, in a pure labour economy like the one represented by the model it does not seem unreasonable to assume that an increase by 1% of public expenditure concentrated on R&D would prompt an increase by 0.17% of productivity.

Of course, no attempt has been made to respect the real proportion of types of expenditure within the public sector in the initial values of the OPENPROD model. According to the "Gross domestic expenditure on research and development" report produced by the Office for National Statistics (latest release 2017) UK government spends about 10.2 billion pounds on R&D (higher education included). This figure represents 0.5% of the 2017 GDP. If the same percentage is applied to the 'lab UK economy' of the OPENPROD it means that 0.48 (=0.005*97) out of 16 pounds of real government expenditure should be devoted to R&D in the baseline scenario. A positive shock of 0.3 pounds to R&D public expenditure, like the one considered in the simulation, would not be compatible with these proportions. In terms of a more 'realistic narrative' it can be thought that a shock of 0.3 pounds to R&D public expenditure actually means an expansionary fiscal policy with a remarkable component of R&D (in line with the baseline share of R&D implicitly comprised in the 'general' public expenditure). By contrast, the 'raw' fiscal stimulus is given by a public expenditure with no R&D component.

Graph 3.9 shows the outcome of the intertwined effects of three different forces on UK GDP. Indeed, the total level of income tends to go down due to the drop in the propensity to export, but at the same time it is pushed up by the fiscal stimulus and the boost in productivity.

Moreover, the graph outlines three different scenarios: scenario 0 describes the effect of a drop of propensity to export without any response by the government. In scenario 2 public institutions react via a 'raw' fiscal stimulus of 0.3 pound (+1.8% of the total level of real expenditure). Scenario 1 displays the effect of the stimulus when the extra-expenditure is concentrated on R&D.

The OPENPROD model turns out to demonstrate the effectiveness of fiscal policy even in a context of flexible exchange rates. This important feature pits the model against the core system of beliefs of most 'mainstream' open economy models (see also chapter 2, section 2.2.6). The following quote is taken from one the most popular university textbook of international economics: "A permanent change in fiscal policy has no net effect on output. Instead, it causes an immediate and permanent exchange rate jump that offsets exactly the fiscal policy's direct effect on aggregate demand. A fall in net export demand counteracts the rise in government demand" (Krugman, Obstfeld and Melitz 2015, p. 509).

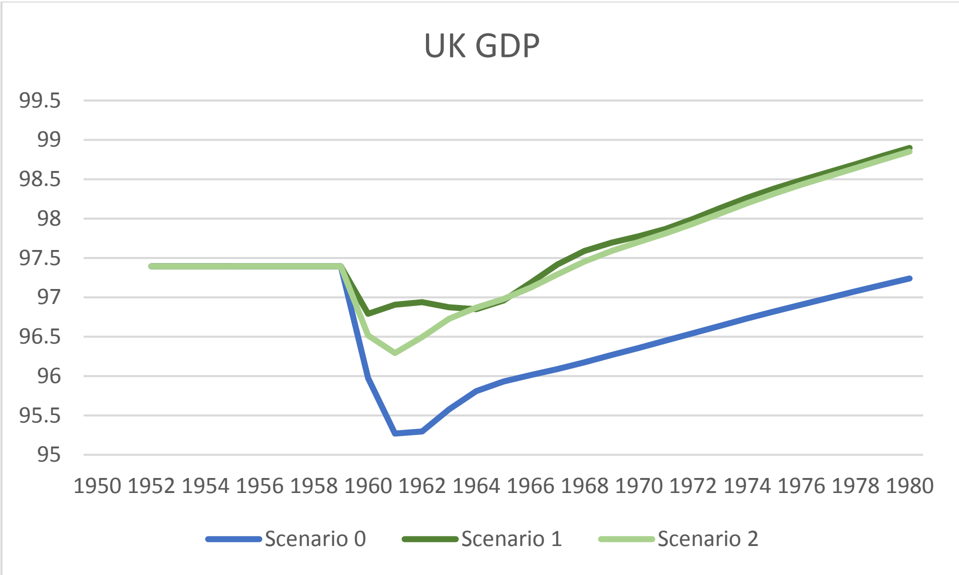
The differences between the OPENPROD and the standard 'textbook model'[96] are ultimately based on the assumptions behind them. In the OPENPROD model money is endogenous and the central bank always provides the supply of money that households demand. Therefore, the interest rate can be assumed as fixed: an increase of public expenditure does not trigger a hike in the interest rate and the latter does not prompt an inflow of capitals which would increase the value of the currency. Also, Post-Keynesian SFC models reject the assumption of perfect capital substitutability: *even if* an inflow of capitals took place, it could not last 'forever'. When the portfolio adjustment is complete, the inflow must end.

Indeed, in OPENPROD model the exchange rate supports fiscal policy: the devaluation of the currency caused by the current account deficit – which is the real

[96] It is true that the standard textbook models are nowadays more didactical tool rather than the staple of advanced research in economic journals. Yet, as Godley and Lavoie underline in their book, models like the IS-LM-BP remain "the workhorse in academic discussions of stabilization policy for the open economy" (Godely and Lavoie 2007 b, p. 488). See more on this in chapter 2.

driver of the value of the currency and is inevitably linked with any expansionary fiscal policy that increases import – helps to boost export and GDP.

Graph 3.9: UK GDP following a step fall in the UK exports: three scenarios of political response



Scenario 0 (blue line) in graph 3.9 is absolutely identical to the path of the British economy featured in graph 3.1. Scenario 1 (dark green) and 2 (light green) show that a fiscal stimulus manages to mitigate the depth of the recession *regardless of how government funds are spent*. Thanks to the stimulus, not only is the recession far less steep, but it is also short-lived. The economy is back to the pre-shock level 15 years before it would have been without intervention.

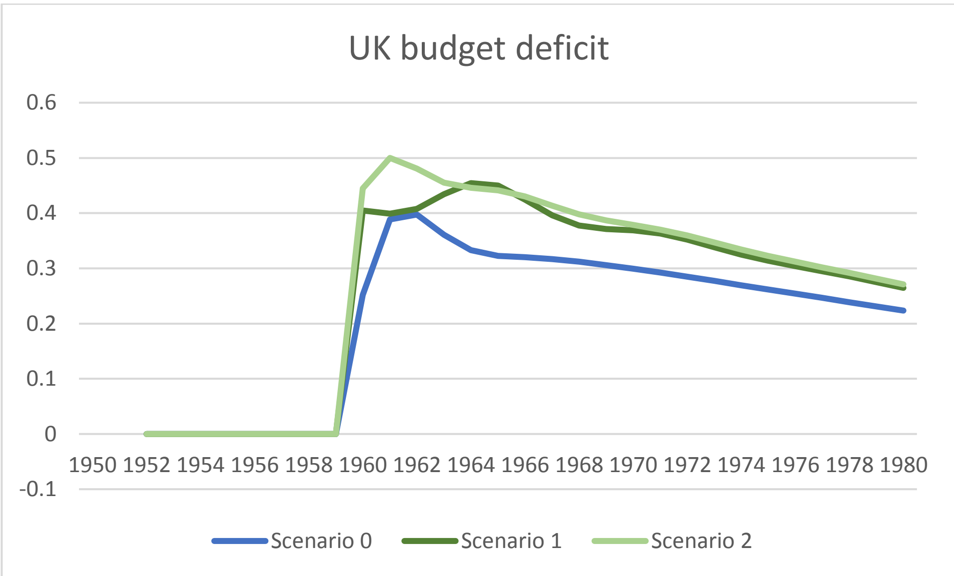
Furthermore, if the government expenditure is focused on R&D the downturn is actually minimal. The dark green line (scenario 1) goes slightly down for a while, but GDP never goes below 96.79 from a pre-shock stable value of 97.39 (-0.6%). In this case, the productivity increase triggered by R&D expenditure offsets the decrease in productivity caused by the Smith effect. A slowly increasing productivity props up exports and keeps down domestic prices despite the fall of the pound and the steep increase in import prices. British income and wealth are not eroded in real terms thanks to the stability of prices.

Obviously, with a more substantial stimulus the recession could even be shunned: higher levels of productivity prompted by R&D funds would be bolstered by the

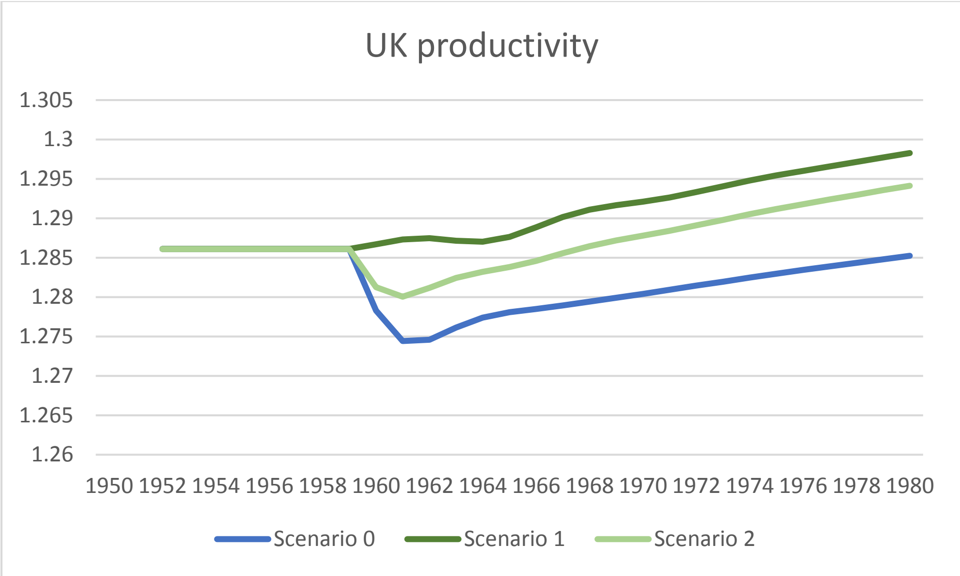
Smith effect linked with the expansion of the scale of production; lower domestic prices would boost real income and wealth, which in turn would affect consumption. By contrast, when the stimulus is not directed to R&D (light green line, scenario 2) the effects of fiscal policy are less powerful: GDP comes back to the pre-shock level in the same span of time, but the recession is deeper.

In addition, a fiscal stimulus focused on R&D expenditure is followed by a lower level of budget deficit (see graph 3.10): a milder recession curbs the losses in revenues linked to a lower level of income and partly offsets the negative effect of the stimulus on the government balance sheet. This result can support the 'political viability' of a fiscal stimulus. Indeed, it is worth to undeline that in the short-run the government deficit in scenario 1 is very close to the value there would be without any fiscal stimulus (scenario 0).

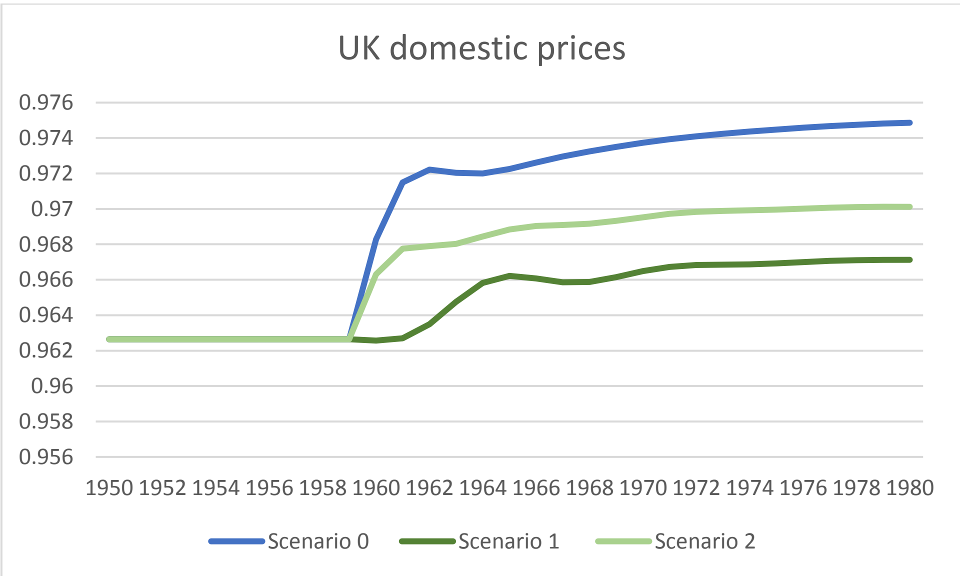
Graph 3.10: UK budget deficit following a step fall in the UK exports: three scenarios of political response



Graph 3.11: UK productivity following a step fall in the UK exports: three scenarios of political response



Graph 3.12: UK domestic prices following a step fall in the UK exports: three scenarios of political response



3.3 CONCLUSIONS

In the first part of this chapter the basic principles of Post-Keynesian Stock-Flow Consistent macro models have been introduced: their origin, their rationale and the trajectory of their development within the broader history of the economic thought via the pioneering contributions of James Tobin (New Haven School) and Wynne Godley (Cambridge School). The SFC methodology combines two different elements: on the one hand the accounting principles, which provide a systematic and consistent framework to the flows and the stocks of the economic variables; on the other hand, the Post-Keynesian theory, which shapes the behavioural equations of the models (see sections 3.1.1 and 3.1.2).

Section 3.1.3 has been focused on the difference between the numerical and the algebraic approach to finding the solutions of a model. The numerical approach – which is the one adopted in this chapter to analyse the OPENPROD model – allows the modeller to handle far more complex and realistic systems of equations, which can represent very sophisticated economic dynamics. The drawback of this method is given by the fact that the model of interest can become less 'transparent' in comparison to simpler versions where algebraic solutions are possible: as every SFC modeller has experienced, sometimes it can be hard to disentangle the web of causal relationships that link the variables together. To some extent, this problem has also characterised the study of the results given by the OPENPROD model: although the main trajectories of the economic variables, and their determinants, turned out to be pretty clear, it has been difficult sometimes to explain minor oscillatory behaviours of the same variables due to the contrasting pushes of a complex array of forces (see note 91).

In the subsequent two sections (3.1.4 and 3.1.5) the main fields and topics of contemporary research on SFC modelling have been covered. Section (3.1.5), in particular, has been focused on recent papers on SFC open economy models, since the original model developed in this chapter (OPENPROD) represents a two-country open economy. The latter has been presented in the second part of the chapter.

The OPENPROD model shares the same matrices with the original OPENFLEX model presented in chapter 12 of Godley and Lavoie (2007 b), except for a new full-integration matrix, which was absent in the original version.

The main innovations of the OPENPROD model with respect to the OPENFLEX model are related to two main topics. First, the system of prices: a more consistent series of equations is provided in order to obtain an autonomous measure of the 'basic' internal prices of goods produced by a country. The price level of 'homemade' goods ($p^{£}_{madeUK}$ and $p^{\$}_{madeUS}$) seems to offer a more convenient indicator of the competitiveness of a production system than the deflator of GDP used by Godley and Lavoie in their original model. It also simplifies the analysis of the impact on the economy of endogenous productivity, which is the second main innovation of the model. Following the recent revival of studies on this field, OPENPROD incorporates two additional equations which 'endogenize' the productivity in line with the so-called Kaldor-Verdoorn law. Productivity was assumed as an exogenous constant in the original OPENFLEX model.

Some secondary interventions – like an amended formula for the Haig-Simons income in real terms – are related to minor imprecisions that affect the original model.

Then the analysis of the model and of its 'behaviour' has been conducted via computer simulations (sections 3.2.5-3.2.7). Starting from a perfectly stationary condition[97], a shock was introduced in the model in the form of a drop in the propensity to export of one of the two countries (United Kingdom).

The effect of the shock is far more pronounced in the OPENPROD model than in the OPENFLEX due to the new system of prices and the related role of productivity as a 'shock-magnifier'. The increased level of 'instability' has important consequences: notwithstanding the flexible exchange rates regime, that provides a mechanism of adjustment via the depreciation of the currency and its impact on the trade balance, recessions can be very deep even in the presence of 'middle size' shocks.

The problem gets even worse when exchange rates are fixed and austerity measures are the only tools at the disposal of the deficit country to rebalance its current account. In section 3.2.6 the closure of the model has been modified in order to study precisely this kind of dynamics. The new version of the OPENPROD assumes an institutional framework that can be regarded as a good proxy of British and

[97] It is important to bear in mind that in the OPENPROD model, as in the original OPENFLEX, there is no endogenous growth: the model settles in a stationary state and after each shock comes back to a stationary state, although it can well be a *different* stationary state.

American economies in the 'Bretton Wood era'. Current arrangements within the euro area work *de facto* on the basis of the same principles too.

Computer simulations in section 3.2.6 suggested that the sacrifice the deficit country is forced to sustain is far higher – in terms of lower levels of national income – when the productivity is endogenous and acts as a shock magnifier. From a 'historical' point of view, this can also explain why public institutions have often underestimated the dose of austerity needed by a country in order to rebalance its current account. The experience of Britain in the Sixties and the more recent case of the Eurozone shed light on the political and the social implications of the theoretical conclusions derived from the fixed exchange rates version of the OPENPROD model. However, the rule of productivity as an endogenous variable is not just a source of increased instability. In fact, it also allows broadening the set of tools at the disposal of the policy maker to put in place growth-enhancing measures or to set up a countercyclical intervention.

The OPENPROD model, in all its versions presented through sections 3.2.5-3.2.7, shares with the original OPENFLEX model an important characteristic: it demonstrates the effectiveness of fiscal policy even in a context of flexible exchange rates. Indeed, the policy implications of this strand of open economy SFC models are clearly at odds with the scepticism about fiscal policy which characterises 'mainstream' open economy models.

Endogenous productivity pushes a step forward the possible development of fiscal policy within the theoretical structure of the SFC approach. Three additional equations have been introduced in the version of the OPENPROD model used for experiment 3. A 'raw' fiscal stimulus – that is to say a 'generic' extension of government expenditure – has been distinguished from a more 'industrial policy focused' fiscal stimulus – namely the use of government money for projects aimed to increase the level of productivity of workers. The results of experiment 3 suggested that industrial policy can be a far more powerful tool than 'generic' fiscal policy to address negative shocks in a context of flexible exchange rates. Furthermore, industrial policy presents an advantage in terms of 'political feasibility' because its impact on short-term government budget deficit is minimal.

APPENDIX I: VARIABLES AND EQUATIONS OF THE OPENPROD MODEL

Macroeconomic Variables

$YD_r^£$ = Regular disposable income UK

$YD_r^\$$ = Regular disposable income US

$Y^£$ = Nominal UK income (GDP at current prices)

$Y^\$$ = Nominal US income (GDP at current prices)

$B_{£s}^£$ = UK bills held by UK households

$B_{£s}^\$$ = US bills held by UK households

$B_{\$s}^\$$ = US bills held by US households

$B_{\$s}^£$ = UK bills held by US households

$xr^£$ = UK exchange rate (value of the pound in US dollars)

$xr^\$$ = US exchange rate (value of the dollar in pounds)

$YD_{hs}^£$ = UK households Haig-Simons disposable income (nominal terms)

$YD_{hs}^\$$ = US households Haig-Simons disposable income (nominal terms)

$V^£$ = UK households' private wealth

$V^\$$ = US households' private wealth

$T^£$ = Taxes paid by UK households

$T^£$ = Taxes paid by US households

$F_{cb}^£$ = UK Central Bank's profits

$F_{cb}^\$$ = US Central Bank's profits

$B_s^£$ = UK public debt (total UK bills issued)

$B_s^\$$ = US public debt (total US bills issued)

$CAB^£$ = UK current account balance

$CAB^£$ = US current account balance

$X^£$ = UK exports (nominal terms)

$X^\$$ = US exports (nominal terms)

$IM^£$ = UK imports (nominal terms)

$IM^\$$ = US imports (nominal terms)

$CABOSA^£$ = UK financial account balance

$CABOSA^{\$}$ = US financial account balance

$p_g^{£}$ = Price of gold in UK

$p_m^{£}$= UK import prices

$p_x^{£}$= UK export prices

$p_m^{\$}$= US import prices

$p_x^{\$}$= US export prices

$p_{madeUK}^{£}$ = Original prices of made in Britain goods

$p_{madeUS}^{\$}$ = Original prices of made in USA goods

$x^{£}$ = UK exports (real terms)

$im^{£}$ = UK imports (real terms)

$x^{\$}$ = US exports (real terms)

$im^{\$}$ = US imports (real terms)

$v^{£}$ = UK households private wealth (real terms)

$v^{\$}$ = US households private wealth (real terms)

$p_{ds}^{£}$ = UK prices of domestic sales

$p_{ds}^{\$}$ = US prices of domestic sales

$yd_{hs}^{£}$ = UK households Haig-Simons disposable income (real terms)

$yd_{hs}^{\$}$ = US households Haig-Simons disposable income (real terms)

$c^{£}$ = UK real consumption

$c^{\$}$ = US real consumption

$yd_{hse}^{£}$= UK households Haig-Simons expected disposable income (real terms)

$yd_{hse}^{\$}$= UK households Haig-Simons expected disposable income (real terms)

$s^{£}$ = Total volume of sales in UK

$s^{\$}$ = Total volume of sales in US

$g^{£}$ = UK pure government expenditure (real terms)

$g^{\$}$ = UK pure government expenditure (real terms)

$S^{£}$ = Value of sales in UK

$S^{\$}$ = Value of sales in US

$p_s^{£}$ = Average price of all sales in UK

$p_s^{\$}$ = Average price of all sales in US

$N^{£}$ = Employment level in UK

$N^{\$}$ = Employment level in US

$DS^{£}$ = UK domestic sales value

$DS^{\$}$ = US domestic sales value

$ds^{£}$ = UK domestic sales volume

$ds^{\$}$ = US domestic sales volume

$Y^{£}$ = Nominal UK GDP

$Y^{\$}$ = Nominal US GDP

$y^{£}$ = Real UK GDP

$y^{\$}$ = Real US GDP

$C^{£}$ = Value of consumption in UK

$C^{\$}$ = Value of consumption in US

$pr^{£}$ = UK productivity (output per worker)

$pr^{\$}$ = US productivity (output per worker)

$B_{£d}^{£}$= Demand for UK bills by UK households

$B_{£d}^{\$}$= Demand for US bills by UK households

$B_{\$d}^{\$}$= Demand for US bills by US households

$B_{\$d}^{£}$= Demand for UK bills by US households

$H_{h}^{£}$ = Money held by UK households

$H_{h}^{\$}$ = Money held by US households

$H_{s}^{£}$ = UK money supply

$H_{s}^{\$}$ = US money supply

$B_{cb£s}^{£}$ = UK bills held by UK central bank

$B_{cb\$s}^{\$}$ = US bills held by US central bank

$B_{cb£d}^{£}$ = Demand for UK bills by UK central bank

$B_{cb\$d}^{\$}$ = Demand for US bills by US central bank

$B_{cb£d}^{\$}$ = Demand for US bills by UK central bank

Exogenous variables

$G^{£}$ = UK pure government expenditure (nominal terms)

$G^{\$}$ = US pure government expenditure (nominal terms)

$W^{£}$ = Wage rate in UK

$W^{\$}$ = Wage rate in US

$r^{£}$ = Interest rate on UK bills

$r^{\$}$ = Interest rate on US bills

$or^{£}$ = UK gold reserves

$or^{\$}$ = US gold reserves

$p_g^{\$}$ = Price of gold in US

$B_{cb£s}^{\$}$ = US bills held by UK central bank

Model Parameters

$\theta^{£}$ = UK Tax rate

$\theta^{\$}$ = US Tax rate

v_0 = First parameter of UK import prices equation

v_1 = Second parameter of UK import prices equation

u_0 = First parameter of UK export prices equation

u_1 = Second parameter of UK export prices equation

ε_0 = Constant of the UK export equation

ε_1= Elasticity of UK exports with respect to US import prices relative to prices of made in USA goods

ε_2 = Elasticity of UK export with respect to US output

μ_0 = Constant of UK import equation

μ_1 = Elasticity of UK imports with respect to UK import prices relative to prices of made in Britain goods

μ_2 = Elasticity of UK import with respect to UK output

$\alpha_1^{£}$ = UK propensity to consume out of income

$\alpha_1^{\$}$ = US propensity to consume out of income

$\alpha_2^{£}$ = UK propensity to consume out of wealth

$\alpha_2^{\$}$ = US propensity to consume out of wealth

$\varphi^{£}$ = Mark-up on unit cost in UK

$\varphi^{\$}$ = Mark-up on unit cost in US

λ_{ij}= Portfolio equations parameters

$prbase$ = Constant of productivity equations

sm = Smith parameter of productivity equations

Equations

$$YD_r^{£} = Y^{£} + r_{-1}^{£} B_{£s-1}^{£} + r_{-1}^{\$} B_{£s-1}^{\$} xr^{\$} - T^{\$}$$

$$YD_{hs}^{£} = YD_r^{£} + \left(\Delta xr^{\$}\right) B_{£s-1}^{\$}$$

$$\Delta V^{£} = (YD_r^{£} - C^{£}) + \left(\Delta xr^{\$}\right) B_{£s-1}^{\$}$$

$$YD_r^{\$} = Y^{\$} + r_{-1}^{\$} B_{\$s-1}^{\$} + r_{-1}^{£} B_{\$s-1}^{£} xr^{£} - T^{£}$$

$$YD_{hs}^{\$} = YD_r^{\$} + (\Delta xr^{£}) B_{\$s-1}^{£}$$

$$\Delta V^{\$} = (YD_r^{\$} - C^{\$}) + (\Delta xr^{£}) B_{\$s-1}^{£}$$

$$T^{£} = \theta^{£}(Y^{£} + r_{-1}^{£} B_{£s-1}^{£} + r_{-1}^{\$} B_{£s-1}^{\$} xr^{\$})$$

$$T^{\$} = \theta^{\$}(Y^{\$} + r_{-1}^{\$} B_{\$s-1}^{\$} + r_{-1}^{£} B_{£s-1}^{£} xr^{£})$$

$$F_{cb}^{£} = r_{-1}^{£} B_{cb£s-1}^{£} + r_{-1}^{\$} B_{cb£s-1}^{\$} xr^{\$}$$

$$F_{cb}^{\$} = r_{-1}^{\$} B_{cb\$s-1}^{\$}$$

$$\Delta B_s^{£} = G^{£} - T^{£} + r_{-1}^{£} B_{£s-1}^{£} - F_{cb}^{£}$$

$$\Delta B_s^{\$} = G^{\$} - T^{\$} + r_{-1}^{\$} B_{\$s-1}^{\$} - F_{cb}^{\$}$$

$$CAB^{£} = X^{£} - IM^{£} + r_{-1}^{\$} B_{£s-1}^{\$} xr^{\$} - r_{-1}^{£} B_{\$s-1}^{£} + r_{-1}^{\$} B_{cb£s-1}^{\$} xr^{\$}$$

$$CAB^{\$} = X^{\$} - IM^{\$} + r_{-1}^{£} B_{\$s-1}^{£} xr^{£} - r_{-1}^{\$} B_{£s-1}^{\$} - r_{-1}^{\$} B_{cb£s-1}^{\$}$$

$$CABOSA^{£} = \Delta B_{\$s}^{£} - \Delta B_{£s}^{\$} xr^{\$} - \{\Delta B_{cb£s-1}^{\$} xr^{\$} + \Delta or^{£} p_g^{£}\}$$

$$CABOSA^{\$} = \Delta B^{\$}_{£s} - \Delta B^{£}_{\$s} xr^{£} - \{\Delta or^{\$} p^{\$}_{g}\}$$

$$\boldsymbol{p^{£}_{m}} = \upsilon_0 - \upsilon_1 * \boldsymbol{xr^{£}} + (1 - \upsilon_1)\boldsymbol{p^{£}_{madeUK}} + \upsilon_1 \boldsymbol{p^{\$}_{madeUS}} \quad 0 < \upsilon_1 < 1 \qquad (3.11)$$

$$\boldsymbol{p^{£}_{x}} = u_0 - u_1 * \boldsymbol{xr^{£}} + (1 - u_1)\boldsymbol{p^{£}_{madeUK}} + u_1 \boldsymbol{p^{\$}_{madeUS}} \quad 0 < u_1 < 1 \qquad (3.12)$$

$$\boldsymbol{x^{£}} = \varepsilon_0 - \varepsilon_1\left(\boldsymbol{p^{\$}_{m-1}} - \boldsymbol{p^{\$}_{madeUS-1}}\right) + \varepsilon_2 \boldsymbol{y^{\$}} \quad (3.13)$$

$$\boldsymbol{im^{£}} = \mu_0 - \mu_1\left(\boldsymbol{p^{£}_{m-1}} - \boldsymbol{p^{£}_{madeUK-1}}\right) + \mu_2 \boldsymbol{y^{£}} \qquad (3.14)$$

$$p^{\$}_{x} = p^{£}_{m} * xr^{£}$$

$$p^{\$}_{m} = p^{£}_{x} * xr^{£}$$

$$x^{\$} = im^{£}$$

$$im^{\$} = x^{£}$$

$$X^{£} = x^{£} p^{£}_{x}$$

$$X^{\$} = x^{\$} p^{\$}_{x}$$

$$IM^{£} = im^{£} p^{£}_{m}$$

$$IM^{\$} = im^{\$} p^{\$}_{m}$$

$$\upsilon^{£} = \frac{V^{£}}{p^{£}_{ds}}$$

$$\upsilon^{\$} = \frac{V^{\$}}{p^{\$}_{ds}}$$

$$yd_{hs}^{£} = \frac{YD_r^{£}}{p_{ds}^{£}} - \Delta p_{ds}^{£}\frac{V_{-1}^{£}}{p_{ds}^{£}} + \frac{\Delta xr^{\$}B_{£s-1}^{\$}}{p_{ds}^{£}} = \frac{YD_{hs}^{£}}{p_{ds}^{£}} - \Delta p_{ds}^{£}\frac{V_{-1}^{£}}{p_{ds}^{£}} \quad (3.4)$$

$$yd_{hs}^{\$} = \frac{YD_r^{\$}}{p_{ds}^{\$}} - \Delta p_{ds}^{\$}\frac{V_{-1}^{\$}}{p_{ds}^{\$}} + \frac{\Delta xr^{£}B_{\$s-1}^{£}}{p_{ds}^{\$}} = \frac{YD_{hs}^{\$}}{p_{ds}^{\$}} - \Delta p_{ds}^{\$}\frac{V_{-1}^{\$}}{p_{ds}^{\$}} \quad (3.5)$$

$$c^{£} = \alpha_1^{£} yd_{hse}^{£} + \alpha_2^{£} v_{-1}^{£}$$

$$c^{\$} = \alpha_1^{\$} yd_{hse}^{\$} + \alpha_2^{\$} v_{-1}^{\$}$$

$$yd_{hse}^{£} = \frac{(yd_{hs}^{£} + yd_{hs-1}^{£})}{2}$$

$$yd_{hse}^{\$} = \frac{(yd_{hs}^{\$} + yd_{hs-1}^{\$})}{2}$$

$$s^{£} = c^{£} + g^{£} + x^{£}$$

$$s^{\$} = c^{\$} + g^{\$} + x^{\$}$$

$$S^{£} = s^{£} p_s^{£}$$

$$S^{\$} = s^{\$} p_s^{\$}$$

$$p_{madeUK}^{£} = (1 + \varphi^{£})UC^{£} = (1 + \varphi^{£})\frac{W^{£}N^{£}}{y^{£}} = (1 + \varphi^{£})\frac{W^{£}N^{£}}{s^{£} - im^{\$}} \quad (3.8)$$

$$p_{madeUS}^{\$} = (1 + \varphi^{\$})UC^{\$} = (1 + \varphi^{\$})\frac{W^{\$}N^{\$}}{y^{\$}} = (1 + \varphi^{\$})\frac{W^{\$}N^{\$}}{s^{\$} - im^{\$}} \quad (3.15)$$

$$p_s^{£} = p_{madeUK}^{£} * \frac{s^{£} - im^{£} - x^{£}}{s^{£}} + p_m^{£} * \frac{im^{£}}{s^{£}} + p_x^{£} * \frac{x^{£}}{s^{£}} \quad (3.10)$$

$$p_s^{\$} = p_{madeUS}^{\$}\frac{s^{\$} - im^{\$} - x^{\$}}{s^{\$}} + p_m^{\$}\frac{im^{\$}}{s^{\$}} + p_x^{\$}\frac{x^{\$}}{s^{\$}} \quad (3.16)$$

$$DS^{£} = S^{£} - X^{£}$$

$$DS^{\$} = S^{\$} - X^{\$}$$

$$ds^{£} = s^{£} - x^{£}$$

$$ds^{\$} = s^{\$} - x^{\$}$$

$$Y^{£} = S^{£} + IM^{£}$$

$$Y^{\$} = S^{\$} + IM^{\$}$$

$$y^{£} = s^{£} + im^{£}$$

$$y^{\$} = s^{\$} + im^{\$}$$

$$C^{£} = c^{£} p_{ds}^{£}$$

$$C^{\$} = c^{\$} p_{ds}^{\$}$$

$$G^{£} = g^{£} p_{ds}^{£}$$

$$G^{\$} = g^{\$} p_{ds}^{\$}$$

$$N^{£} = \frac{y^{£}}{pr^{£}}$$

$$N^{\$} = \frac{y^{\$}}{pr^{\$}}$$

$$pr^{£} = prbase + sm * y^{£} \quad (3.17)$$

$$pr^{\$} = prbase + sm * y^{\$} \quad (3.18)$$

$$B_{£d}^{£} = V^{£}(\lambda_{10} + \lambda_{11}r^{£} - \lambda_{12}r^{\$})$$

$$B_{£d}^{\$} = V^{£}(\lambda_{20} + \lambda_{21}r^{£} - \lambda_{22}r^{\$})$$

$$B_{\$d}^{\$} = V^{\$}(\lambda_{40} + \lambda_{41}r^{\$} - \lambda_{42}r^{£})$$

$$B_{\$d}^{£} = V^{\$}(\lambda_{50} + \lambda_{51}r^{\$} - \lambda_{52}r^{£})$$

$$H_{h}^{£} = V^{£} - B_{£s}^{£} - B_{£s}^{\$}xr^{\$} \quad (3.6)$$

$$H_{h}^{\$} = V^{\$} - B_{\$s}^{\$} - B_{\$S}^{£}xr^{£} \quad (3.7)$$

$$H_{s}^{£} = H_{h}^{£}$$

$$B_{£s}^{£} = B_{£d}^{£}$$

$$B_{cb£s}^{£} = B_{cb£d}^{£}$$

$$H_{s}^{\$} = H_{h}^{£}$$

$$B_{\$s}^{\$} = B_{\$d}^{\$}$$

$$B_{cb\$s}^{\$} = B_{cb\$d}^{\$}$$

$$\Delta B_{cb£d}^{£} = \Delta H_{s}^{£} - \Delta B_{cb£s}^{£} - \Delta or^{£}p_{g}^{£}$$

$$B_{cb£d}^{\$} = H_{s}^{\$} - or^{\$}p_{g}^{\$}$$

$$p_{g}^{£} = p_{g}^{\$}xr^{\$}$$

$$xr^{\$} = \frac{1}{xr^{£}}$$

$$B_{\$s}^{£} = B_{\$d}^{£} xr^{\$}$$

$$B_{cb£d}^{\$} = B_{cb£s}^{\$} xr^{\$}$$

$$xr^{£} = \frac{B_{£s}^{\$}}{B_{£d}^{\$}}$$

$$B_{£s}^{\$} = B_{s}^{\$} - B_{\$s}^{\$} - B_{cb\$s}^{\$} - B_{cb£s}^{\$}$$

(redundant equation:

$B_{cb£s}^{£} = B_{s}^{£} - B_{£s}^{£} - B_{\$s}^{£}$)

Initial values of stocks

$B_{cb£s}^{£}$ = 0.3271126

$B_{cb£d}^{£}$ = 0.3271126

$B_{cb£d}^{\$}$ = 0.02031

$B_{£d}^{£}$= 102.8436

$B_{£d}^{\$}$= 36.73843

$B_{\$d}^{\$}$= 102.8532

$B_{\$d}^{£}$= 36.733289

$B_{£s}^{£}$ = 102.8436

$B_{£s}^{\$}$ = 36.73843

$B_{\$s}^{\$}$ = 102.8532

$B_{\$s}^{£}$ = 36.733289

$B_{cb\$s}^{\$}$ = 0.3455884

$B_{cb\$d}^{\$}$ = 0.3455884

$H_{s}^{£}$ = 7.345973

$H_{h}^{£}$ = 7.345973

$H_{s}^{\$}$ = 7.346658

$H_h^{\$}$ = 7.346658

$B_s^{£}$ = 139.8939

$B_s^{\$}$ = 139.9575

$V^{£}$ = 146.9195

$V^{\$}$ = 146.9195

$v^{£}$ = 152.6205

$v^{\$}$ = 152.6356

Initial values for lagged endogenous variables

$xr^{£}$ = 1.000233

$xr^{\$}$ = 0.9997667

$p_m^{£}$= 0.9624716

$p_x^{£}$= 0.9625255

$p_m^{\$}$= 0.9627501

$p_x^{\$}$= 0.9626961

$p_{madeUK}^{£}$ = 0.9626701

$p_{madeUS}^{\$}$ = 0.9626248

$p_{ds}^{£}$ = 0.9626458

$p_{ds}^{\$}$ = 0.9626401

$yd_{hs}^{£}$ = 81.39556

$yd_{hs}^{\$}$ = 81.40363000000001

Initial values for exogenous variables

$G^{£}$ = 16

$G^{£}$ = 16

$W^{£}$ = 1

$W^{\$}$ = 1

$r^{£}$ = 0.03

$r^{\$}$ = 0.03

$or^{£}$ = 7

$or^{\$}$ = 7

$p_g^{\$}$ = 1

$B_{cb£s}^{\$}$ = 0.02031

Model's parameters

$\theta^{£}$ = 0.2

$\theta^{\$}$ = 0.2

ε_0 = -2.1

ε_1= 0.7

ε_2 = 1

μ_0 = -2.1

μ_1 = 0.7

μ_2 = 1

$\alpha_1^{£}$ = 0.75

$\alpha_1^{\$}$ = 0.75

$\alpha_2^{£}$ = 0.13333

$\alpha_2^{\$}$ = 0.13333

λ_{10}= 0.7

λ_{11}= 5

λ_{12}= 5

λ_{20}= 0.25

λ_{21}= 5

λ_{22}= 5

λ_{40}= 0.7

λ_{41}= 5

λ_{42}= 5

λ_{50}= 0.25

λ_{51}= 5

λ_{52}= 5

v_0 = - 0.00001

v_1 = 0.7

u_0 = - 0.00001

u_1 = 0.5

$\varphi^{£}$ = 0.2381

$\varphi^{\$}$ = 0.2381

$prbase$ = 0.750442905

sm = 0.0055

APPENDIX II: SENSITIVITY TEST EXPERIMENT 1

Experiment 1: drop in UK GDP 5 periods after the shock				
Model	alpha1_uk = 0.77 alpha1_us = 0.77	alpha2_uk = 0.14 alpha2_us = 0.14	eps1= 0.9 mu1 = 0.9	nu1m = 0.8 nu1x = 0.4
OPENPROD	-2.91%	-2.39%	-1.34%	-1.53%
OPENFLEX	-2.49%	-1.97%	-1.04%	-1.20%

CHAPTER 4: A NEW SIMPLE TOOL TO TEST INEQUALITY AND FINANCIALISATION IN A SFC OPEN ECONOMY FRAMEWORK

"All models are wrong, but some are useful".

George Box, Robustness in the strategy of scientific model building, 1979

4.1 INTRODUCTION

As it has been noticed in chapter 1, after the outbreak of the financial crisis in 2007/2008 the research in macroeconomics has somehow broadened its scope. Among the "hundred intellectual flowers" that have been blooming (Blanchard 2015), the relationship between inequality and 'financialization' has attracted more and more attention both from the general public and within the economists' community.

Stock-flow Consistent models have been widely used on the frontier of this 'post-crisis' strand of research, which has also seen the re-discovery of 'old' theories – for instance, the relative income hypothesis of James Duesenberry (1949) – and their application to new problems and contexts.

Most of these studies tend to be focused on single countries or on groups of countries *considered individually.* In the case of macro models developed within the Stock-Flow Consistent methodology pioneered by Godley and Lavoie (2007 b), this preference for a 'closed economy' approach has a strong justification from a practical point of view. A SFC model keeps track not only of the movements in the flows of money (and goods), but also of their relationships with the stocks of assets that characterise an economic system. Modelling the 'external world' in a rigorous sense means finding the same network of relationship between flows and stocks outside the country of interest, and finding how this network can affect the economic dynamics *inside* the country of interest. The 'opening' of a closed SFC model may entail the doubling of its number of equations, and the task is proportionally more challenging if the modeller aims to build a three (or more)-

country open economy model. When a SFC model features some very complicated mechanisms that try to capture pretty complex economic phenomenon – like, for instance, the operation of the new financial products behind the last cycle of financialization – it can be challenging to devise the representation of the external world too. The risk is that of building a cumbersome system, where the 'causal relationships' between the variables are somehow opaque: even when the model is in its steady state and it is 'exogenously shocked', it can become hard to identify the main drivers of an outcome.

The SFC 'basic' open economy model (OPENSIME) developed in this chapter is a first step to address the problems mentioned above. Thanks to its simplicity and flexibility, it can find several applications in the study of complex issues as the relationship between financialization and inequality. The OPENSIME model economises the number of the equations that are necessary to replicate the results of the open economy SFC benchmark (the OPENFLEX model form chapter 12 of Godley and Lavoie 2007 b). Also, it includes an alternative closure for a flexible exchange rate regime based on a more transparent use of the balance of payments accounting.

The advantages of having a reduced form of an open-economy-flexible-exchange-rate benchmark model should be quite evident: if different series of 'theoretical building blocks' can be easily added to its structure, the model can represent the starting point to move from the 'close' to the 'open' economy context via a simple process of gradually embedding more and more modules initially developed for a single country.

Indeed, the second part of the chapter will be focused on the attempt to build on the basic OPENSIME model in order to test its ductility. Three building blocks will be used to show how the relationship between inequality and financialization can be treated within this new framework: 1. Households will be divided into two groups along the threshold of the median income. In a two-country model this obviously results in a total of four different 'agents' that exercise the consumption function (hence the name of the model OPENTWOFOUR); 2. Two different patterns of consumption will be modelled, one for the more affluent portion of the population and one for the poorer. An emulative behaviour can characterise the latter in line with the relative income hypothesis; 3. The possibility for the poor to (partially) mimic the consumption pattern of the rich rests on access to loans. Therefore, a whole new sector of the economy will be introduced in the benchmark model: the financial sector, where commercial banks create money[98] and supply loans to households that want to consume more than their income and collect saving from all kind of households in the form of bank deposits. Banks can invest in government bonds too.

The literature review featured at the beginning of the second part of the chapter will show that a significant amount of research has already been devoted to these themes. The work proposed here aims to contribute to this debate with a more 'methodological' approach: the computer simulations conducted with the new models are mostly a way to test *tools* whereby these topics can be addressed.

The economies of the nations of the world *are open*, and their interactions with *the outside* are of enormous importance not only for the pace of their growth, but also for its quality, first of all from the point of view of the distribution of its benefits. Likewise, it is not possible to study the financial sector and its impact on the productive system without considering its global nature, especially in an era of almost complete free movement of capitals.

If it is added to these elements one of the core principles of the SFC approach – namely that *stocks matter* – it becomes evident why the development of a flexible and efficient SFC open economy model can provide valuable help to study crucial themes like the relationship between financialization and inequality.

4.2 AN ALTERNATIVE CLOSURE FOR THE OPEN ECONOMY MODEL: THE OPENSIME MODEL

The origins of the SFC methodology and the role played by James Tobin and the so-called 'New Haven School' have already been reconstructed in chapter 3 of this thesis. Tobin brought "to life"[99] the work of Morris A. Copeland (1949) on the flow

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[98] Post-Keynesian Stock-Flow Consistent models endorse the endogenous money theory (Kaldor 1970, Graziani 2003). However, here, it has been chosen not to dwell on the theoretical background of this feature of the model. As Lavoie put it: "While a considerable amount of space was devoted in the past to arguments and statements supporting the claim of money supply endogeneity, this is no longer required. First, many central banks have changed the way they implement monetary policy" and "their behaviour is now much more transparent". Second, even within 'orthodox' and 'mainstream' economics, "the more advanced macroeconomic models do make room for endogenous money" (Lavoie 2014, p. 183).

[99] These are the words used by Tobin himself when he described the task of the theory with regard to the flow of funds account: "to bring the columns to life by functions relating sectorial portfolio and saving

of funds account and many of the theoretical features of the New Haven approach are still part of contemporary SFC macro modelling.

The legacy of this methodology was continued by the Cambridge Economic Policy Group, led by Wynne Godley. However, there are essential differences between the theoretical framework shared by the neo-Keynesian 'New Heaven School' and contemporary Post-Keynesian SFC modelling pioneered by Godley. The core of the gap is not adequately captured by the method, but by the way whereby the relationships between the main variables of an economic system are modelled.

In the introduction of their "Monetary Economics" (2007 b) Godley and Lavoie wrote:

> "agreement on the method does not preclude disagreement on the model. While it is crucial to have coherent accounting and stock-flow consistency, the behaviour of the model and its results depend as well on the *closure* and the *causality* of the model, that is, on the behavioural equations that will be associated with the accounting equations. More precisely, as defined by Lance Taylor (1991: 41): 'Formally, prescribing closure boils down to stating which variables are endogenous or exogenous in an equation system largely based upon macroeconomic accounting identities, and figuring out how they influence one another... A sense of institutions and history necessarily enters into any serious discussion of macro causality'" (Godley and Lavoie 2007 b, p. 15).

That is why the closures of the models are so important. Far from being a way to simply find out the right number of equations necessary for a given number of unknowns, the closure is – together with a handful of behavioural equations – the real 'soul' of a Stock-Flow Consistent model.

The open economy model with flexible exchange rate presented in Godley and Lavoie 2007 b (chapter 12) constitutes the "centre of gravity of the open economy SFC literature" (Nikiforos and Zezza 2017, p. 1220) also because it has supplied the closure mechanism to several subsequent SFC open economy models with flexible exchange rate (e.g. Lavoie and Zhao 2010, Lavoie and Daigle 2011, Mazier and Tiou-Tagba Aliti 2012, Mazier and Valdecantos 2015).

This model, the so-called OPENFLEX model, has been already analysed in chapter 3, together with its transactions flow matrix and its balance sheet matrix. In that

decisions to relevant variables, and to bring the rows to life as a set of simultaneous market-clearing equations" (Tobin 1982, p. 16).

occasion, the closure of the model in a flexible exchange regime did not receive too much attention since – like in the papers just mentioned – the whole mechanism was simply 'borrowed'. As far as the *results* it carried out were reasonable, the *tool* whereby those results were obtained was not questioned.

However, that mechanism is not very 'transparent'. Let us remember the equation that sets the exchange rate of one of the two countries of the model (the other follows as the inverse of this one):

$$xr^{£} = \frac{B^{\$}_{£s}}{B^{\$}_{£d}} \quad \text{(OPENFLEX 12.89FL)}$$

The pound exchange rate is given as the ratio of the supply of US bills to UK households and the demand of US bills by UK households. Godley and Lavoie firstly presented this closure in a paper published in 2003, where the logic of the mechanism was explained. It is worth to report the entire paragraph because it gives a good idea of the implicit mechanisms which are 'at work' behind that equation. No similar description is presented in Godley and Lavoie 2007 b.

"The endogeneity of the exchange rate only finds itself (only can find itself) expressed in one single equation. But when the whole model is solved as a completely interdependent system, the effect works its way round so that the supply and demand for all assets are all brought into equivalence at (and by) the new exchange rate. What is happening (supposing there has been a spontaneous rise in UK imports) is that the private income and budget flows are immediately affected. The UK has a higher budget deficit; the US has a lower deficit, the UK has a current account deficit, the US has a balance of payments surplus. The net change in the supply of foreign assets causes sterling to fall in order to clear the market in all assets simultaneously.

But the dynamic response of the system as a whole is only just beginning. For as long as the balance of payments is non-zero this must be generating a change in the net supply of foreign denominated assets in each country causing a further change in the exchange rate. When exchange rates change, the absolute and relative prices of exports and imports all change; so trade volumes and values, income flows and accumulations of wealth all change. A train of sequences ensues – and continues until the balance of payments and all changes in stock variables revert to zero" (Godley and Lavoie 2003, p. 24)

As it is evident, the mechanism that leads to a balance of payments equilibrium is rather complicated. Most of all, it is not immediately evident from the equations of the model.

The two-country open economy SFC model presented here reverses the logic of the closure of the OPENFLEX model in order to provide a more transparent narrative for the dynamic of the exchange rate.

When a currency is allowed to float, its value – its price – is determined by the supply and the demand for that currency in the foreign exchange market. Many factors can affect this market, and these factors are ultimately mirrored in the balance of payments. Therefore, the new approach sets the balance of payments at the centre of the closure mechanism. The role played by the trade of goods and financial assets at the international level in the determination of the exchange rate is recognised *explicitly*.

To unburden the model of any other complication which is not essential to the object of interest, prices are assumed to be fixed, like in the famous IS-LM model and in its international economics version, the IS-LM-BP model, or the Mundell-Fleming model (Mundell 1960, 1961 a and 1961 b and 1963, Fleming 1962, see chapter 2).

The result is a straightforward model made of 36 equations: the OPENSIME model. In the following section, the explanation of the main economic assumptions behind the more critic relationships captured by the OPENSIME model will be given together with the corresponding block of equations.

4.2.1 The equations of the OPENSIME model

The OPENSIME model is a two-country model. The countries will be called the US and the UK to keep the same names and symbols used by Godley and Lavoie in chapter 12 of "Monetary Economics" and facilitate the comparison.

The model works in a 'pure' flexible exchange rate regime. This means that the central banks do not intervene to stabilise – or to influence – the value[100] of the currency they issue. Thus, international reserves – which are assumed to be fixed in a 'pure' flexible exchange rate regime – are not even modelled as assets held by the central banks. For this reason, it is virtually irrelevant that one of the two currencies is the American dollar, that is to say, the main reserve currency held by monetary institutions all over the world. Besides, no gold is detained by the central banks of

[100] Of course, the value of a currency must be interpreted as a value *against* another currency: in other words, the exchange rate against a foreign currency.

the OPENSIME model (in the OPENFLEX model gold was modelled, by in practice it was 'silenced' and played no role even in the fixed exchange regime).

As in the OPENFLEX model, in the OPENSIME model "there is no domestic or foreign investment in fixed or working capital, firms do not hold financial assets, there is no endogenous wage inflation, there are no commercial banks or credit money" (Godley and Lavoie 2007 b, p. 446).

The balance sheet and the transaction flow matrices follow the same accounting rules and principles presented in Godley and Lavoie 2007 b.

Table 4.1: OPENSIME balance sheet matrix

	UK Households	UK Firms	UK Government	UK Central Bank		US Households	US Firms	US Government	US Central Bank	Sum
	all in £				Ex. rate	all in $				
Money	$+H^{£}$			$-H^{£}$		$+H^{\$}$			$-H^{\$}$	0
£ Bills	$+B_{£}^{£}$			$+B_{cb£}^{£}$	$xr^{£}$	$+B_{\$}^{£}\, xr^{£}$				0
$ Bills	$+B_{£}^{\$}\, xr^{\$}$		$-B^{£}$		$xr^{£}$	$+B_{\$}^{\$}$		$-B^{\$}$	$+B_{cb\$}^{\$}$	0
Balance	$-V^{£}$		$-NW_g^{£}$		$xr^{£}$	$-V^{\$}$		$-NW_g^{£}$		0
Sum	0		0	0	$xr^{£}$	0		0	0	0

Table 4.2: OPENSIME Transactions-Flow Matrix

	UK House.	UK Firms	UK Gov.	UK C.B.		US House.	US Firms	US Gov.	US C. B.	Sum
	all in £				Exch. rate	all in $				
Consumption	$-C^{£}$	$+C^{£}$				$-C^{\$}$	$+C^{\$}$			0
Gov. Expend.		$+G^{£}$	$-G^{£}$				$+G^{\$}$	$-G^{\$}$		0
Trade		$-IM^{£}$			$xr^{£}$		$-IM^{\$}$			0
		$+X^{£}$			$xr^{£}$		$+X^{\$}$			0
GDP/Income	$+Y^{£}$	$-Y^{£}$				$+Y^{£}$	$-Y^{\$}$			0
Taxes	$-T^{£}$		$+T^{£}$			$-T^{\$}$		$+T^{\$}$		0
Interes paym.	$+r^{£}B^{£}_{£}$		$-r^{£}B^{£}$	$+r^{£}B^{£}_{cb£}$	$xr^{£}$	$+r^{\$}B^{\$}_{\$}xr^{\$}$				0
	$+r^{\$}B^{\$}_{\$}xr^{\$}$			$+r^{\$}B^{\$}_{cb£}xr^{\$}$	$xr^{£}$	$+r^{\$}B^{\$}_{\$}$		$-r^{\$}B^{\$}$	$+r^{\$}B^{\$}_{cb\$}$	0
CB profits			$+F^{£}_{cb}$	$-F^{£}_{cb}$				$+F^{\$}_{cb}$	$-F^{\$}_{cb}$	0
Flows of funds (changes in assets)										
Money	$-\Delta H^{£}$			$+\Delta H^{£}$		$-\Delta H^{\$}$			$-\Delta H^{\$}$	0
£ Bills	$-\Delta B^{£}_{£}$		$+\Delta B^{£}$	$-\Delta B^{£}_{cb£}$	$xr^{£}$	$-\Delta B^{£}_{\$}\, xr^{£}$				0
$ Bills	$-\Delta B^{\$}_{£}\, xr^{\$}$				$xr^{£}$	$-\Delta B^{\$}_{\$}$		$+\Delta B^{\$}$	$-\Delta B^{\$}_{cb\$}$	0
Sum	0	0	0	0		0		0	0	0

Income and wealth

The first building block of the OPENSIME model includes the equations of income and wealth of British and American households. The explanation will be focused on the British side, as the American side follows symmetrically.

$$YD_r^{£} = Y^{£} + r_{-1}^{£}B_{£s-1}^{£} + r_{-1}^{\$}B_{£s-1}^{\$}xr^{\$} - T^{\$} \quad (4.1)$$

Disposable income of British households is made of UK total factor income $Y^{£}$ and the interests from British and American bills held by UK households as savers ($B_{£s-1}^{£}$and $B_{£s-1}^{\$}$), minus taxes ($T^{\$}$). Haig-Simons disposable income ($YD_{hs}^{£}$) is derived by the disposable income plus capital gains (capital losses), which in this model are brought about by the revaluation (devaluation) of foreign bills caused by the appreciation (depreciation) of the foreign currency in which foreign bills are denominated. In turn, the accumulation of wealth by British households ($\Delta V^{£}$) is given by the saving of each period out of Haig-Simons disposable income (where $C^{£}$ stands for UK consumption).

$$YD_{hs}^{£} = YD_r^{£} + \left(\Delta xr^{\$}\right)B_{£s-1}^{\$} \quad (4.2)$$

$$\Delta V^{£} = YD_{hs}^{£} - C^{£} \quad (4.3)$$

The analogous equations for the US are:

$$YD_r^{\$} = Y^{\$} + r_{-1}^{\$}B_{\$s-1}^{\$} + r_{-1}^{£}B_{\$s-1}^{£}xr^{£} - T^{£} \quad (4.4)$$

$$YD_{hs}^{\$} = YD_r^{\$} + (\Delta xr^{£})B_{\$s-1}^{£} \quad (4.5)$$

$$\Delta V^{\$} = YD_{hs}^{\$} - C^{\$} \quad (4.6)$$

Taxes are given as a simple share ($\theta^{£}$) of the disposable income:

$$T^{£} = \theta^{£}(Y^{£} + r_{-1}^{£}B_{£s-1}^{£} + r_{-1}^{\$}B_{£s-1}^{\$}xr^{\$}) \quad (4.7)$$

$$T^{\$} = \theta^{\$}(Y^{\$} + r^{\$}_{-1}B^{\$}_{\$s-1} + r^{£}_{-1}B^{£}_{£s-1}xr^{£}) \quad (4.8)$$

UK total factor income equals the aggregate demand of the economy: consumption, plus an exogenous public expenditure ($G^{£}$), plus trade balance (export, $X^{£}$, minus import, $IM^{£}$). The OPENSIME follows the so-called Keynesian, or Kaleckian, quantity adjustment mechanism: "production is the flexible element of the model. Producers produce exactly what is demanded" (Godley and Lavoie 2007 b, p. 65).

$$Y^{£} = C^{£} + G^{£} + X^{£} - IM^{£} \quad (4.9)$$

$$Y^{\$} = C^{\$} + G^{\$} + X^{\$} - IM^{\$} \quad (4.10)$$

Finally, UK consumption is determined – as in most of SFC models – by the so-called Modigliani consumption function, which attaches a propensity to consume to both the Haig-Simons disposable income ($\alpha^{£}_{1}$) and to the accumulated wealth ($\alpha^{£}_{2}$):

$$C^{£} = \alpha^{£}_{1}YD^{£}_{hs} + \alpha^{£}_{2}V^{£}_{-1} \quad (4.11)$$

$$C^{\$} = \alpha^{\$}_{1}YD^{\$}_{hs} + \alpha^{\$}_{2}V^{\$}_{-1} \quad (4.12)$$

Trade

In a context of fixed prices, nominal values correspond to real values. The equations of import and export in the OPENSIME model are much simplified in comparison with the ones featured in the OPENFLEX model. UK (nominal and real) export is a function of the pound exchange rate ($xr^{£}$; in the following formulas bold characters denote natural logarithm of the variables) and US total factor income ($Y^{\$}$). Given that the exchange rate is quoted in indirect terms (dollar units per 1 pound), when the UK currency appreciates (higher $xr^{£}$), British goods become more expensive for American consumers and this hinders British export (this is the reason of the minus sign of the ε_1 parameter). By contrast, when US income rises, American consumers spend more and import more British goods, boosting UK export.

$$\boldsymbol{X}^{£} = \varepsilon_0 - \varepsilon_1 \boldsymbol{xr}^{£}_{-1} + \varepsilon_2 \boldsymbol{Y}^{\$} \quad (4.13)$$

UK import follows the same principles. When their currency is stronger, British consumers buy more American goods. Likewise, when their income rises they spend more and import more foreign goods.

$$\boldsymbol{IM}^{£} = \mu_0 + \mu_1 \boldsymbol{xr}^{£}_{-1} + \mu_2 \boldsymbol{Y}^{£} \quad (4.14)$$

The exchange rate is lagged in both import and export equations in order to account for the delay in the response of consumers to a change in the exchange rate. Indeed, import and export orders are usually placed well in advanced. This is the international trade time structure behind the famous J-Curve, which shows a worsening of the current account balance after a depreciation of the currency[101]. American export and import are just the 'other side' of the UK's trade flows (adjusted by the exchange rate, since their original values are expressed in pounds):

$$X^{\$} = IM^{£} xr^{£} \quad (4.15)$$

$$IM^{\$} = X^{£} xr^{£} \quad (4.16)$$

Asset demand and supply

The equations of asset demand are set following the principles of Tobin's portfolio model (Tobin 1969), one of the pillars of SFC macro models as already explained in chapter 3. However, in the simplified context of the OPENSIME model, UK households demand of domestic ($B^{£}_{£d}$) and foreign bills ($B^{\$}_{£d}$) are only functions of the rates of return (interest rates) of these assets.

[101] For the sake of simplicity and to keep the analogy with the OPENFLEX model the income variable is not lagged (the lag would have created problems when the model is initially run with all starting values at 0 except the exchange rate: the natural log of 0 is undefined). However, the total factor income does not include the capital gains/loss linked to the depreciation/appreciation of the domestic currency. Therefore, it is quite isolated from the shock which is affecting the currency in the same period.

$$B_{£d}^{£} = V^{£}(\lambda_{10} + \lambda_{11} r^{£} - \lambda_{12} r^{\$}) \quad (4.17)$$

$$B_{£d}^{\$} = V^{£}(\lambda_{20} - \lambda_{21} r^{£} + \lambda_{22} r^{\$}) \quad (4.18)$$

It is worthwhile to notice three features of these equations: 1. When the wealth of the households ($V^{£}$) is on the right-hand side, the dependent variable is given by the absolute value of the demand of an asset rather than its percentage on the total value of wealth; 2. The demand for an asset in open economy SFC models is always expressed in local currency (whereas its supply is expressed in the currency in which that asset is denominated). 3. The parameters λ related to interest rates have to respect the 'horizontal constraints' stated by Godley (1996) to guarantee the logical consistency of portfolio choices; by contrast, Tobin's 'vertical constraints' can be assumed as respected by default given the fact that one of the asset – money – is set as a residual variable.

US portfolio equations are established precisely in the same way:

$$B_{\$d}^{\$} = V^{\$}(\lambda_{40} + \lambda_{41} r^{\$} - \lambda_{42} r^{£}) \quad (4.19)$$

$$B_{\$d}^{£} = V^{\$}(\lambda_{50} - \lambda_{51} r^{\$} + \lambda_{52} r^{£}) \quad (4.20)$$

As just anticipated, money held by UK households ($H_{h}^{£}$) is obtained as a residual variable: the wealth which is not invested in financial assets is kept in the form of cash. Money can be held in domestic currency only[102]. Of course, it was possible to define an equation for cash similar to the ones of the other assets[103]. However, the residual form allows preventing problems related with the approximation in the calculus when the model is run: any 'loss' of wealth due to the approximation would imply a leakage in the Stock-Flow Consistent model that is supposed to be 'watertight'.

[102] Far from being just a convenient assumption, this is a quite realistic feature that is part of the standard structure of open economy SFC models. Indeed, whereas it is absolutely normal for households to own foreign assets, perhaps via mutual or pension funds, foreign currency is usually held in minimal quantity in the occasion of travels abroad. Foreign currency bank accounts are very rare too.

[103] The possibility for this complete symmetry to be given rests also on the fact that money has actually its own 'rate of return', which is assumed to be zero in the OPENSIME model.

Therefore, the equations of money held by the UK and US households are the following:

$$H_h^{£} = V^{£} - B_{£s}^{£} - B_{£s}^{\$}xr^{\$} \quad (4.21)$$

$$H_h^{\$} = V^{\$} - B_{\$s}^{\$} - B_{\$s}^{£}xr^{£} \quad (4.22)$$

Equations 4.21 and 4.22 feature the exchange rates of the two currencies. This is because the variables of domestic and foreign government bills refer to assets actually held by households and not just demanded by them (note the s as subscript instead of the d). The distinction is crucial conceptually, but with limited practical implications at this stage of the presentation of the OPENSIME model, since the supply of assets for the private sector is assumed to follow its demand.
Equations 4.23-4.26 represent the supply of assets consistently with these principles.

$$B_{£s}^{£} = B_{£d}^{£} \quad (4.23)$$

$$B_{£s}^{\$} = B_{£d}^{\$}xr^{£} \quad (4.24)$$

$$B_{\$s}^{\$} = B_{\$d}^{\$} \quad (4.25)$$

$$B_{\$s}^{£} = B_{\$d}^{£}xr^{\$} \quad (4.26)$$

It is essential to draw attention now on equation 4.24. There is no equivalent equation in Godley and Lavoie's closure of the OPENFLEX model. In that model, a 'rearranged' version of this equation sets the level of the pound exchange rate (see equation OPENFLEX 12.89FL shown previously). The closure of the OPENSIME model, by contrast, treats every asset and every country equally, so that there is perfect symmetry in the equations of the asset supply between the UK and the US.

Public Sector

The OPENSIME model assumes that central banks act as lenders of last resort, or "the residual purchaser of bills. Any outstanding bill not purchased by households of both regions [countries in our case] will be purchased by the central bank[s]" (Godley and Lavoie 2007 b, p. 176). The behavioural equations that capture this institutional arrangement "allow us to assume that the central bank set the rate of interest on bills of its choice" (Godley and Lavoie 2007 b, p. 176).

This approach appears particularly realistic in a time when central banks in all major Western countries (FED, BOE, ECB) have unequivocally demonstrated, via the so-called Quantitative Easing, their power to control the whole term structure of interest rates, not only its shortest-term segment. Yet in the OPENFLEX model this role of the central bank is somehow opaque. Indeed, the quotations above come from the open economy model described in chapter 6 of Godley and Lavoie 2007 b. In the model of chapter 12 (OPENFLEX) UK central bank *does act* as lender of last resort, but the equation that captures this behaviour is, in fact, the *redundant equation* behind the model. Equation 12.82A in the book *must be removed* for the model to run if the modeller chooses to keep equation 12.82, which has already set the variable of the supply of UK bills to UK central bank (this is also the solution adopted in the 'official code' of the model[104]).

With respect to the US, in the OPENFLEX model the lender of last resort seems to be… British private sector!

$$B_{£s}^{\$} = B_{s}^{\$} - B_{\$s}^{\$} - B_{cb\$s}^{\$} - B_{cb£s}^{\$} \quad \text{(12.90FL)}$$

In practice, UK households 'are offered' to purchase all the remaining US bills in the system. And the equation of exchange rate makes sure that what is offered ends up to be equal to what is originally demanded. It is true that "when the whole model is solved as a completely interdependent system" (Godley and Lavoie 2003, p. 24) the whole process brings the balance of payments in equilibrium and the dynamic of the exchange rate mirrors this 'itinerary' toward equilibrium. The cat catches the mouse. But it does it… in a 'black box'!

[104] http://gennaro.zezza.it/software/eviews/gl2006.php

A clearer narrative can be offered if the whole mechanism is explicitly 'extracted'. Both central banks act as lenders of last resort. UK bills held by the Bank of England ($B^{£}_{cb£s}$) are the bill issued by the UK Government ($B^{£}_{s}$) and not purchased by households of both countries. The same applies to the US. Of course, central banks pay these bills with the money they create themselves. This is the device whereby liquidity is pumped into the system. Thus the 'supply of money' equals the volume of government bills purchased by both central banks. Still, this does not mean that one of the foremost theoretical assumptions of post-Keynesian SFC models – the endogeneity of money – is breached: money supply depends on bills purchased, but the latter in turn depend on the behaviour of households. As the redundant equations will show later, the supply of money is ultimately driven by its demand. The following equations capture both the role of central banks as lenders of last resort and the supply of money that derives from it:

$$B^{£}_{cb£s} = B^{£}_{s} - B^{£}_{£s} - B^{£}_{\$s} \quad (4.27)$$

$$B^{\$}_{cb\$s} = B^{\$}_{s} - B^{\$}_{£s} - B^{\$}_{\$s} \quad (4.28)$$

$$H^{£}_{s} = B^{£}_{cb£s} \quad (4.29)$$

$$H^{\$}_{s} = B^{\$}_{cb\$s} \quad (4.30)$$

As in most SFC models, central banks give back to the government profits gained from interests on domestic bills held ($F^{£}_{cb}$). The government funds the discrepancy between its gains (taxes plus profits of the central bank) and its expenditure (exogenous government expenditure plus interest paid to bills holders) with the issue of new bills. These four relationships complete the public sector set of equations.

$$F^{£}_{cb} = r^{£}_{-1} B^{£}_{cb£s-1} \quad (4.31)$$

$$F^{\$}_{cb} = r^{\$}_{-1} B^{\$}_{cb\$s-1} \quad (4.32)$$

$$\Delta B_s^{£} = G^{£} - T^{£} + r_{-1}^{£} B_{£s-1}^{£} - F_{cb}^{£} \quad (4.33)$$

$$\Delta B_s^{\$} = G^{\$} - T^{\$} + r_{-1}^{\$} B_{\$s-1}^{\$} - F_{cb}^{\$} \quad (4.34)$$

Exchange rates

Finally, the equation of the exchange rate, which provides the *closure* to the system of the OPENSIME model.

The value of the currency in this model is determined by market forces, as in every flexible exchange rate regime. Let us look at the model – as usual – from the 'point of view' of the United Kingdom. In addition, let us assume that every international payment of a good or an asset must be made in the currency of the country which produced that good or issued that asset.

British current account, $CA^{£}$, is given by the trade balance plus unilateral transfers of income, which in the OPENSIME model are just interests yielded on foreign bills. $CA^{£}$ is expressed in pounds, therefore the entries not denominated in pound must be converted from dollars:

$$CA^{£} = X^{£} - IM^{£} - r_{-1}^{£} B_{\$s-1}^{£} + r_{-1}^{£} B_{£s-1}^{\$} xr^{\$}$$

The formula above has not been numbered as it will not be part of the model: it just represents the first step to find the 'final equation' of the exchange rate.

Even if in the $CA^{£}$ equation everything is expressed in pounds – in order to compare homogenous entries – British households need dollars for their import. They receive part of the dollars they need from the interests that the US government pays to them due to the US bills they hold. Furthermore, they can be confident to 'find' these dollars in the foreign exchange market at the existing exchange rate level as far as US households need pounds to import British good in the US (this import is represented in the $CA^{£}$ equation by the variable $X^{£}$, since it is British *export* from the point of view of the UK). American households receive themselves some pounds from the interests of UK bills they hold, but we can assume they still need other foreign currency for trade. Now, let us assume that the net sum of all these entries in the $CA^{£}$ equation is negative: it means that British households need dollars for

international trade more than American households need pounds. Exchange of currencies at the current exchange rates appears to be impossible at this stage.
However, British households could find the dollars that they need thanks to international transactions of financial assets. The following equation represents the British financial account (expressed in pounds):

$$FA^{£} = \Delta B^{£}_{\$s} - \Delta B^{\$}_{£s} xr^{\$}$$

Again, British households need dollars to buy the US bills they demand[105], but they can rely on the fact that American households need pounds too if they want to buy the UK bills they desire. Let us assume that the net sum of these entries is zero. This means that UK households, *for now*, cannot find the money to 'finance' their current account deficit from their financial account. UK balance of payments (current account plus financial account) is – *notionally*[106] – negative. Indeed, the demand for dollars by UK households is greater than the dollars offered by US households on the foreign exchange market to buy the pounds that American agents need. As the demand for dollars is greater than the supply, the dollar will appreciate. Symmetrically, the pound will depreciate.
In other words, the exchange rate of the dollar $xr^{\$}$ will go up (1 dollar will be exchanged with more pounds than before). This will not affect the trade balance, since the exchange rate enters the equations of import and export with a lag. However, it will affect the international trade of financial assets via two different channels.
Let us imagine US households want to invest the equivalent of 20% of their wealth in foreign bills; for instance, they would like to hold \$ 20 of securities issued by the UK government out of a total wealth of \$ 100. Given an exchange rate $xr^{\$}$ = £ 1, they will buy bills denominated in pounds for £ 20. Yet, if the pound depreciates – say, the exchange rate becomes $xr^{\$}$ = £ 1.5 – they will have to buy £ 30 of UK bills to reach their ideal threshold of \$ 20. It means that the first term of the equation of the

[105] The variables in the equations are actually the supplies of assets, but we have seen with equation 4.23-4.26 they correspond to the demand of assets (the use of the supply variables just ensures currency consistency).
[106] As it has already been explained in detail in chapter 2, the balance of payments always equals zero by definition. When it is said to be *notionally* negative the reader should interpret the expression as 'thought experiment' to track down the forces at work behind the currency fluctuations *before* the adjustment of the value of the currency itself.

financial account ($\Delta B^{£}_{\$s}$) will rise. The contrary is true for UK households: in order to hit their target of foreign bills as a share of their wealth they will need fewer US bills denominated in dollars as their value in pounds has increased ($\Delta B^{\$}_{£s}$ will go down, even if its multiplication factor will go up due to the increasing value of $xr^{\$}$). What is happening is that the demand for dollars is decreasing and the demand for pounds is increasing. How long will this process of devaluation of the pound last? Naturally, until the market where the two currencies are traded reach the equilibrium. That is to say until the UK balance of payments – and, symmetrically, the US balance of payments – are finally at zero. And *here it is the closure* of the model: if it is the equilibrium of the balance of payments that set the 'final' (or better: the *inter-period*) level of the exchange rate, the latter is given by the equation of the balance of payments set at zero:

$$CA^{£} + FA^{£} = X^{£} - IM^{£} - r^{£}_{-1}B^{£}_{\$s-1} + r^{£}_{-1}B^{\$}_{£s-1}xr^{\$} + \Delta B^{£}_{\$s} - \Delta B^{\$}_{£s}xr^{\$} = 0$$

With a little algebra, it is easy to end up with an equation with only $xr^{\$}$ on the left-hand side:

$$xr^{\$} = \frac{-X^{£} + IM^{£} + r^{£}_{-1}B^{£}_{\$s-1} - \Delta B^{£}_{\$s}}{r^{£}_{-1}B^{\$}_{£s-1} - \Delta B^{\$}_{£s}} \quad (4.35)$$

The other value of the exchange rate ($xr^{£}$) is nothing but the inverse of the result obtained with equation 4.35:

$$xr^{£} = 1/xr^{\$} \quad (4.36)$$

Will this level of the exchange rate be the new 'stationary state' level of the exchange rate? Probably not: in the next period the trade balance will also be affected by the same chain of events just described and a new equilibrium will be found. Only when the UK current account will have reached the equilibrium there will be no need for the financial account to 'adjust' any longer to cover excess or lack of demand of dollars and the US exchange rate will settle on its long-term value.

Does this mean that the financial account plays a merely 'passive role' and it is not able to influence the exchange rate directly? Not at all. An increase of the interest rate in the UK, for instance, would imply a rise of demand for UK assets by US households and the appreciation of the pound. However, contrary to what happens in the standard Mundell-Fleming model (and in its more recent variants), the inflow of capitals from the US does not continue forever. When US portfolios have adjusted to the new level of interest rate the flow stops and the pressure on the exchange rate ends. This dynamic is based on the set of assumptions typical of open economy SFC models: even if 'perfect capital mobility' is supposed to hold, 'perfect asset substitutability' is discarded as unrealistic. As Lavoie put it: "In its open-economy variant, the Tobin-Godley approach to portfolio choice leads to rates-of-return differentials, even between no-risk treasury bills of different countries, simply because asset holders will not want to put all their eggs in the same basket" (Lavoie 2015, p. 848).

The redundant equations

Any SFC "properly constructed model must contain one equation which is redundant, in the sense that is logically implied by all the others and which can be – indeed must be – 'dropped' out of the model if a solution of the model is not to be over-determined" (Godley and Lavoie 2007 b, p. 68. See also chapter 3 of this thesis on Tobin's manifesto for good macro modelling).

In the original OPENFLEX model equation 12.82A (UK central bank acting as a lender of last resort) had to be dropped.

The closure of the OPENSIME model is based on the principle that each central bank explicitly acts as a lender of last resort of the respective government and the exchange rate is set via the principle that the balance of payments must always equal zero. Two watertight systems are built, one for each country. In fact, the OPENSIME model could be considered as the combination of two separate models which communicate with each other via international trade of goods and financial assets. After all, this seems to be a good approximation of both the behaviour of contemporary economies and their institutional frameworks: even if most of the industrial economies are deeply intertwined in terms of flows of commodities, services and financial asset, their national governments and central banks are entrusted with the managing of economic policies on a national level[107]. Indeed, no buyer of last resort for government securities exists at the international level and no institution is in charge of a *global* fiscal policy; monetary and fiscal policies are usually conducted taking into account national interests – and sometimes at the expense of a more balanced international order.

As a two-country model made of two communicating sub-models, the OPENSIME has two different redundant equations. In line with the principle of complete symmetry that has characterised the model so far, the equations states that the money held by UK and US households (derived by equation 4.21 and 4.22) equal the money 'created' by the respective central banks via the purchase of domestic bills (see equation 4.29 and 4.30):

$$H_h^{£} = H_s^{£} \quad \text{(redundant equation I, 4.37)}$$

$$H_h^{\$} = H_s^{£} \quad \text{(redundant equation II, 4.38)}$$

In all the computer simulations made with the OPENSIME model in the next section, it has been verified that both conditions have always been respected.

4.2.2 The mysterious leakage in the original OPENFLEX model

The strength of the OPENSIME model is to make explicit what in the OPENFLEX model is made in a 'black box', namely the process that brings about the equilibrium in the balance of payments.

The latter should end up to be zero in every period in both models. The more complex structure of the original model should not imply the occurrence of a 'leakage' in the accounting of the balance of payments.

However, whereas the redundant equations are always perfectly verified in the OPENSIME model, this is not the case in the original one, where a small discrepancy emerges. Table 4.3 shows the values of the variables (or the expressions) which are

[107] From this point of view the euro area could be modelled as a single 'country', given the existence of a single currency and a single central bank.

part of the redundant equations in both models. In each case the model has been shocked in the year 1960.

Table 4.3: The variables of the redundant equations in the OPENSIME and OPENFLEX model following a step fall in the UK exports

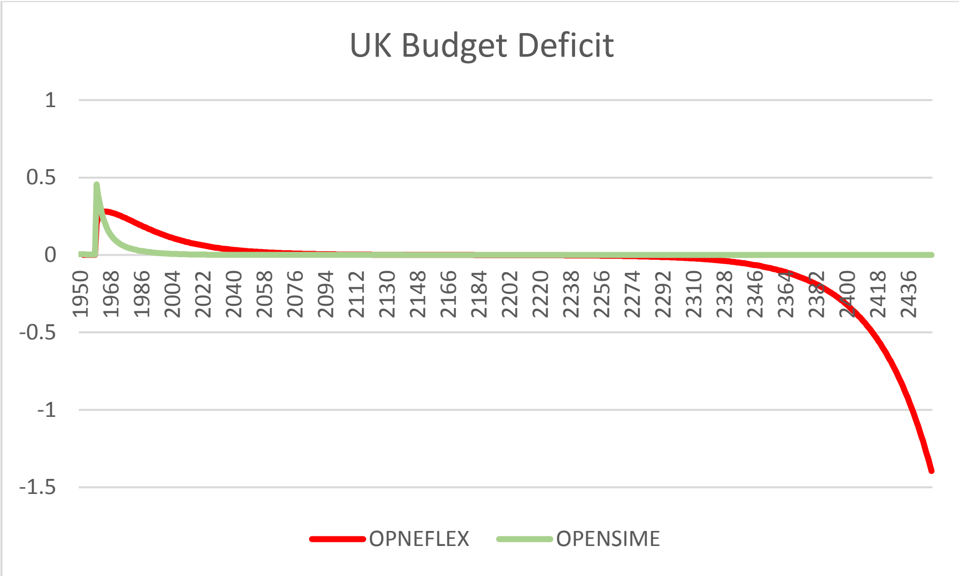
	OPENSIME				OPENFLEX	
	Redundant equation I (4.37)		Redundant equation II (4.38)		Redundant equation 12.82A	
Year	$H_h^£$	$H_s^£$	$H_h^\$$	$H_s^£$	$B_s^£ - B_{£s}^£ - B_{\$s}^£$	$B_{cb£s}^£$
1953	7.6277520	7.6277520	7.6277520	7.6277520	0.2794900	0.2795100
1954	7.6279440	7.6279440	7.6279440	7.6279440	0.2795700	0.2795417
1955	7.6281250	7.6281250	7.6281250	7.6281250	0.2795300	0.2795684
1956	7.6282970	7.6282970	7.6282970	7.6282970	0.2795800	0.2795924
1957	7.6284600	7.6284600	7.6284600	7.6284600	0.2796400	0.2796148
1958	7.6286140	7.6286140	7.6286140	7.6286140	0.2797000	0.2796358
1959	7.6287600	7.6287600	7.6287600	7.6287600	0.2796700	0.2796556
1960	7.6137860	7.6137860	7.6437760	7.6437760	0.2660600	0.2661651
1961	7.6036100	7.6036100	7.6536260	7.6536260	0.2588400	0.2588568
1962	7.5971340	7.5971340	7.6596930	7.6596920	0.2537800	0.2538603
1963	7.5934820	7.5934820	7.6629870	7.6629870	0.2502600	0.2503441
1964	7.5919620	7.5919620	7.6642600	7.6642600	0.2480100	0.2479431
1965	7.5920280	7.5920280	7.6640680	7.6640680	0.2465100	0.2464501
1966	7.5932560	7.5932560	7.6628290	7.6628290	0.2456800	0.2457294
1967	7.5953170	7.5953170	7.6608570	7.6608570	0.2456300	0.2456803
1968	7.5979570	7.5979570	7.6583890	7.6583890	0.2462300	0.2462212
1969	7.6009810	7.6009810	7.6555990	7.6555990	0.2472900	0.2472822
1970	7.6042410	7.6042410	7.6526210	7.6526210	0.2487200	0.2488014

It is clear from the table that while the redundant equations of the OPENSIME model (4.37, 4.38) correctly hold in each period, the redundant equation of the original model (OPENFLEX 12.82A) does not hold rigorously. This could be due to a hidden leakage in the model, or to an approximation problem with the initial values of the stocks[108].

The little discrepancy does not create problems as far as it remains negligible and does not trigger any 'avalanche effect'. This is the case for a reasonably long interval of time, within which all the simulations in the previous chapter – made with the OPENPROD model, which uses the same closure of the OPENFLEX – have been run. However, if the simulations are 'prolonged' for many years/periods in the future, a problem does emerge.

[108] The model starts from a steady state with non-zero values for the stocks of both countries. By contrast, the initial values of the OPENSIME model are all set at zero

Graph 4.1: UK Budget Deficit following a step fall in the UK exports (OPENSIME and OPENFLEX models)



Graph 4.1 displays the UK budget deficit after a drop in British export. While in the OPENSIME model the budget deficit settles in the new balanced steady state some periods after the shock and it remains there, in the OPENFLEX model the same variable goes 'out of control' after a long period in which it *seemed* to have settled. This could be the result of the accumulation of many, negligible, inconsistencies for an extended period and their sudden break out as one, big, accounting inconsistency. Yet, the complexity of the closure of the original model implies that the task of spotting 'where the problem lies' is not an easy one.

4.2.3 The behaviour of the OPENSIME model

One of the most attractive features of the OPENSIME model is that it yields essentially the same results[109] of the original OPENFLEX model, while representing a much more simplified version of a SFC two-country model with flexible exchange rates. It seems to be a successful use of the 'Occam's razor'.

This section will replicate the same shocks which were applied to the OPENFLEX model in Godley and Lavoie 2007 b, chapter 12. It will be shown that when the OPENSIME model is shocked the behaviour of its main variables is qualitatively the same as the behaviour of the equivalent variables after an identical shock in the OPENFLEX model.

Before going forward with the computer simulations, it is necessary to point out that the initial values of all the stocks of the OPENSIME model have been set to 0. The exchange rate has been set to 1. The shocks are triggered after that the model has settled in its steady state. For the sake of comparison, most of the parameters[110] of OPENSIME's equations are the same as the ones featured in the OPENFLEX model.

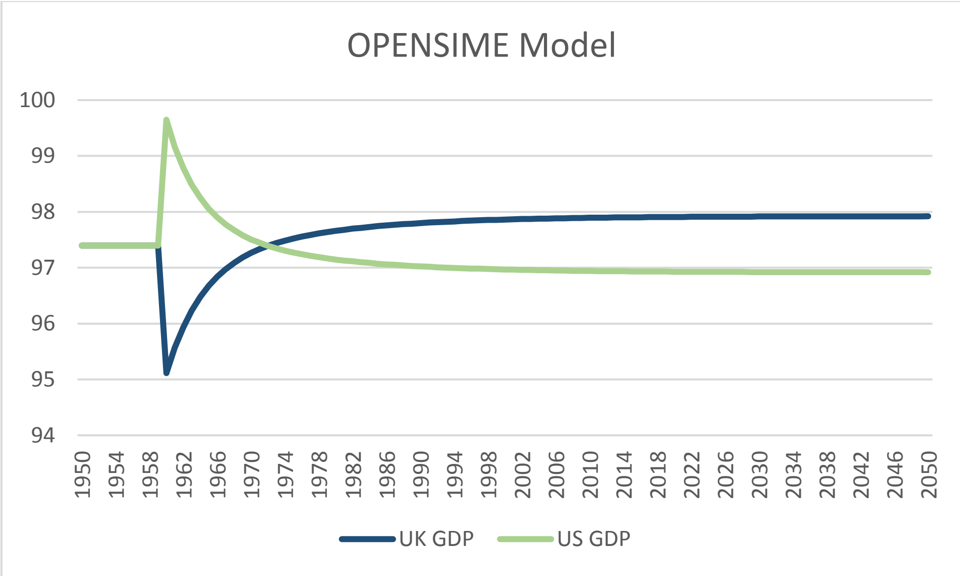
Experiment 1: a step fall in the UK exports

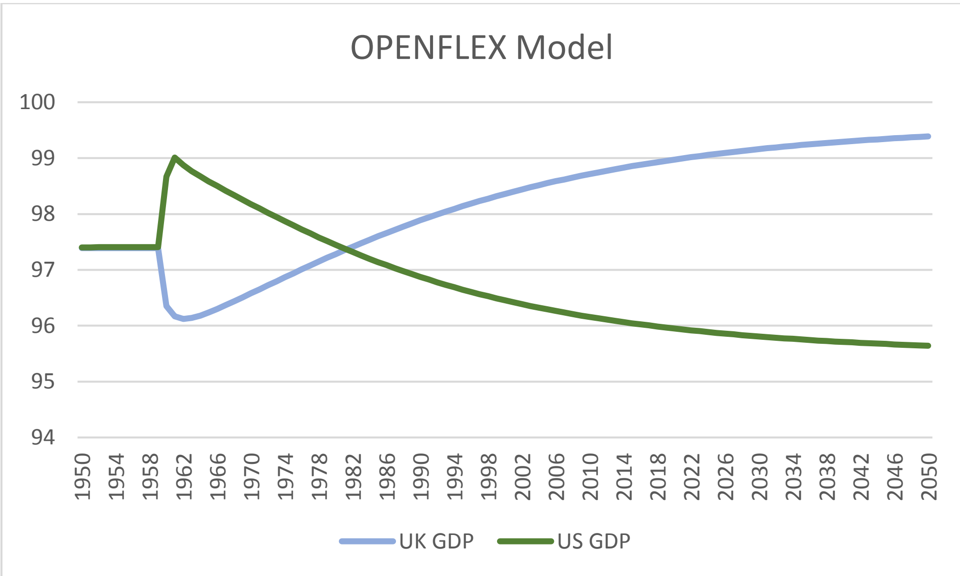
In this experiment the value of the parameter ε_0 of the equation of British export passes from -2.1 to -2.2 in 1960 (as explained in chapter 3, ε_0 can be considered a 'residual indicator' of the international competitiveness of British productive system, capturing elements such as the reputation of its brands, the quality of its products, etc.).

[109] Of course, this is true for the economic dynamics that can be represented through the limited number of variables of the OPENSIME model. As no system of prices is embedded in the OPENSIME model, the 'price related dynamics' of the OPENFLEX model cannot be replicated.

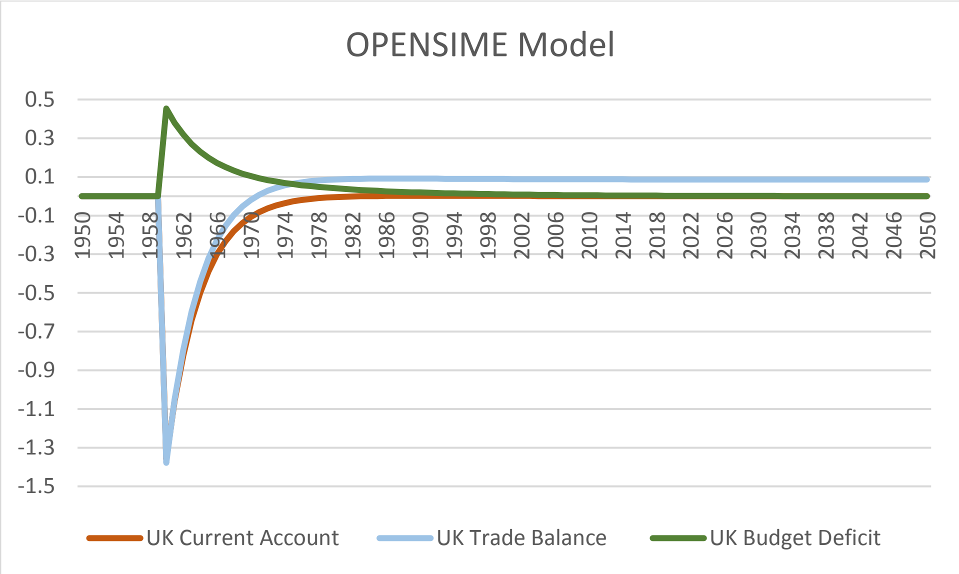
[110] Obviously, as far as there are equivalent equations, variables and parameters in the two models.

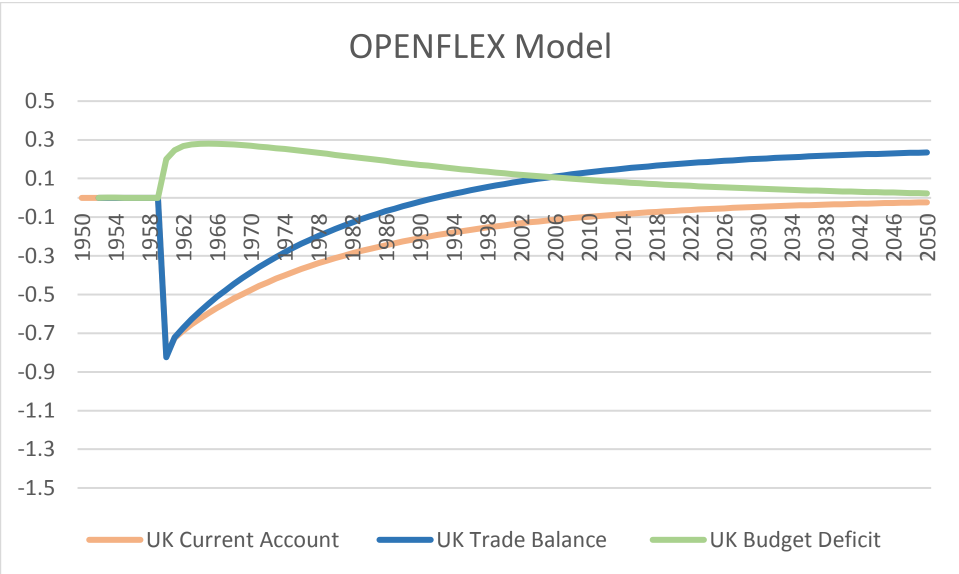
Graphs 4.2: US and UK GDP following a step fall in the UK exports (OPENSIME and OPENFLEX models)





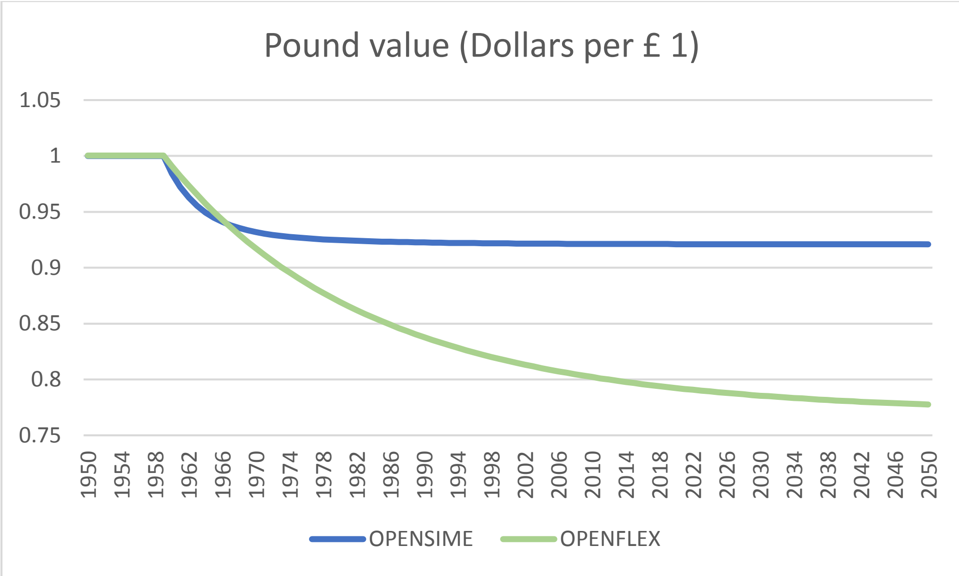
Graphs 4.3: UK Current Account, Trade Balance and Budget Deficit following a step fall in the UK exports (OPENSIME and OPENFLEX models)





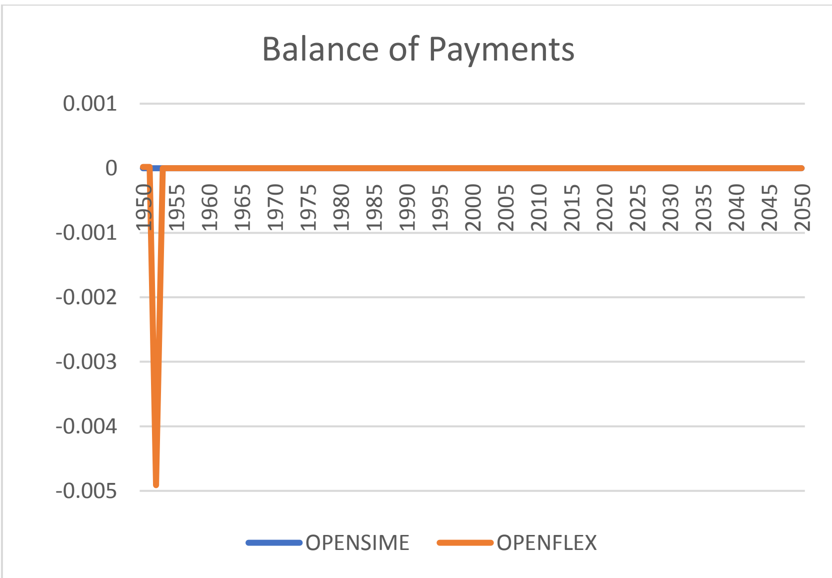
The behaviour of real GDP is pretty similar in the two models, although in the OPENSIME it stabilises much earlier. The depreciation of the pound affects import and export more 'directly' in the OPENSIME model given equations 4.13 and 4.14. Therefore, the adjustment of the economy is much faster and the new steady state is reached earlier than in the OPENFLEX model, where a far more complicated system of prices is in place. These dynamics are also reflected by the path of the pound, which needs to depreciate far more in the OPENFLEX model in order to drive the current account to the equilibrium (see graph 4.4).

Graph 4.4: UK currency following a step fall in the UK exports (OPENSIME and OPENFLEX models)



Finally, it is worth to verify whether in the models the balance of payments for both countries is always in equilibrium. This is an obvious result for the OPENSIME model, where the exchange rate is set precisely *to drive* the balance of payments to zero. In the OPENFLEX the process is much opaquer, but it has been argued at the beginning of section 4.2.2 that the outcome *should be the same*.

Graph 4.5: UK Balance of Payments following a step fall in the UK exports (OPENSIME and OPENFLEX models)



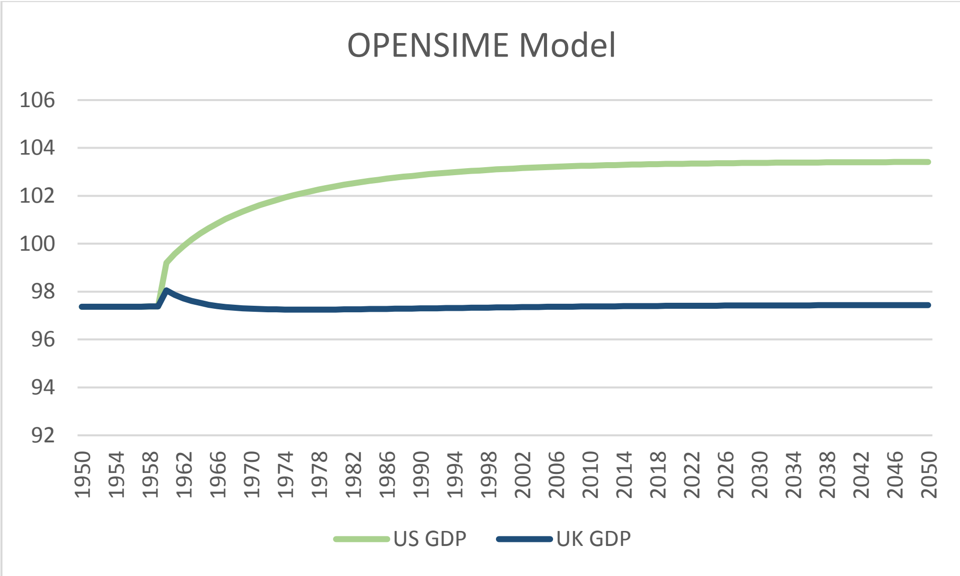
As it is evident from the graph 4.5 the balance of payments is zero in both models before and after the shock that occurs in 1960. However, in 1952 the UK balance of payments in the OPENFLEX model is negative. That is a 'nonsensical' value from an accounting perspective, since the balance of payments (current account plus financial account) must equal zero *by definition* in every period when there is a pure flexible exchange regime and the central bank does not intervene in the foreign exchange market with its foreign currency reserves. It is possible that this inconsistency is related to the leakages already examined in section 4.2.2.

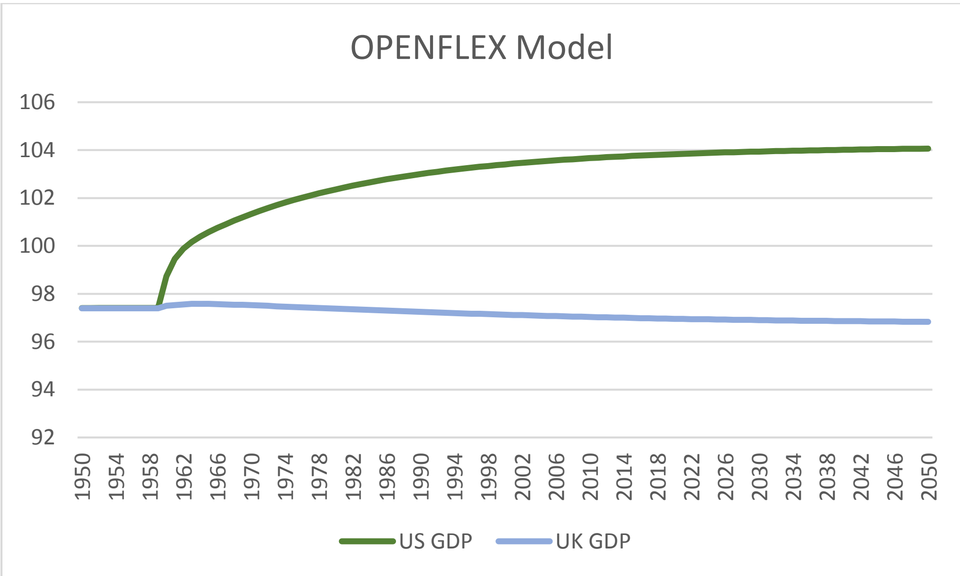
Experiment 2: a step increase in the US government expenditures

This experiment allows testing the effects of fiscal policy in an open economy framework. One of the most interesting results of the original OPENFLEX model is that fiscal policy turns out to be effective even in a flexible exchange rate regime. By contrast, 'mainstream' models tend to consider fiscal policy utterly ineffective in a context of floating exchange rates: the positive impact of government spending on GDP is thought to be offset by the tendency of the interest rate to rise and by the resulting appreciation of the currency.
In this experiment (real[111]) US public expenditure is raised by one unit (from 16 to 17).

[111] Of course, the distinction between real and nominal variables applies only to the OPENFLEX model, given the fact that the OPENSIME model assumes fixed price and real and nominal variables coincide.

Graphs 4.6: US and UK GDP following a step increase in the US government expenditures (OPENSIME and OPENFLEX models)

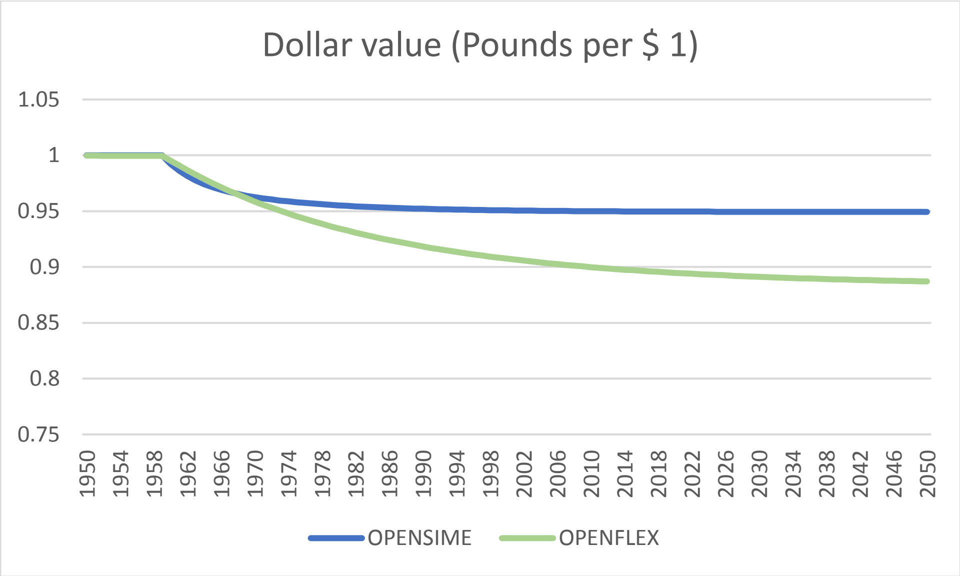




Graph 4.6 shows that the behaviour of the two models is, again, very similar: in both cases, fiscal policy is effective in pushing up US GDP. In both models not only does the public expenditure contributes to the increase in aggregate demand, but the depreciation of the currency which follows the appearance of a current account deficit reinforces the process: a weaker currency curbs import (which have been boosted by the fiscal stimulus) and facilitate export. Far from being the factor which annuls the effort of the government to promote expansionary policies, the flexible exchange rate is an additional help to deliver the task. Indeed, the path of the dollar

following the US policy intervention is very close to the path of the pound following the shock to the UK propensity to export (experiment 1).

Graph 4.7: US currency following a step increase in the US government expenditures (OPENSIME and OPENFLEX models)



Experiment 3: a change in liquidity preference

In order to conduct the comparison of the models over all the cases tested in Godley and Lavoie's "Monetary Economics" it is now necessary to deal with the effect of a change in interest rate, liquidity preference or exchange rate expectations[112]. Following the example of Godley and Lavoie (2007 b) only the 'liquidity preference case' will be taken into consideration, since the other two are virtually equivalent: "an increase in liquidity preference of asset holders in favour of US treasury bills (through the constant λ_{i0}) and an expected increase in the dollar exchange rate, just as an increase in the interest rate on US treasury bills, lead to an attempt by households to increase their share of US securities in their portfolios" (Godley and Lavoie 2007 b, p. 484).

[112] Exchange rate expectations are not included in the OPENSIME due to the effort to keep the model as simple as possible. If one would like to incorporate them, an additional variable should be added to equations 4.17-4.20. Then a theory to model the expectations should be introduced, like for instance in Lavoie and Daigle (2011).

However, to reproduce the size of the shock applied to the original model, the OPENSIME model needs a little amendment to its consumption equations. In the OPENFLEX model these equations feature the expected real disposable income (see OPENFLEX 12.37 and 12.38), which in turn is calculated as an average of the current Haig-Simons disposable income and the same variable with one lag (see OPENFLEX 12.39 and 12.40). It means that capital gains produced by a sudden depreciation of a currency do not *fully* affect the behaviour of consumers in the very same period in which the depreciation comes about. In the versions of the OPENSIME model used so far, the expected real disposable income variable has been scrapped to limit the total number of the unknowns: consumption equations (OPENSIME 4.11 and 4.12) encompass the standard, current Haig-Simons disposable income, which *fully* takes into account capital gains. With large currency shocks, as the one tested in this case, the effects of capital gains are so large that computational issues arise (setting aside the fact that too significant effects of capital gains on consumption are not even realistic). Thus, the Haig-Simons disposable income variable is substituted with the one of regular disposable income. The new consumption equations are:

$$C^{£} = \alpha_1^{£} YD_r^{£} + \alpha_2^{£} V_{-1}^{£} \quad \text{(OPENSIME 4.11 bis)}$$

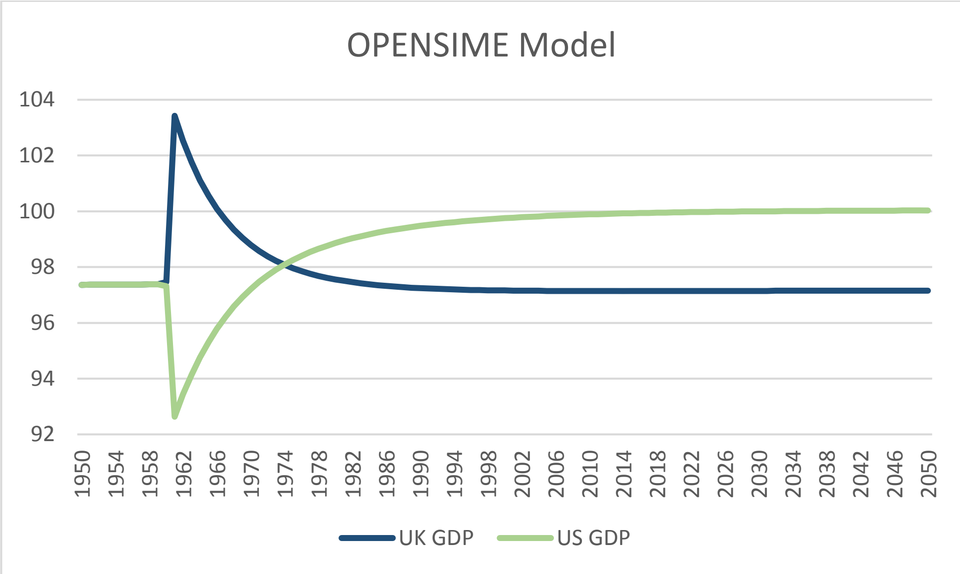
$$C^{\$} = \alpha_1^{\$} YD_r^{\$} + \alpha_2^{\$} V_{-1}^{\$} \quad \text{(OPENSIME 4.12 bis)}$$

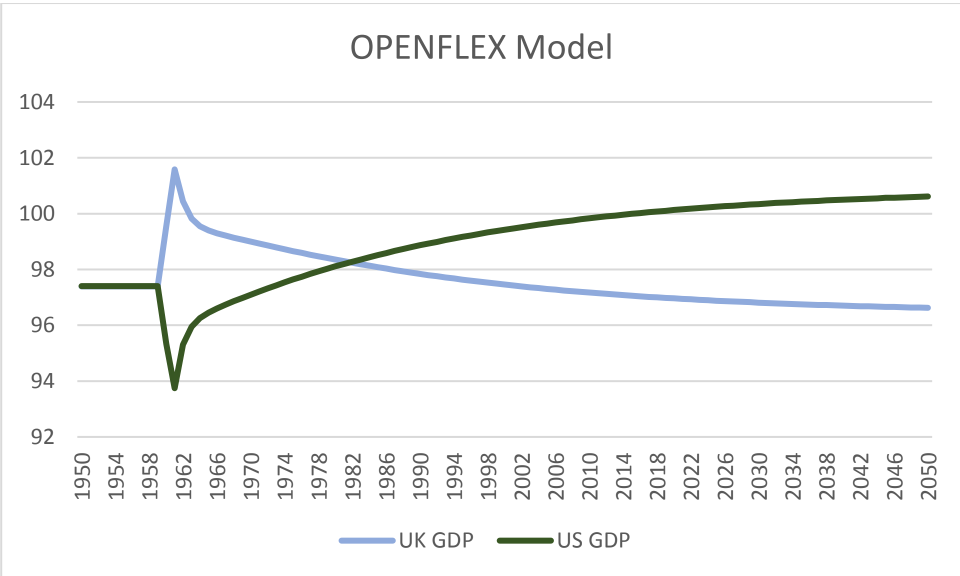
Now capital gains affect consumption only via the wealth channel[113].

The shock of experiment 3 consists in an increase of λ_{20} from 0.25 to 0.3 and an increase of λ_{40} from 0.7 to 0.75. In other words, since a specific moment in time onwards (the year 1960 in the computer simulations below), both UK and US households desire a larger share of their wealth in the form of American bills. The following graphs capture the consequences on the economic system.

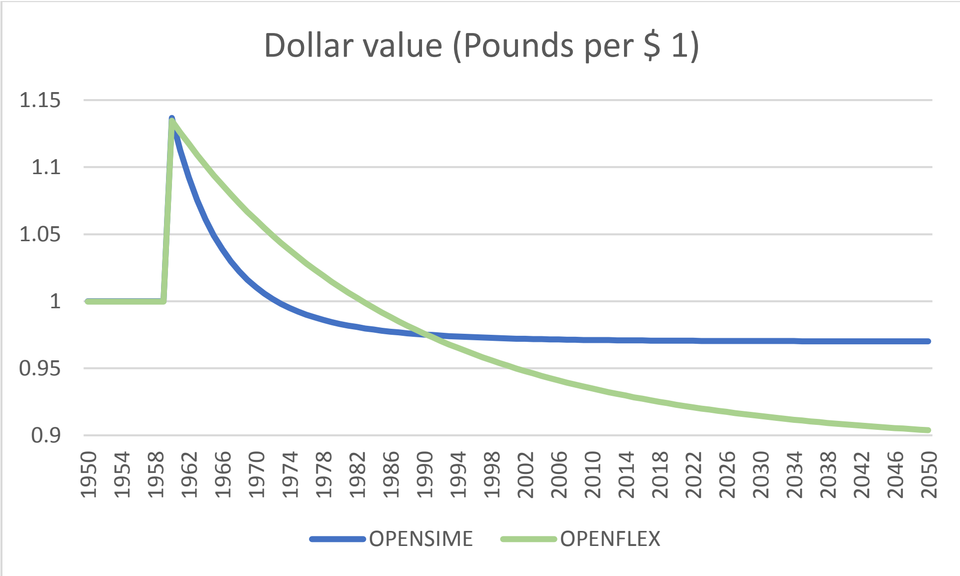
[113] Obviously, if one does not want to modify the OPENSIME model, the same kind of experiment can still be conducted, as far as the magnitude of the shock is scaled down.

Graphs 4.8: US and UK GDP following a change in liquidity preference (OPENSIME and OPENFLEX models)

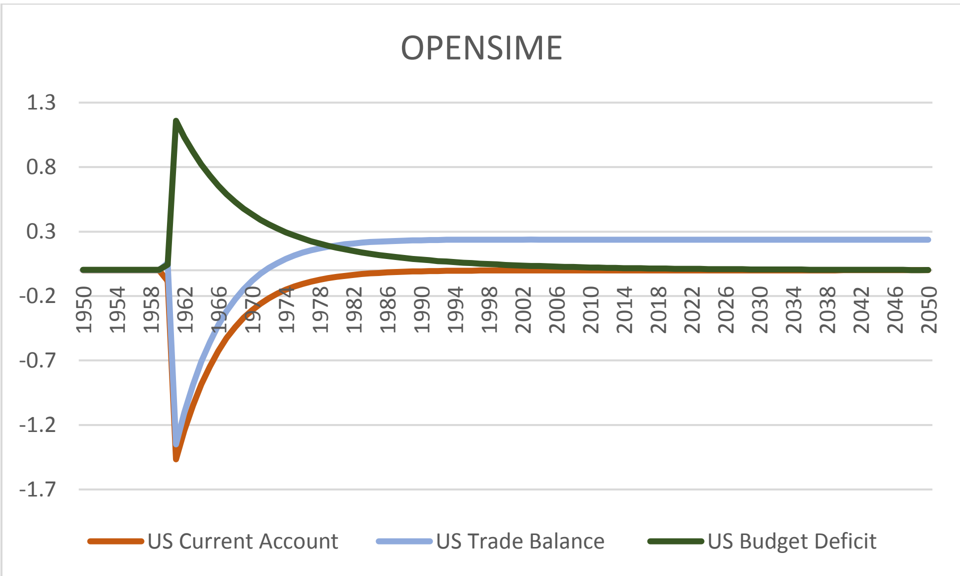


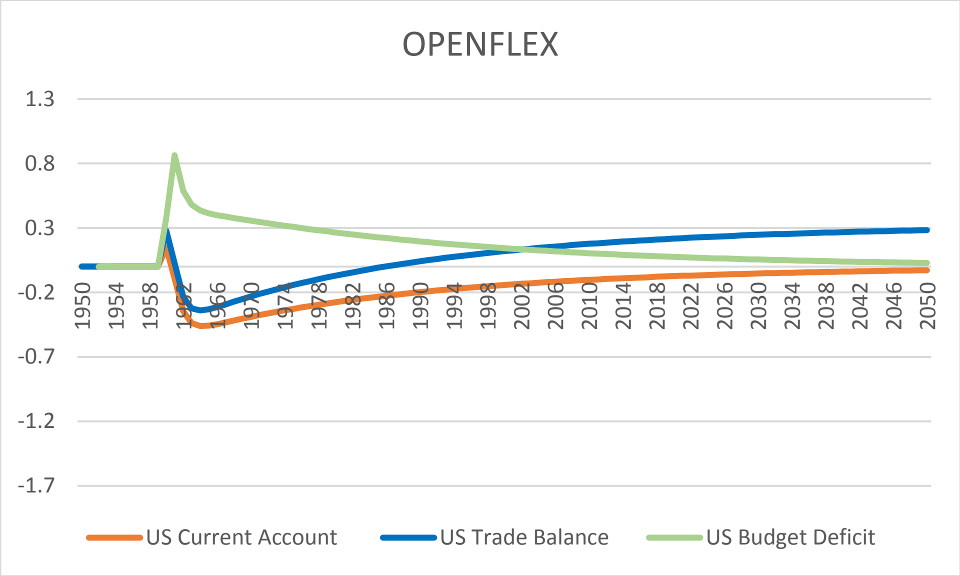


Graph 4.9: US currency following a change in liquidity preference (OPENSIME and OPENFLEX models)



Graphs 4.10: US Current Account, Trade Balance and Budget Deficit following a change in liquidity preference (OPENSIME and OPENFLEX models)





Graphs 4.8, 4.9 and 4.10 show, once again, that the OPENSIME and the OPENFLEX model behave in an analogous way after the same type of shock. The higher appetite for American bills initially brings about an appreciation of the dollar. A weaker pound helps the UK to improve its external position and pushes up UK GDP in the first periods after the shock. However, in the long-run, US deficit in the current account reverses the gains of the dollar: the American currency starts to depreciate and the US ends up with a higher GDP than before thanks to a lower level of the dollar. Godley and Lavoie's explanation of the paradox applies to both models: "Because of the additional costs of servicing the now larger external debt, the US current account balance will be brought back to zero only if trade balance remains positive. (…). As a consequence, the new steady state value of the dollar exchange rate is lower than its original steady state value, and the new US GDP steady state value is higher than what it was before the change in portfolio preferences" (Godley and Lavoie 2007 b, p. 487).

The only difference between the models that appears in these simulations can be identified in graph 4.10. In the OPENSIME the US current account is negative since the occurrence of the shock; by contrast, in the OPENFLEX the same variable is positive in the year of the shock and just after 1961 it becomes negative. Yet the discrepancy is absolutely negligible: in the 'new version' of the OPENSIME model capital gains produced by the depreciation of the pound do not affect immediately UK consumption and therefore do not boost US current account and trade balance in the year of the shock[114]. As soon as the stronger dollar start to affect the equations of export and import in the OPENFLEX model the US current account and trade balance turn negative and the behaviour of the models is substantially equivalent. The larger value of the external deficit in the OPENSIME model is entirely due to the more direct effect of the currency on the import and export equations that have been explained earlier.

4.3 AN APPLICATION OF THE OPENSIME MODEL: STUDYING INEQUALITY IN AN OPEN ECONOMY FRAMEWORK (THE OPENTWOFOUR MODEL)

4.3.1 Inequality, financialization and relative income hypothesis: a summary of the literature

Section 4.2.2 has shown how the OPENSIME model carries out similar results with respect to the OPENFLEX model with a considerable economy of equations.

This simplification can reveal itself useful to study specific and complex issues in the context of a complete two-country model. The OPENSIME model can be used as the basic structure upon which several other 'building blocks' can be added and combined in different ways. The same operation ends up being much more difficult when one starts with a basic framework already made of about one hundred equations, given the fact that every successive building block needs to be replicated in both countries if the symmetrical structure of the model is to be preserved. Every equation must be doubled.

This section will illustrate precisely how the format of the OPENSIME model can be combined with three additional modules in order to study the interplay of financialization, inequality and international trade of goods and assets, and the

[114] Furthermore, in equation 4.14 the exchange rate is lagged and therefore UK *real* import is not immediately affected by the depreciation of the pound. UK *nominal* import *should be* higher in value due to lower purchasing power of the pound. However, the fact that prices were ruled out from import and export equations – and from the model as a whole – produce the partial 'neutralisation' of the sterling depreciation on UK current account just after the shock. In other words, no 'J-Curve alike' phenomenon fully emerges. UK current account can turn positive almost *immediately*; consequently, the US external position is in deficit right from the beginning.

consequences of the dynamics of these interactions on the economic performance of a country.

The relationship between financialization and inequality has received much attention by economic theory in recent years.

A summary of the present state of the discussion is offered below, with an important caveat: an extensive investigation on the relationship between inequality and financialization falls beyond the scope of this thesis. As already stated, here the goal is, first of all, to demonstrate how a simple open economy SFC model like the OPENFLEX can prove itself flexible enough to address these topics; secondly, the objective is to point out the importance of variables that are usually neglected in this kind of studies – such as the exchange rates – to shed light on crucial economic dynamics.

It goes without saying that a more extensive inquiry should be preceded by a much more precise definition of its objects: what is exactly a 'financial crisis'? What defines a 'banking crisis'? Which indicators should be used to gauge the level of 'inequality' and with what type of combination? Are we concerned by the absolute *level* of inequality or by its *growth*? Etc. For the purposes of this literature review it will be enough to establish some concepts in more general terms: only if strictly needed slightly more elaborated taxonomies will be borrowed from other works.

Following the broad categorisation firstly proposed by Abiad, Oomes and Ueda (2008), de Haan and Sturm (2017) have distinguished between 'financial liberalisation' and 'financial development' in their recent review on the topic: the former "is most often measured by the financial liberalization index of Abiad et al. (2010), which summarizes *de jure* changes in credit controls, interest rate controls, entry barriers for banks, regulations, privatization, and restrictions on international financial transactions" (de Haan and Sturm 2017, p. 171); the latter can in theory be divided between 'extensive margin', which "is about the use of financial services by individuals who had not been using those services" (de Haan and Sturm 2017, p. 172), and 'intensive margin', which is about the improvement of the "quality of financial services enjoyed by those already purchasing financial services" (de Haan and Sturm 2017, p. 172). However, most of the studies treat financial development via a unique and quite simple variable, namely the total of credit to the private sector relative to GDP.

The two dimensions of the financialization just mentioned are often correlated, but do not coincide and can potentially have a different impact on inequality.

Many authors have underlined the positive impact that 'financial development' could play to improve economic performances and reduce income inequality (see, for instance, Clarke, Xu and Zou 2006, Beck, Levine and Levkov 2010, Kappel 2010, Hamori and Hashiguchi 2012, Agnello, Mallick and Sousa 2012, Kunieda, Okada and Shibata 2014, Naceur and Zhang 2016). Positive effects had also been identified with respect to 'financial liberalisation' (Abiad, Oomes and Ueda 2008, Beck, Levine and Levkov 2010, Agnello, Mallick and Sousa 2012, Delis, Hasan and Kazakis 2014, Li and Yu 2014).

Said that, there is strong empirical evidence that goes exactly in the opposite direction, pointing to 'financial development' as a major cause of the income inequality increase recorded in the last decades both in advanced economies and in developing countries (Jauch and Watzka 2012, Jaumotte, Lall and Papageorgiou 2013, Li and Yu 2014, Denk and Cournède 2015, Dabla-Norris, Kochhar, Ricka, Suphaphiphat and Tsounta 2015). Likewise, 'financial liberalisation' has been identified as an essential determinant of rising income inequality by Jaumotte and Osorio Buitron (2015).

The new evidence provided in de Haan and Sturm (2017) – via a panel fixed effect model based on a sample of 121 countries covering the period 1975-2005 – indicates that *all* the financial variables contribute to the increase of income inequality: in addition to 'financial development' and 'financial liberalisation', de Haan and Sturm have introduced a third dimension in the study of the phenomenon, namely the impact of financial crises in the form of banking crises[115].

From a purely theoretical point of view a financial crisis dents the value of financial assets held by the wealthier segment of the society and therefore could bring down the level of inequality (see, for instance, Roine, Vlachos and Waldenström 2009 on the effects of bank crises on the income share of the top 1% of the population). On the other hand, when a financial crisis leads to a proper economic crisis, it is the lower layer of the population that pays the price in terms of unemployment and

[115] Banking crisis are identified via "exceptional events or policy interventions, such as bank closures, deposit freezes and government rescues" (de Haan and Sturm 2017, p. 172)

increased levels of poverty. The final outcome depends on which driver is the strongest and which tendency prevails[116].

Empirical evidence provided by de Haan and Sturm (2017) suggests that financial crises boost income inequality, a result consistent with other studies conducted on the subject (Baldacci, de Mello, Inchauste 2002, Atkinson and Morelli 2011, Li and Yu 2014; by contrast Honohan 2005, and Jaumotte and Osorio Buitron 2015 have not found evidence of a correlation between financial crises and higher income inequality).

Another branch of studies has dealt with the same theme but with a different direction of the causal relationship: from inequality to financialization and crisis. One of the main ideas behind this strand of research is that the financial fragility brought about by the hypertrophy of the financial sector in the run-up of the 2007-2008 crisis was strictly connected with the rising inequality of income and wealth experienced by Western countries in the last decades (van Treeck 2014, Stockhammer 2015, Kumhof, Rancière and Winant 2015, Russo, Riccetti, and Gallegati 2016). Especially in the US, the negative impact on the aggregate demand of a more uneven distribution of income and wealth has been offset by looser credit conditions which drove to a debt-led boom followed by a bust.

While some scholars have focused on the importance of the demand for loans coming from impoverished middle and low-income households (Rajan 2010, Fitoussi and Saraceno 2010), others have tackled the same phenomenon from the opposite point of view, stressing that the first shove has come from the demand for more sophisticated financial products coming from the wealthier portion of the society looking for more lucrative ways of saving (Lysandrou 2011, Goda and Lysandrou 2014).

In the paper "Inequality and finance in a rent economy" (2019) Botta, Caverzasi, Russo, Gallegati and Stiglitz have built a formal model in order to investigate the complex relationship between financialization on the one side and income and wealth inequality on the other side, assuming that there is no one-direction causality

[116] Of course, the narrative presented here represents a huge simplification of the dynamics in contemporary economies. For instance, it is not strictly correct that financial assets are held just by a small minority of the richer part of the population: according to Moore and Palumbo (2010) in 2007 the share of the population in the US with a direct or indirect – for example via pension funds – ownership of stocks was 51%. However, this simplification allows sketching a first image of the forces pushing in different directions. It is this entanglement of competing forces that makes the relationship between inequality and financial crises so complex.

and both phenomenon "jointly contributed to the run-up towards the 2007-2008 financial crisis" (Botta, Caverzasi, Russo, Gallegati and Stiglitz 2019).

This formal model is essentially a Stock-Flow Consistent model consisting of six sectors: households, non-financial productive firms, the government, commercial banks, Special Purpose Vehicles (SPVs) and investment funds. All sectors are treated at the macro-aggregate level but households. An Agent-Based element is thus added to the model since an exogenous wage bill is distributed to 1000 heterogenous agents-households via a stochastic process based on a log-normal distribution.

Financialization takes the form of the production of collateralised debt obligation (CDOs) via the securitisation of debts conceded to households by commercial banks. The CDOs are ultimately sold to affluent households via investment funds. A baseline scenario of the model rules out the process of securitization and allows comparing the behaviour of the economy with respect to two different levels of financialization. The results of the simulations presented in the paper show that financialization and inequality are deeply intertwined: financialization increases income and wealth inequality and exposes the economy to the standard credit boom-and-bust cycle that makes the system much more unstable and fragile. On the other hand, inequality has many other determinants, that are assumed exogenous in the model (such as the tax regime or the labour legislation which affects the primary distribution of income): higher levels of (exogenously set) inequality undermine economic growth and can increase financial fragility fostering the riskiest practises of debt securitisation.

Still, the Botta, Caverzasi, Russo, Gallegati and Stiglitz AB-SFC model simulates the behaviour of a closed system: not only the economy and the financial sector of just one country is modelled, but there is no presence of a 'foreign sector' (not even in a stylised representation). The very simple structure of the OPENSIME model can be exploited to frame these themes within an open economy context.

Although linked to the previous topic, the 'relative income' hypothesis deserves a separate discussion.

The hypothesis is often behind the theory of consumers' demand which underpins many recent pieces of research on the relationship between inequality and economic and financial crisis. Its origin harks back to the seminal work by James Duesenberry: "Income, Saving and the Theory of Consumer Behaviour" (1949). The importance and the originality of Duesenberry contribution lies on the fact that it built a consumption theory which explicitly accounts for cultural, psychological, sociological and anthropological factors that affect consumer behaviours. It did not share the ambition – widely popular among 'mainstream' economists – to build a consumption theory in imitation of 'exact science'. This 'institutionalist' approach, that evidently echoed the work of Thorstein Veblen (1899), has been excellently described by Roger Mason (2000) in a paper on the fortune of the relative income hypothesis fifty years after the publication of Duesenberry's book:

"Existing assumptions about consumption choices were badly flawed and simplistic, he argued, because they failed, *inter alia*, to recognize the central importance of habit formation and took no account of how levels of expenditures could be increased not by changes in income and prices, but by contact with 'superior' goods generated by the consumption expenditures of others with whom the individual or family came into frequent contact" (Mason 2000, p. 554-555).

The core of the theory has been summarised by Duesenberry himself with the following, vivid example:

"What kind of reaction is produced by looking at a friend's car or looking at houses or apartments better than one's own? The response is likely to be a feeling of dissatisfaction with one's own house or car. If this feeling is produced often enough it will lead to action which eliminates it, that is, to an increase in expenditure" (Duesenberry 1949, p. 27).

Some hints about the 'cultural' dimension of consumption can even be found in "The General Theory" (1936) by Keynes. Chapter 9 is entitled "The propensity to consume: 2. The subjective factors", where the adjective 'subjective' should be understood on a 'macro' level. Keynes was not referring to 'subjective' motives of consumption which differ from individual to individual; he meant 'subjective' factors which characterise a community in every point in space and time. These 'subjective' factors – which can "lead to an excess of consumption over income" (Keynes 1936, p. 95) – are "Enjoyment, Shortsightedness, Generosity, Miscalculation, Ostentation and Extravagance" (Keynes 1936, p. 95):

"The strength of all these motives will vary enormously according to the institutions and organisation of the economic society which we presume, according to habits formed by race, education, convention, religion and current morals, according to present hopes and past experience, according to the scale and technique of capital equipment, and according to the prevailing distribution of wealth and the established standards of life" (Keynes 1936, p. 96).

However, Keynes preferred not to dig into this topic as he thought the habits above represented a relatively stable characteristic of a society which would not change in the short-run (a contention that perhaps he would have been ready to retract had he lived the cultural and technological revolution brought about by contemporary social networks). Thus, Keynes treated "as given the main background of subjective motive to saving and to consumption" (Keynes 1936, p. 96) and the matter was relegated in this very short chapter of "The General Theory".

In the Fifties, the theory almost disappeared into oblivion, despite the theoretical power of Duesenberry's hypothesis, its consistency with the empirical evidence of the time and an initial interest by prominent economists such as Franco Modigliani (who would win the Nobel Prize in 1985). The 'irresistible' rising of Friedman's 'permanent income hypothesis' (Friedman 1957) contributed to this outcome.

In the Seventies a partial re-discovery of the relative income hypothesis can be found in the works of Krelle (1972), Gaertner (1973), Pollack (1976), Hayakawa and Venieris (1977), Douglas and Isherwood (1978). However, the academic 'revival' turned up to be short-lived and throughout the Eighties and the Nineties Duesenberry's contribution was once again overlooked: the publication of the book "Choosing the right pond" (1985) by Robert Frank represented an exception.

Only recently the same imitation mechanism that was behind Duesenberry's theory has been widely popularised by the expression "keeping up with the Joneses", that refers to an imaginary 'Jones' family that sets the 'standard of living' for the whole neighbourhood. And in the US a fast growth in consumption that could hardly be explained with the traditional theories such as the permanent income hypothesis has paved the way for a new strand of research.

The 'expenditure cascades' hypothesis has been put forward by Frank, Levine and Dijk (2014) grounding on the hypothesis proposed by Duesenberry more than 60 years earlier:

"We use the term *expenditure cascade* to describe a process whereby increased expenditure by some people leads others just below them on the income scale to spend more as well, in turn leading others just below the second group to spend more, and so on. Our expenditure cascade hypothesis is that a pervasive pattern of growing income inequality in the United States has led to the observed decline in savings rates" (Frank, Levine and Dijk 2014, p. 57).

The transmission mechanism from higher levels of inequality to generalised lower saving rates has been initially showed by Frank, Levine and Dijk (2014) with the help of a theoretical model and computer simulations. However, a series of regressions on US data[117] was also used to provide empirical evidence to the theory. Given the unavailability of data on the saving rates of households for different levels of income on a state or county level, the regressions were built using various indicators of financial distress as dependent variables (i.e. the number of bankruptcies, divorce rates, travel time to work). In fact, the relative income hypothesis was tested via the use of a 'hypothesis proxy', that is to say that "families living in high-inequality areas will find it harder to live within their means than their counterparts in low-inequality income" (Frank, Levine and Dijk 2014, p. 63). The strong correlation between inequality and financial distress that emerged in those econometrics models chimes with the results of other research on the impact of inequality on total hours worked (Bowles and Park. 2005) and median house prices (Ostvik-White 2003).

The relative income hypothesis has been used also within formal Stock-Flow consistent frameworks.

In Detzer (2018) a SFC model has been used to test the effects of a change in the functional distribution of income or in the wage dispersion to countries with different "imitation regimes" of consumption (Low Emulation Country vs High Emulation Country). A 'rest of the world' sector was embedded, but exchange rates and term of trades were ignored.

Cardaci and Saraceno (2016) included the 'expenditure cascade' hypothesis in a closed economy SFC model with an Agent-Based household sector. The model showed the dilemma faced by economies affected by an increase in income inequality and the potential fall in aggregate demand. On the one hand, keeping a strict regulation of the credit market would tame the risk of a financial crisis but would also expose the economy to stagnant growth if an export-led strategy fails to take off. On the other hand, consumption fostered by private debt can support a high

[117] US Census data for the 50 states and the 100 more populous counties in the period between 1990 and 2000, when a steep increase in inequality was recorded.

level of aggregate demand – as the US economy has recently demonstrated – at the price of higher financial instability: indeed, the debt-fuelled growth in the US ended with a huge financial crisis in 2007-2008. In order to avoid the choice between these economic *Scylla* and *Charybdis*, a more progressive tax system is much more recommended than a traditional Keynesian stimulus. The latter can still be useful for a prompt intervention to curb the consequences of a slump: the difference between the performance of the US and the 'austerity prone' Eurozone in the aftermath of the recent crisis is quite telling. Yet Cardaci and Saraceno have underlined that a more structural approach is needed for sustainable growth in a time of growing inequality.

Belabed, Theobald and van Treeck (2018) have studied the 'dual pattern' of rising inequality via a SFC three-country model (the US, China and Germany) calibrated with real-world data. Their goal was to explain how the 'bottom-up' redistribution of income in recent decades have produced different effects in regions with diverse economic, social and political institutions. The current account deficit that has characterised the American external position in the run-up of the Great Recession was directly linked with the 'expenditure cascade' hypothesis. Paradoxically, even the opposite phenomenon, namely the current account surplus of countries like China and Germany, was rooted in a more uneven distribution of income and wealth: in these countries, more regulated capital markets and different institutional arrangements fostered an 'export-led' growth which bore very little resemblance with the American model. Both the deficit and the surplus paradigm were explained and reconstructed by the model via computer simulations[118].

In Belabed, Theobald and van Treeck (2018) exchange rates were treated as exogenous: their values were calibrated using time-varying real word data.

[118] It is worth to notice that Hein and Dodig (2014 and 2015) have analysed a very similar dualism – "debt-led consumption boom" and "export-led mercantilism" as products of financialization and increasing inequality – with the use of small analytical models. The authors concluded that both paradigms contain "internal contradictions, with respect to household debt in the first regime and with respect to foreign debt of the counterpart current account deficit countries in the second regime, which finally undermine the sustainability of these regimes and lead to financial and economic crises" (Hein and Dodig 2014, p. 64). The fact that these conclusions are in line with the results showed by larger SFC models is consistent with the idea that small analytical models and large SFC models "are complementary and the results obtained should, in principal, not contradict each other" (Hein and Dodig 2014, p. 6). Hein and Dodig's contribution is part of Work Package 3 of the FESSUD (Financialization, Economy, Society, Sustainable Development) project, that has been focused on "Causes and Consequences of the Financial Crisis". For a presentation of the Work Package, and of the other contributions it comprises, see Hein 2016.

Furthermore, no international financial transactions were modelled (except for loans to households made by foreign banks).

By contrast, the model presented in the next section includes an endogenous determination of exchange rates and cross-country financial transactions of government securities.

Three building blocks will be integrated into the OPENSIME model: the first one introduces two different types of households with the corresponding income equations; then a consumption pattern is associated to each agent (second building block). Finally, a brand-new sector is added – the financial sector made of private banks (third building block). The latter allows modelling deposits, loans and private debt and accounting for the crucial role that these financial variables play in the distribution of income and wealth. As the purpose of the model is mainly theoretical and methodological, both the households' representation and the financial mechanisms will be very simplified in order to obtain 'readable' and 'understandable' economic dynamics in the computer simulations.

The combination of the three building blocks in the structure of the OPENSIME model results in a two-country-four-household SFC model (OPENTWOFOUR).

4.3.2 The OPENTWOFOUR model

First building block: two different kinds of households: "rich" and "poor"

The first building block deals with the introduction of heterogeneity among households. As a simplifying starting point households are divided into two halves: the "rich" and the "poor". The household whose income corresponds to the median determines the boundary of the division. Since this division is carried out in both countries (US and UK) we obtain four different categories of households: British rich and poor households and American rich and poor households.

Two parameters (one for each country: $ic^{£}$ and $ic^{\$}$[119]) are set to define which portion of the national income is earned by the richer half of households. For the purpose of

[119] $ic^{£}$ = UK inequality parameter (the portion of UK GDP earned by UK rich households); $ic^{\$}$ = US inequality parameter (the portion of US GDP earned by US rich households).

these simulations both parameters have been provisionally set at 0.6[120], but of course they could be set at any other different value according to country-specific empirical data or a scenario-specific calibration of the model.

In addition, it is assumed that only rich households hold financial asset (domestic or foreign government bills) and – as equity holders of the financial firms[121] – rich households acquire the total profits that the commercial banking sector earns from its activities (investments in government bills and loans to private customers). By contrast, poor households do not hold financial assets like bills, bonds or equities: their wealth is entirely held in the form of bank deposits and cash. However, in order to sustain their preferred pattern of consumption (see next building block in this section) poor households can access bank loans. They pay an interest to the banks on their overall debt. The interest is set equal to the interest yielded by government bills (this is in order to economise the number of variables of the model, but of course it can be set to any other different value with no *qualitative* change in the behaviour of the model).

The dynamics just described can be summarised by the following equations (they refer just to the UK, but the US ones follow by symmetry. In the appendix of the chapter it is possible to find the complete list of the equations of the OPENTWOFOUR model):

$$YD_r^{£} = Y_r^{£} + F_{bank}^{£} + r_{-1}^{£} B_{£s-1}^{£} + r_{-1}^{\$} B_{£s-1}^{\$} xr^{\$} - T_r^{£} \quad (4.39)$$

$$YD_p^{£} = Y_p^{£} - r_{-1}^{£} L_d^{£} - T_p^{£} \quad (4.40)$$

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[120] Actually, the income share of the 50% richer households is far higher both in the US and in the UK. For instance, according to Alvaredo, Chancel, Piketty, Saez, and Zucman (2017) the share of income of the richer 50% portion of the population in the US has increased to roughly 88% in recent years. However, the parameters of the OPENTWOFOUR model refer to a share of income which *does not include interests from government bills and profits from the financial sector.* Furthermore, there is no need to focus too much on these parameters of the model as they could be considered 'right' by definition if we assume a moving boundary of the division between the rich and the poor. Indeed, for every parameter arbitrarily set, there is always a percentage of the richer X% part of the population that can be matched with that income (evidently with a parameter set at 0.6 the richer part can be assumed to be smaller than 50% of the population. Yet, for the sake of simplicity, in the remaining part of the chapter this portion will be still labelled as the 'richer half').

[121] The assumption is made on a purely theoretical basis, since it is 'reasonable' to set this kind of distribution of financial assets for the purposes of the model. However, the assumption could even be grounded on empirical research: according to Moore and Palumbo (2010) in 2007 the share of the US population with direct or indirect ownership of stocks was 51%

$YD_r^£$ is the regular disposable income of rich households, whereas $YD_p^£$ is the corresponding variable for poor households. $Y_r^£$ is the portion of GDP acquired by rich households ($Y_r^£ = ic^£ Y^£$) and $Y_p^£$ is the portion acquired by poor households ($Y_p^£ = Y^£ - Y_r^£$). $F_{bank}^£$ is the profit of commercial banks, $L_d^£$ is the demand for loans by poor households and $T_r^£$ and $T_p^£$ are the taxes paid respectively by rich and poor households. It will be shown later on that the supply of loans follows the demand (credit constraints are ruled out); thus, the total demand for loans equals the total stock of debt on which poor households have to pay interests. All the other symbols refer to the same variables as in the OPENSIME model.

While the accumulation of wealth for richer households can be captured by a function identical to equation 4.3 of the OPENSIME model, for poorer households it is necessary to introduce the concept of gross wealth: $\Delta V_p^£$. Loans can fund part of the consumption of poorer households. Therefore, this part should not be subtracted from the disposable income in order to measure the growth of gross wealth made of cash and bank deposits. Two additional elements are noteworthy: in the equation of $\Delta V_p^£$ it is featured regular disposable income instead of Haig-Simons disposable income because poor families do not have foreign financial assets that can yield capital gains (losses) via depreciation (appreciation) of the domestic currency; secondly, it can be the case that poor households demand loans even if they have a positive net wealth. For instance, when a disadvantaged family access a loan to buy a car and at the same time it holds 5000 $ on its bank deposit, that family is demanding the loan while having a *positive* financial wealth. Since the family wants to keep a buffer of 5000 $ in the bank account for potential unexpected expenditure, it does not use that money and resorts to a loan for the full amount of the price of the car. In order to calculate its gross wealth, it is essential to subtract the amount of the loan from consumption.

To sum up, the gross wealth accumulation of poorer UK households is given by:

$$\Delta V_p^£ = YD_p^£ - (C_p^£ - \Delta L_p^£) \quad (4.41)$$

The net wealth of poor UK households is obviously given by the difference between gross wealth and total level of debt. The gross wealth can never be negative: it is not possible to hold a negative amount of cash or bank deposits! By contrast, the net wealth turns negative when the total level of liabilities (loans from commercial banks, in this case) overcomes the total level of assets.

$$NW_p^{£} = V_p^{£} - L_p^{£} \quad (4.42)$$

With respect to how the wealth is stored, as it has been said earlier rich households buy domestic and foreign government bills with their saving[122]. The acquisition of financial assets follows the traditional Tobin's portfolio model (Tobin 1969. See equations 4.17 and 4.18 of the OPENSIME model, bearing in mind that the wealth variable now refers only to rich households: $V_r^{£}$). What is left from these acquisitions is not held just in cash, like in the OPENSIME model, but – more realistically – can be held in the form of bank deposits too ($DEP_r^{£}$). The proportion between bank deposits and cash is given for each country by a parameter ($depsh^{£}$ for the UK) linked to the local habits in the use of cash or electronic money for payments. Since poor households do not purchase bills, their whole *gross* wealth can take the form either of cash or of bank deposits:

$$DEP_r^{£} = (V_r^{£} - B_{£d}^{£} - xr^{\$} B_{£s}^{£})\, depsh^{£} \ (4.43)$$

$$DEP_p^{£} = V_p^{£}\, depsh^{£} \ (4.44)$$

Second building block: consumption and total income

Consumption of rich households follows the standard pattern of the Modigliani equation widely used in SFC models. It features a 'class-specific' parameter for the propensity to consume out of income, since the propensity to consume of rich families ($\alpha_{1r}^{£}$) is usually lower than the propensity to consume of poor families ($\alpha_{1p}^{£}$). To get rid of non-essential complications Haig-Simons disposable income has been replaced with regular disposable income, so that the consumption equations of rich and poor households include the same income variable. Capital gains still impact consumption via the wealth channel.

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122 The purchase of equities of the commercial banks is not formally modelled as it has been assumed that domestic rich households hold all the equities of domestic banks.

$$C_r^{£} = \alpha_{1r}^{£} YD_r^{£} + \alpha_2^{£} V_{r-1}^{£} \quad (4.45)$$

The consumption equation of poor households is slightly more complicated. An 'emulation parameter', $emu^{£}$, measures the level of imitation of poor households of the consumption pattern of rich households. When $emu^{£}$ equals zero there is no imitation and the consumption of poor households follows the classical Modigliani equation, with a class-specific propensity to consume given by $\alpha_{1p}^{£}$. However, the higher is the 'emulation parameter', the higher is the tendency to follow the consumption pattern of the rich households, as it is evident from the following equation.

$$C_p^{£} = (1 - emu^{£}) \left(\alpha_{1p}^{£} YD_p^{£} + \alpha_2^{£} NW_{p-1}^{£}\right) + \ emu^{£}\ C_r^{£} \quad (4.46)$$

Note that equation 4.46 encompasses the *net* level of poor households' wealth ($NW_{p-1}^{£}$) and not its *gross* level. Indeed, it is reasonable to think that even if loans allow poor households to consume more in the short-term, the accumulation of debt will be detrimental for their capacity to spend in the longer-term.

Third building block: the financial sector

Consumer loans are what allow poor households not to be tied to their 'standard' pattern of consumption – set via their level of income – and to undertake a higher level of spending. Yet to open this option, a proper banking sector must be embedded in the OPENTWOFOUR.

The total level of deposit supply in the UK is just given by the sum of the demand from rich and poor households:

$$DEP_{bank}^{£} = DEP_p^{£} + DEP_r^{£} \quad (4.47)$$

Given the consumption preferences expressed via equation 4.46, a 'borrowing parameter' takes the value of 1 if British poor households want to consume more than their income, 0 otherwise:

$$g_{con}^{£} = 1 \; iff \; \left(C_p^{£} - YD_p^{£}\right) > 0 \quad (4.48)$$

Even when poor households access loans, it is expected they do not want to fund the whole amount of their shortfall via bank loans. The parameter $bo^{£}$ gives the share of the shortfall (the difference between desired consumption and disposable income) which is financed by loans. The remaining is financed by cash or bank deposits (gross wealth). For the sake of simplicity, the value of $bo^{£}$ is set at 0.5 for both the US and the UK. The following equation therefore gives the level of new borrowing in each period:

$$\Delta L_d^{£} = \left(C_p^{£} - YD_p^{£}\right)(1 - bo^{£}) g_{con}^{£} \quad (4.49)$$

Equation 4.49 also clarifies the function of the 'borrowing parameter'$g_{con}^{£}$: if the consumption is greater than income, $g_{con}^{£}$ takes the value of 1 and equation 4.49 is fully 'active'; if consumption is smaller than income, $g_{con}^{£}$ takes the value of 0 and no loans are demanded.

Banks' supply of loans is assumed to match the demand passively (no credit constraints). Again, this crude simplification can be easily removed at the price of a higher number of equations. However, a slightly more sophisticated narrative can be envisaged if credit constraints are thought to be implicitly encapsulated in the imitation parameter of the consumption function (see experiment 1 in section 4.3.3). When this parameter is set at zero, no consumption based on an imitative pattern takes places. This can be due to multiple reasons, and unavailability of loans may be one of them.

$$L_s^{£} = L_d^{£} \quad (4.50)$$

The balance sheet of private banks is made of assets and liabilities. The liabilities are, first of all, the deposits of all the households of the country. The assets can be either loans to poor households or domestic government bonds. In other words, no reserves are kept idle at the central bank by private banks. Since the supply of loans follows the demand passively, it is the second asset – government bills – that is calculated as a residual.

Still, government bills are purchased by private banks only if there is 'room' in their balance sheets to do so. By contrast, if the level of loans exceeds the level of deposits, not only the banking sector cannot buy government bill, but it also needs to resort to loans from the central bank to 'finance' its shortfall. These mechanisms are captured by the following equations (the whole banking sector is treated as a huge, single bank, but the result would be identical if multiple banking sector agents were introduced):

$$B_{bnot}^{£} = DEP_{bank}^{£} - L_{s}^{£} \quad (4.51)$$

$$z^{£} = 1 \; iff \; B_{banknot}^{£} > 0 \quad (4.52)$$

$$B_{bank}^{£} = z^{£} B_{bnot}^{£} \quad (4.53)$$

$$A_{d}^{£} = -B_{bnot}^{£} \, (1 - z^{£}) \quad (4.54)$$

$$A_{s}^{£} = A_{d}^{£} \quad (4.55)$$

$$F_{bank}^{£} = r_{-1}^{£} B_{bank-1}^{£} + r_{-1}^{£} L_{s-1}^{£} \quad (4.56)$$

$B_{bnot}^{£}$ is the 'notional' level of domestic bills held by the UK banking sector. It is computed by subtracting loans from deposits (equation 4.51). If the difference is positive, $z^{£}$ equals 1 in equation 4.52. It means there is 'room' in the balance sheets of the banks to actually purchase domestic government bills. $B_{bank}^{£}$ in equation 4.53 is the level of *actually* purchased domestic bills: as it is evident, this level is zero if the notional level of domestic bills is negative ($z^{£}$ = 0).

In the case of a negative notional level of domestic bills, commercial banks have to 'cover' the shortfall in their balance sheet resorting to the advances of the central bank, which in turn has to meet the demand of commercial banks if it wants to control the short-term interest rate[123]. In equation 4.54 the negative value of the notional level of domestic bill takes the form of (positive) demand for advances ($A_d^£$). Equation 4.55 sets the supply of advances ($A_s^£$) by the UK central bank equal to the demand.

Finally, equation 4.56 represents the profit of the banking sector, which are made of interests yielded from loans and government bills.

Like in the OPENSIME model, in the OPENTWOFOUR model the central bank acts as a lender of last resort when government bills are issued[124]. Naturally, given the presence of central bank's advances towards the commercial banks, the supply of high-powered money[125] equals the sum of these advances and the government bills held by the central bank:

$$H_s^£ = B_{cb£s}^£ + A_s^£ \quad (4.57)$$

With equation 4.57 the third building block – covering the financial sector – is concluded. The fact that the simple framework of the OPENSIME model has easily incorporated additional parts without altering its own structure is demonstrated by the redundant equations of the OPENTWOFOUR model, which are still the same:

$$H_h^£ = H_s^£ \quad (4.58)$$

$$H_h^\$ = H_s^£ \quad (4.59)$$

Overall the OPENTWOFOUR model is made of 76 equations: 40 more than the OPENSIME model. Table 4.4 and 4.5 feature the transaction-flow matrix and the balance sheet matrices of the model

[123] In the OPENTWOFOUR model – as in most SFC models – the interest rate on short-term government bills is assumed as an exogenous variable, whose value is decided by the policy makers.

[124] In the OPENTWOFOUR model government bills are not purchased just by UK and US households but also by private banks: therefore, the intervention of the central bank takes place 'after' all these three agents have done their portfolio choices.

[125] From the assumption that the banking sector never leaves 'idle' reserves at the central bank derives the fact that the high-powered money in the OPENTWOFOUR model consists only in cash. Equation 4.57 tells us how this money is 'pumped' into the system. $A_s^£$ are liabilities – not assets! – of the banking sector: that is why they are not part of the high-powered money like standard reserves.

Table 4.4: OPENTWOFOUR balance sheet matrix

	UK Rich House.	UK Poor House.	UK Firms	UK Government	UK Banks	UK C.B.		US Rich House.	US Poor House.	US Firms	US Government	US Banks	US C. B.	Sum
	all in £						Ex. rate	all in $						
Money	$+H_r^£$	$+H_p^£$				$-H^£$		$+H_r^\$$	$+H_p^\$$				$-H^\$$	0
Deposits	$+Dep_r^£$	$+Dep_p^£$			$-Dep_{bank}^£$			$+Dep_r^\$$	$+Dep_p^\$$			$-Dep_{bank}^\$$		0
£ Bills	$+B_£^£$				$+B_{bank}^£$	$+B_{cb£}^£$	$xr^£$	$+B_\$^£\ xr^£$				$+B_{bank}^\$$		0
$ Bills	$+B_£^\$\ xr^\$$			$-B^£$			$xr^£$	$+B_\$^\$$			$-B^\$$		$+B_{cb\$}^\$$	0
Loans		$-L^£$			$+L^£$				$-L^\$$			$+L^\$$		0
Advances					$-A^£$	$+A^£$						$-A^\$$	$+A^\$$	0
Balance	$-V_r^£$	$-NW_p^£$		$-NW_g^£$	0	0	$xr^£$	$-V_r^\$$	$-NW_p^\$$		$-NW_g^\$$	0	0	0
Sum	0	0		0	0	0	$xr^£$	0	0		0	0	0	0

Table 4.5: OPENTWOFOUR transactions-flow matrix

	UK Rich House.	UK Poor House.	UK Firms	UK Gov.	UK Banks	UK C.B.		US Rich House.	US Poor House.	US Firms	US Gov.	US Banks	US C. B.	Sum
	all in £						Exch. rate	all in $						
Consumption	$-C_r^\pounds$	$-C_p^\pounds$	$+C^\pounds$					$-C_r^\$$	$-C_p^\$$	$+C^\$$				0
Gov. Expend.			$+G^\pounds$	$-G^\pounds$						$+G^\$$	$-G^\$$			0
Trade			$-IM^\pounds$				$xr^\pounds$			$-IM^\$$				0
			$+X^\pounds$				$xr^\pounds$			$+X^\$$				0
GDP/Income	$+Y_r^\pounds$	$+Y_p^\pounds$	$-Y^\pounds$					$+Y_r^\$$	$+Y_p^\$$	$-Y^\$$				0
Taxes	$-T_r^\pounds$	$-T_p^\pounds$		$+T^\pounds$				$-T_r^\$$	$-T_p^\$$		$+T^\$$			0
Interes paym.	$+r^\pounds B_\pounds^\pounds$			$-r^\pounds B^\pounds$	$+r^\pounds B_{bank}^\pounds$	$+r^\pounds B_{cb\pounds}^\pounds$	$xr^\pounds$	$+r^\pounds B_\$^\pounds xr^\$$						0
	$+r^\$ B_\$^\$ xr^\$$						$xr^\pounds$	$+r^\$ B_\$^\$$			$-r^\$ B^\$$	$+r^\$ B_{bank}^\$$	$+r^\$ B_{cb\$}^\$$	0
		$-r^\pounds L^\pounds$			$+r^\pounds L^\pounds$				$-r^\$ L^\$$			$+r^\$ L^\$$		0
CB profits				$+F_{cb}^\pounds$		$-F_{cb}^\pounds$					$+F_{cb}^\$$		$-F_{cb}^\$$	0
Banks profits	$+F_{bank}^\pounds$				$-F_{bank}^\pounds$			$+F_{bank}^\pounds$				$-F_{bank}^\pounds$		0
Flows of funds (changes in assets)														
Money	$-\Delta H_r^\pounds$	$-\Delta H_p^\pounds$				$+\Delta H^\pounds$		$-\Delta H_r^\$$	$-\Delta H_p^\$$				$+\Delta H^\$$	0
Deposits	$-\Delta Dep_r^\pounds$	$-\Delta Dep_p^\pounds$			$+\Delta Dep_{bank}^\pounds$			$-\Delta Dep_r^\$$	$-\Delta Dep_p^\$$			$+\Delta Dep_{bank}^\$$		0
£ Bills	$-\Delta B_\pounds^\pounds$			$+\Delta B^\pounds$	$-\Delta B_{bank}^\pounds$	$-\Delta B_{cb\pounds}^\pounds$	$xr^\pounds$	$-\Delta B_\$^\pounds xr^\pounds$				$-\Delta B_{bank}^\$$		0
$ Bills	$-\Delta B_\pounds^\$ xr^\$$						$xr^\pounds$	$-\Delta B_\$^\$$			$+\Delta B^\$$		$-\Delta B_{cb\$}^\$$	0
Loans		$+\Delta L^\pounds$			$-\Delta L^\pounds$				$+\Delta L^\$$			$-\Delta L^\$$		0
Advances					$+A^\pounds$	$-A^\pounds$						$+A^\$$	$-A^\$$	0
Sum	0	0	0	0	0	0		0	0	0	0	0	0	0

4.3.3 Some experiments with the OPENTWOFOUR model

Experiment 1: A new consumption pattern for the poorer portion of the population: long-term outcome of a private debt-fuelled expansion

The OPENTWOFOUR model can be used to study via computer simulations the impact of an economic shock not only on one country, and on different social groups within that country, but also on *another* country which has trade and financial connections with the first one. In turn, the effects on the *other* country can be analysed not only with respect to the main, aggregate economic variables, but also with regard to its internal distribution of income and wealth.

It also becomes possible to understand the role played by 'external factors' such as the exchange rate in these dynamics, despite the fact that the distributional issues are often studied within a closed economy framework.

The first experiment consists of a change in the consumption pattern of the poorer portion of the population in the UK.

In the baseline scenario, it is assumed that poor households in the UK follow a simple consumption pattern based on *their own* propensity to consume. Even if their propensity to consume out of income is higher than the one of rich households, they still tend to leave 'within their means': the overall consumption out of income and wealth of poor households is smaller than their disposable income and therefore their net accumulation of wealth is positive (as far as the steady state is not reached). Consequently, equation 4.46 is reduced as follows:

$$C_p^{£} = \alpha_{1p}^{£} YD_p^{£} + \alpha_2^{£} NW_{p-1}^{£} \quad (4.60)$$

Then – in the year 2020 – the model is 'shocked' via a change in the consumption habits of UK poor households.

Of course, to hypothesise a sudden change in the consumption habits which takes place 'overnight' represents, to some extent, a blunt simplification. Yet the expedient allows shedding light on the effect of such a change more easily. After all, this is exactly what one can expect from an economic model. A map is not as detailed and realistic as the photo of a landscape, but it is much more useful if the intent is to walk around the landscape and to understand its morphology. Likewise, an economic model can miss some realistic details of the reality to grasp the underlying 'morphology' of an economic system.

However, the need to simplify is not the only reason why this kind of approach seems reasonable. Consumption patterns are rooted in the institutional characteristics of a society, in its 'social pact'. As Belabed, Theobald and van Treeck (2018) put it:

"It would certainly be misleading to qualify emulation as irrational or to attribute it to an excessive desire for luxury goods (…). The relative income hypothesis highlights the difficulties faced by the middle and upper-middle class in providing for what they perceive as basic needs in the face of rising inequality at the top of the distribution. Typical middle-class needs include the aspiration to send one's children to relatively good schools or universities, or to live in relatively decent neighbourhoods. Such goods can be qualified as positional goods, because their value is determined by relative rather than absolute consumption" (Belabed, Theobald and van Treeck 2018, p. 49).

The same applies to another basic need whose quality can be extremely diversified, like health services. Societies with a more robust welfare state are less prone to imitative consumption behaviours because public goods like education and healthcare are universally available at a decent standard. The assumption of *country-specific* imitation parameters adopted by Belabed, Theobald and van Treeck (2018)[126] can consequently be extended to justify *time-specific* imitation parameters *within the same country*. A vast program of privatisations of public services or welfare cuts – like the ones implemented in Southern Europe during the last financial crisis – may well be considered a process capable of triggering a rapid spike of the 'imitation parameter'.

The regulation of financial markets is another important factor behind the possibility of an emulation consumption process to take place. In the OPENTWOFOUR model, no credit constraints curb the will of poor households to borrow and to consume in line with their imitative pattern. Yet more conservative bank lending practices can limit credit access and lower the *de facto* imitation

[126] Country-specific imitation rates in Belabed, Theobald and van Treeck 2018 are estimated via the use of a series of proxies of both the labour market arrangements (share of long-term unemployment in total unemployment; average job tenure in years) and the public infrastructures (social transfers as a percentage of GDP; number of private schools per one million inhabitants and tuition fees per student). In essence, these are indicators of the type of 'social pact' which characterises a society.

parameter of an economy. Again, the same *country-specific* assumption can be translated into a *time-specific* assumption on the level of the parameter *within the same country*. From this point of view, a shock in the imitation parameter could be interpreted as the result of a reform of the banking sector that ends the existing restrictions to lend. Given the existence of many examples of quick and radical reforms of the capital markets throughout the world in the last decades, this kind of narrative is far from being unrealistic.

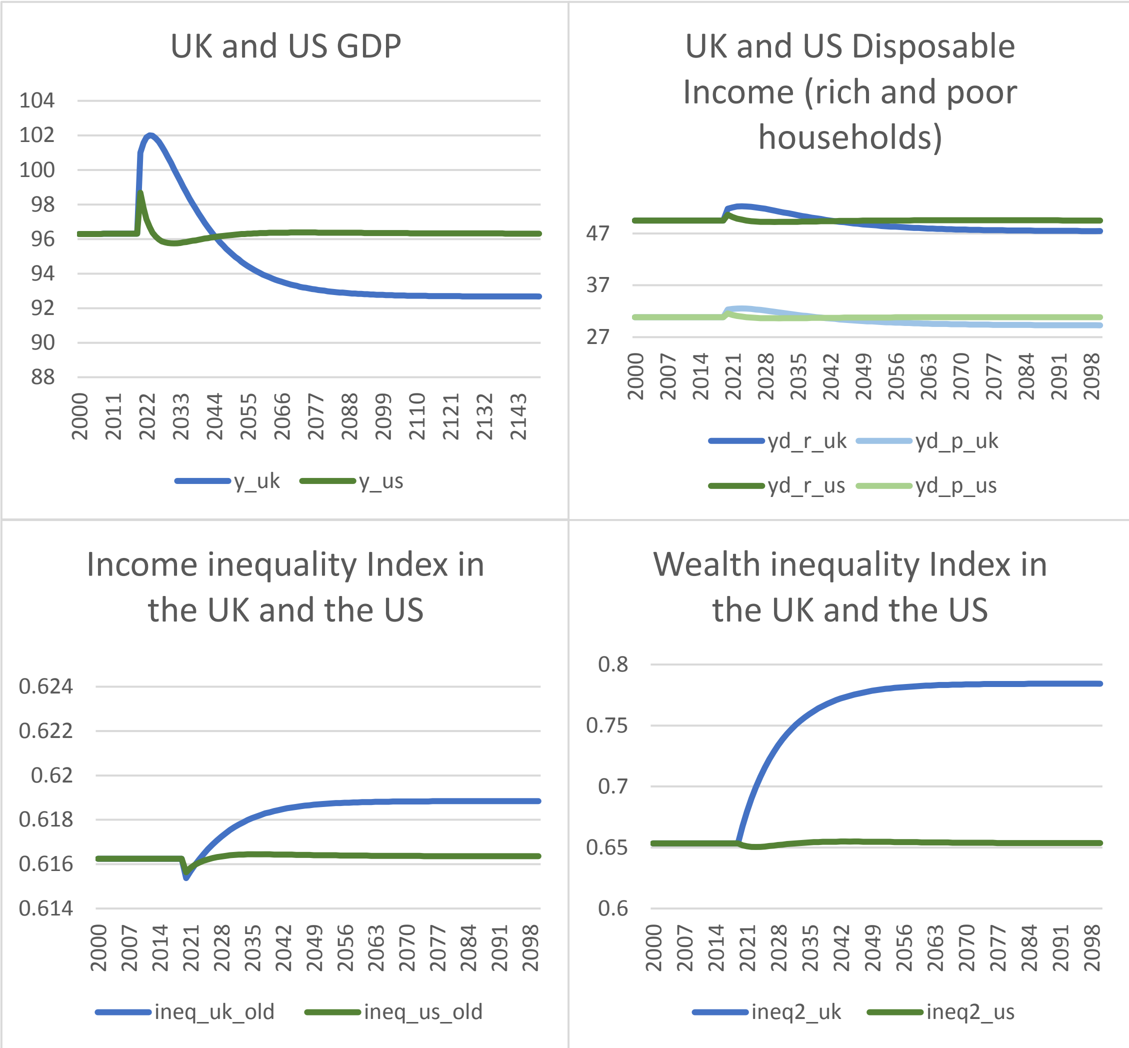
After the shock, the emulation parameter ($emu^{£}$, which indicates the share of the consumption of the rich that the poor want to replicate) passes from 0 to 0.15. The equation of consumption of poor UK households is back to its original form:

$$C_p^{£} = (1 - emu^{£}) \left(\alpha_{1p}^{£} YD_p^{£} + \alpha_2^{£} NW_{p-1}^{£} \right) + emu^{£} \, C_r^{£} \quad (4.61)$$

The immediate – and predictable – effect of a boost of UK poor households' consumption via credit provided by commercial banks is an increase in production and total income for the whole country. As far as a higher level of income in the UK sustains British import, the beneficial effect spills over the US, increasing American production and income too.

However, this is not the end of the story. Computer simulations help to outline a medium-long-term picture that takes into consideration *all* the effects related to the debt spiral and the income re-distribution triggered by the change in British consumption pattern.

Graph 4.11: GDP, Disposable Income (rich and poor), Index of income distribution and Index of wealth distribution in the UK and in the US following an increase of the emulation parameter in the UK.



Three striking results emerge from graph 4.11:

1) Despite the initial boost of total income provided by the higher consumption of poor households in the UK, in the mid-long-run the growth peters out and reverses: the new steady state in the UK is *lower* than before the shock.
2) Both poor *and rich households'* disposable incomes are *lower* in the new steady state in the UK. This is quite surprising since the access of poor households to bank loans corresponds in the OPENTWOFOUR model to a long-term bottom-up redistribution of income from the poor to the rich: indeed, as the debt of poor households growths, so do the interest payments

to British banks, which in turn make the profits gained by the rich households (the owner of British banks). Therefore, rich households should benefit twice from the change in the consumption behaviour of the poor: first of all, from the short-term shove to production; secondly, from the long-term redistribution effect of the debt accumulated by the poor.

One could think that the actual result hinges on the difference in the propensity to consume of rich and poor households: as the income is redistributed from the poor to the rich, the general propensity to consume of the overall economy decreases and for this reason the steady state total level of income becomes lower. However, a brief univariate and multivariate sensitivity analysis can easily show that this is not the case (see table 4.6). Even with different levels of the parameter of the propensity to consume of British and American rich households, it turns out that all the variables of interest (UK GDP, disposable income of poor UK households and disposable income of rich UK households) decrease after the shock. The same happens when the propensity to consume is exactly equal between rich and poor.

In addition, it is worthwhile to remember that in 'standard' SFC models a lower propensity to consume out of income tends to bring about a higher level of long-term total income due to a higher level of saving and consequently a higher level of public expenditure for the service of the government debt held by the private sector[127]. The frequent 'disappearance' of the Keynesian 'paradox of thrift' has been emphasised by Godley and Lavoie in their book despite being at odds with one of the main features of the post-Keynesian tradition[128].

To understand graph 4.11, another explanation is required. It will be provided with the analysis of the external position of the British economy. Indeed, the key to the explanation is to be found in the interaction between international trade and the internal social structure of the British economy.

[127] Private saving usually takes the form of government bills and bonds in standard SFC models.

[128] In a final summary on this issue in chapter 11 of the book, Godley and Lavoie wrote: "The reader may recall that in models devoid of a government sector, Keynes's paradox of thrift held up: an increase in the propensity to consume led to an increase in national income; by contrast, in models with a government sector, a higher propensity to consume led, in the long run, to reduced national income" (Godley and Lavoie 2007 b, p. 422).

Table 4.6: Sensitivity test: GDP and Disposable Income (rich and poor households) in the UK following an increase of the emulation parameter in the UK[129].

Propensity to consume out of income		Pre-shock steady state values			Post-shock steady state values			Change after the shock		
$\alpha_{1p}^{£}$	$\alpha_{1r}^{£}$	$Y^{£}$	$YD_r^{£}$	$YD_p^{£}$	$Y^{£}$	$YD_r^{£}$	$YD_p^{£}$	$\Delta Y^{£}$	$\Delta YD_r^{£}$	$\Delta YD_p^{£}$
0.77	0.73	96.31	49.49	30.82	92.67	47.47	29.28	-3.77%	-4.09%	-4.99%
0.77	0.75	95.21	48.75	30.47	91.70	46.75	28.95	-3.69%	-4.09%	-4.98%
0.77	0.76	94.68	48.38	30.30	91.23	46.42	28.80	-3.65%	-4.05%	-4.93%
0.77	0.77	94.16	48.03	30.13	90.76	46.10	28.66	-3.61%	-4.01%	-4.89%
0.8	0.8	91.96	46.53	29.43	88.81	44.75	28.06	-3.43%	-3.82%	-4.66%

3) Very simple indices of inequality of income and wealth can be given by the percentage of income and wealth held by the richer portion of the population over the total income and private wealth of the economy. Both the UK and the US experience a slight increase in inequality of the income index after the shock. Yet the greatest effect of the change in the pattern of consumption is recorded in the distribution of wealth: while in the US the wealth index remains virtually unchanged, a steep increase is recorded in the UK, where the percentage of net wealth held by the richer families goes from 65% to 81%[130]. This is the long-run consequence of the debt spiral that captures poor British households and erodes their net wealth.

   Since both rich and poor households' disposable income decreases, the disparity between them does not change significantly; on the other hand, the net wealth of rich UK households is pretty stable, while the net wealth of poor UK households slumps owing to debt accumulation.

It is now possible to analyse the 'structural reasons' behind the behaviour of the variables displayed in graph 4.11. As anticipated earlier, these reasons are related to the openness of British and American economies to international trade of goods and financial assets.

When the consumption pattern of poor UK households changes, the overall UK income increases in the short-term. Consequently, UK import – which is a function

[129] The first line – $\alpha_{1r}^{£}$= 0.73 and $\alpha_{1p}^{£}$= 0.77 – represents the 'standard' setting used in the experiments of this chapter.

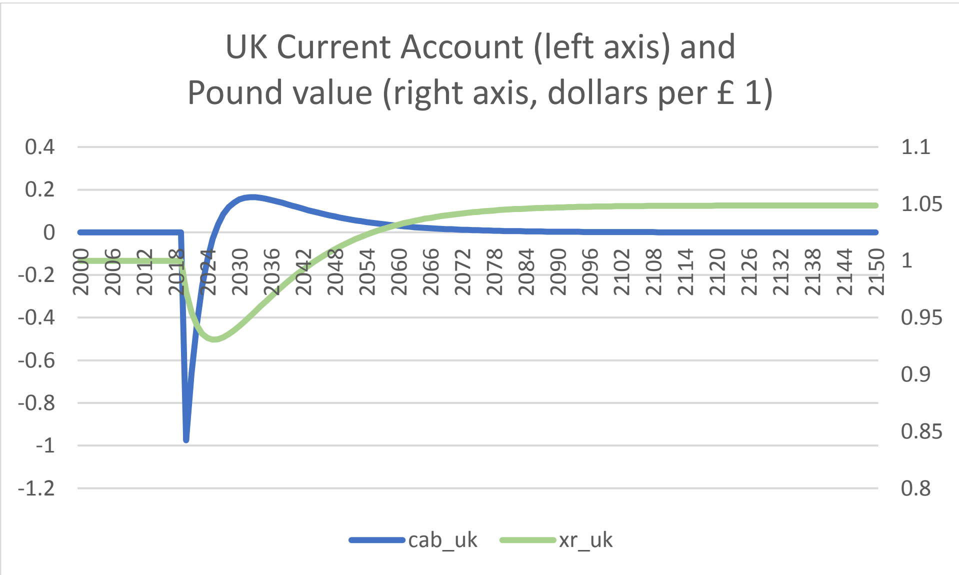
[130] Both percentages refer to steady state values pre and post shock.

of total income – rises and British current account deteriorates. The pound depreciates. The current account deficit has to be 'financed' by the inflow of capitals from abroad (in this case from the US). The accumulation of foreign debt represents an additional burden to the external position of the country as interest payments to American holders of British government bills weaken the current account even further.

Then the depreciation of the pound helps the British trade balance to recover and to close the deficit in the UK current account. Up to now, the story is identical to the one described in the OPENFLEX and in the OPENSIME models when an unbalance in the external position of a country emerges (see graph 4.3).

Yet this time the medium-long term evolution is different. Graph 4.12 shows a pretty original 'overshooting' of the recovery of the British current account and of the pound. Not only does the current account comes back to zero, but it even turns positive, pulling up the value of the sterling.

Graph 4.12: UK Current Account and UK currency following an increase in the emulation parameter in the UK.



What is the reason for the overshooting? Six periods after the shock the deficit of the current account is closed. At this point, the currency 'normally' – meaning: according to the standard 'physiology' of SFC models - stabilises and the trade balance settles in its steady state level (which may or may not equal zero). The problem is that private debt accumulated during the time by British poor households has started to become sizeable, squeezing the consumption of this portion of the UK population. Lower consumption implies a lower internal demand and a lower level of import, exactly when a mild recovery in the US is supporting UK export. The outcome is a positive British current account and a progressive appreciation of the currency.

The appreciation of the pound has two consequences: it reduces the competitiveness of the country, reabsorbing the trade balance's positive position; it causes capital losses for all the rich UK families that hold asset denominated in dollars. These capital losses affect consumption of both rich and poor households: the first effect is *direct*, via the wealth component of the consumption function of the rich; the second is *indirect*, via the portion of consumption of the poor which replicate a share of the consumption of the rich. Capital losses constantly characterise the whole 'appreciation stage' of the pound and they contribute to the length of this stage: notwithstanding the deterioration of the competitiveness of the UK economy due to a dearer currency, the reduction of wealth, consumption and income in the UK keeps import down and delays the closure of the trade surplus.

The end of the story is that *everybody* in the UK – that is to say poor *and rich* – are worse off in the long-run, when the debt-fuelled boom fades away. Also, the distribution of income and wealth has shifted to a more inequalitarian pattern: slightly more in the case of income; substantially more in the case of wealth (despite the fact that the steady state net wealth of rich UK households is lower after the shock than before). By contrast, the US ends up being roughly in the same situation as they were before: the long-term contraction of their neighbour's economy – which could bring about less export for the US – is offset by the depreciation of the dollar and the capital gains accrued to American holder of financial assets denominated in pounds.

Finally, it is important to point out that the outcome just described does not depend on the size of the shock, or on the level of the parameters involved in the rebalancing mechanism of the external deficit of the economies, in the consumption functions of households or in the portfolio choices of asset holders (Table A in the appendix provides a multivariable sensitivity test with several different combinations of these parameters).

Experiment 2: A new distribution pattern for the whole population: the economic consequences of "more inequality"

After having tested the effects of a change in the consumption pattern of poor UK households on the economy as a whole and on the distribution of income and wealth, it is possible to make a step forward to verify *directly* what is the effect of a change in the primary distribution of income. By 'primary distribution of income' is meant the income earned from the production process, before the contributions of interest payments and other secondary capital incomes.

In the OPENTWOFOUR model, this test can be conducted in a quite straightforward way by tweaking the 'inequality coefficient' ($ic^{£}$ for the UK) whereby the distribution of primary income is set. In the following experiment it changes from 0.6 to 0.7 in the UK, while in the US it remains stable at 0.6. Again, this is not a change that in the real world can happen overnight. However, the 'synthetic shock' allows studying *in vitro* the consequences of a structural change like, for instance, the one brought about by a new balance of power between trade unions and employer organisations who leads to a lower wage share of national income for workers[131].

In a 'standard' SFC framework, as suggested in the analysis of experiment 1 (see point 2 above and note 128), the absence of the 'paradox of thrift' would imply that when income is moved from 'spendthrift' consumers to households with a higher propensity to save – and therefore more capacity to spend out of their wealth *in the future* – there is a short-run negative effect on the GDP and a long-term positive effect which more than offset the initial negative effect. Yet precisely *the opposite* happens in the OPENTWOFOUR model. Graph 4.13 shows a very short-lived recession in the UK just after the shock, followed by a medium-term expansion and a long-run steady state of GDP which is *lower* than the one before the shock.

The first conclusion which can be drawn from the experiment is that inequality is detrimental to the economy as a whole in the long-run. Interestingly, it appears to be beneficial to the economy of the trading partner (again, in the long-run).

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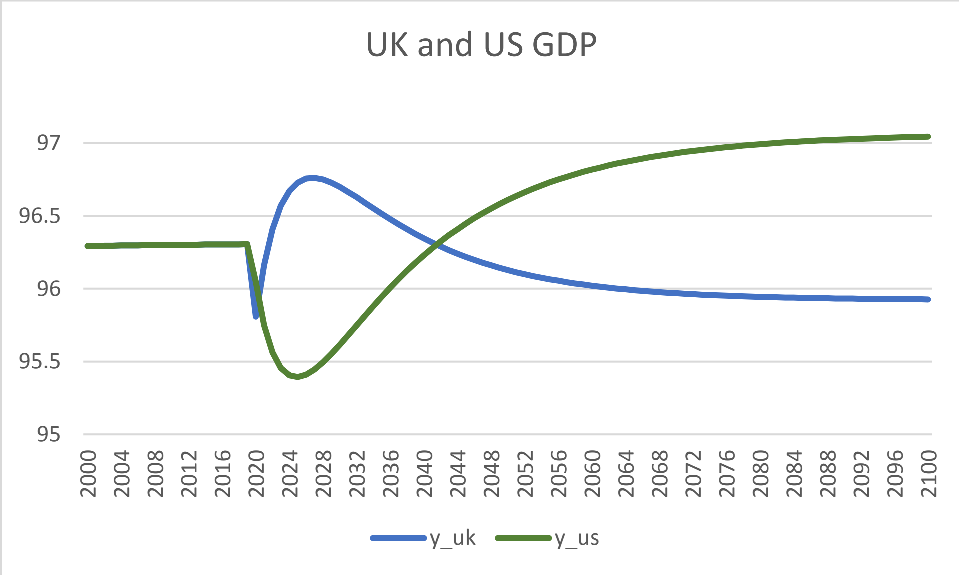
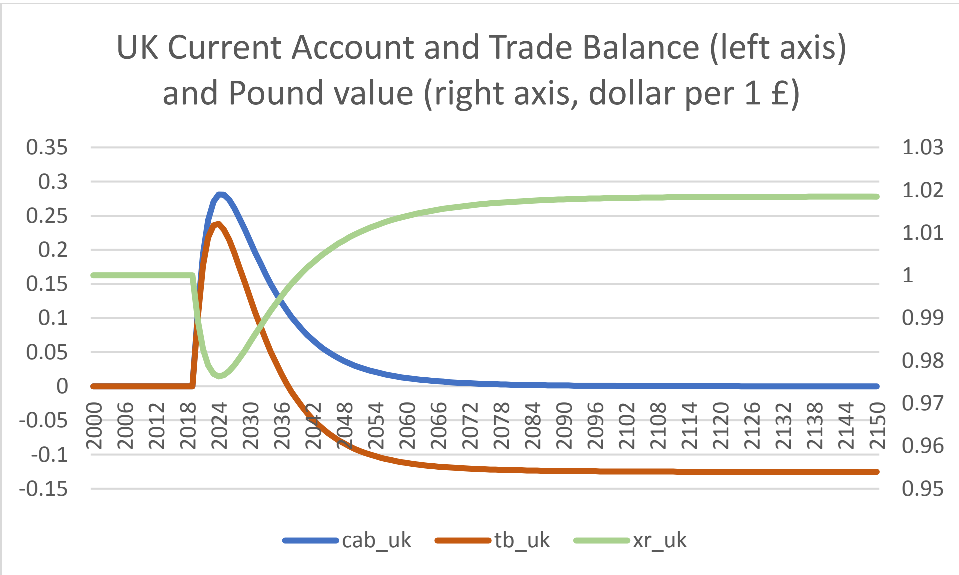
[131] Many other different narratives can be displayed to justify this shift in the $ic^{£}$ parameter, from a modification in the degree of competition of firms – which affect the magnitude of the mark-up and therefore the pattern of distribution – to a new government that intervenes in labour legislation. However, as far as all these factors can be more or less captured by the $ic^{£}$ parameter, there is no need to go further in examining their exact origin.

Graph 4.13: UK and US GDP following a shock in the UK inequality coefficient.



The external position of the British economy and the exchange rate of the pound are the keys to understand the reasons for the outcome shown in graph 4.13.

Graph 4.14: UK Current Account, Trade Balance and currency following a shock in UK inequality coefficient



Just after the shock, the consumption of UK poor households goes down while the consumption of rich households goes up. Due to the lower propensity to consume of rich households the immediate overall effect of the bottom-up income redistribution is negative. Hence the brief recession in the UK. The recession and a lower level of UK income and import bring about a positive trade balance and current account in the UK (US economy is initially barely hit by the recession 'imported' from their trading partner). When the trade balance and the current account turn positive, the currency tends to appreciate. However, in this case the sterling depreciates (see the green line in graph 4.14). It happens because the new distribution of income has boosted the saving of rich households. Part of this saving is invested in American bills. The outflow of capital more than offsets the positive position of the current account *given the initial level of the exchange rate*[132] and puts downward pressure on the pound that depreciates.

The weaker pound explains why the UK recession is so short-lived: one period later capital gains generated by the depreciation of the domestic currency boost the consumption of rich UK households and trigger the recovery. In the meantime, the UK continues to 'enjoy' the paradox of a positive current account and a weakening currency: this is again the effect of the portfolio decisions of UK rich households (and of the initial capital losses experienced in the US that drag down their import despite a stronger domestic currency).

At this point one could infer that a more unequal distribution of income has been beneficial for both the British economy as a whole and UK rich households. However, the situation reverses when the portfolio adjustment of rich British households is close to completion and there is no more outflow of capitals that offsets the positive current account and trade balance position. The pound starts to appreciate and to slow down the economy.

The new steady state of the pound is higher than the pre-shock steady state level: the large amount of foreign financial assets accumulated by British households implies a constant inflow of interest payments from the US that decreases the demand for dollars in the foreign exchange market and sustains the value of the sterling. That is why UK current account (blue line in Graph 4.14) ends up to be zero even if there is a negative permanent position on the trade balance (orange line in Graph 4.14). It is the constant upward pressure on the pound that is responsible for the 'hard landing' of the UK economy after the boom.

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[132] Naturally, it is impossible to track this discrepancy with a graph because in every single period the balance of payments is led to the equilibrium by the adjustment of the exchange rate. To grasp the reference to the discrepancy one should conduct a 'mental experiment' in an intra-period moment, when the change in the exchange rate has not taken place yet.

Furthermore, UK GNP (Gross National Product, that takes into account the net income earned by residents from overseas investments) is obviously higher than the UK GDP in the new steady state, exactly because the negative position of the trade balance is offset by the positive position of international unilateral transfers. However, UK GNP's steady state level is also lower after the shock than before, since the long-term burden[133] on the currency brought about by a higher volume of overseas investments makes UK's second recession steeper[134].

The 'narrative' just unfolded has tried to account for the results of the simulations in order to understand what 'the numbers are about'. Still, it is evident that the particular scenario described above is extraordinarily complicated, and it is quite difficult to pinpoint the 'main forces' at work among so many variables and equations.

Therefore, it is legitimate to ask: if the narrative does not emerge so 'clear' from the simulations, is there a way to 'test' it? It is possible to prove that the narrative is correct?

At the centre of the explanation of why UK total income is lower after the shock than before there is the role played by the higher level of overseas investment by UK rich households. If this explanation is correct, the lower is the interest rate on American government bonds, the lower is the volume of interest payments from the US, the lower should be the long-run positive[135] effect of these payments on the level of the pound. To the limit, in a world where the interest rates on government bonds are zero the whole mechanism previously described should not work, and the long-term effect of a bottom-up redistribution of income from poor to rich households should be null.

This is exactly what happens to the OPENTWOFOUR model when all the interest rates are set at zero and then the 'inequality shock' is activated ($ic^{£}$ passes from 0.6 to 0.7).

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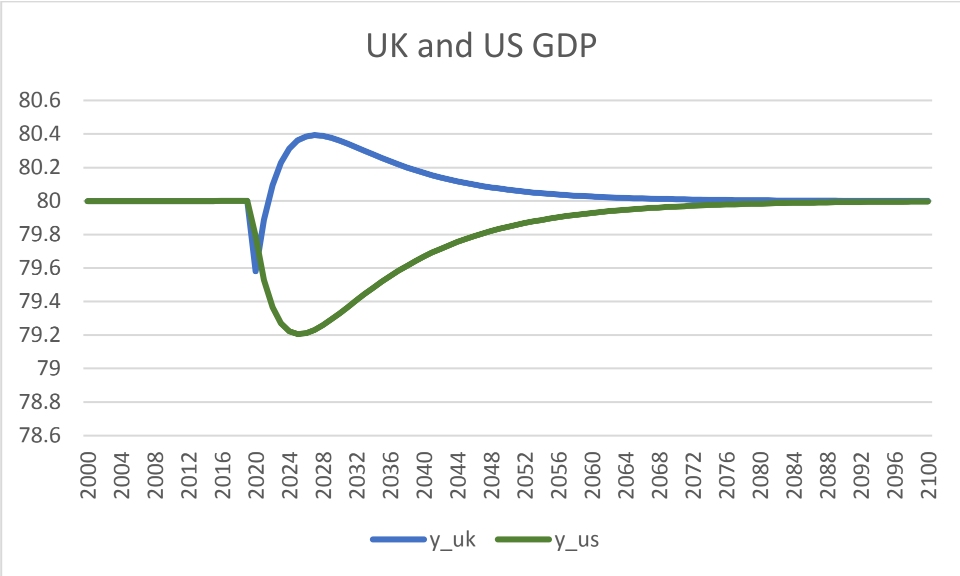
[133] Perhaps the metaphor of the *burden* can be misleading, because it is a kind of burden that pushes *upwards*, towards the appreciation of the currency. However, since this has negative consequences on the economy, it seems acceptable to use this term to describe the process.

[134] As far as the currency appreciates not only does the trade balance worsen, but the wealth of UK rich households is eroded by capital losses (dollar-denominated financial assets are worth less in domestic currency).

[135] Positive in the sense that this contributes to the strengthening of the currency. However, the economic effect is *negative*, because a stronger currency dampens economic growth.

Graph 4.15: UK and US GDP following a shock in the UK inequality coefficient in a world of zero interest rates



Graph 4.15 validates the narrative provided above and underlines the importance of interest rates and foreign investments on the interaction between economic performances and income distribution. More generally, it emphasises the fact that stocks matter: that is why Stock-Flow Consistent models offer a very good set of tools to deal with international economics issues.

In the appendix, the shift in the UK inequality coefficient has been controlled against the same variations of parameters displayed in the sensitivity test for the first experiment. From Table B it is apparent that the results just examined are absolutely robust to those alterations of parameters. The only circumstance in which post-shock British total income is not lower than its pre-shock value is when the parameters of import and export's sensitivity to the exchange rate are doubled (ϵ_1 and μ_1 pass from 0.5 to 1). This comes with no surprise as in this case the speed of the adjustment of the external position of both countries prevents the excessive accumulation of foreign assets by British UK households and the consequent over-appreciation of the pound. From this point of view, a trade which is 'ultra-sensitive' to exchange rates is equivalent to a very low level of interest rates.

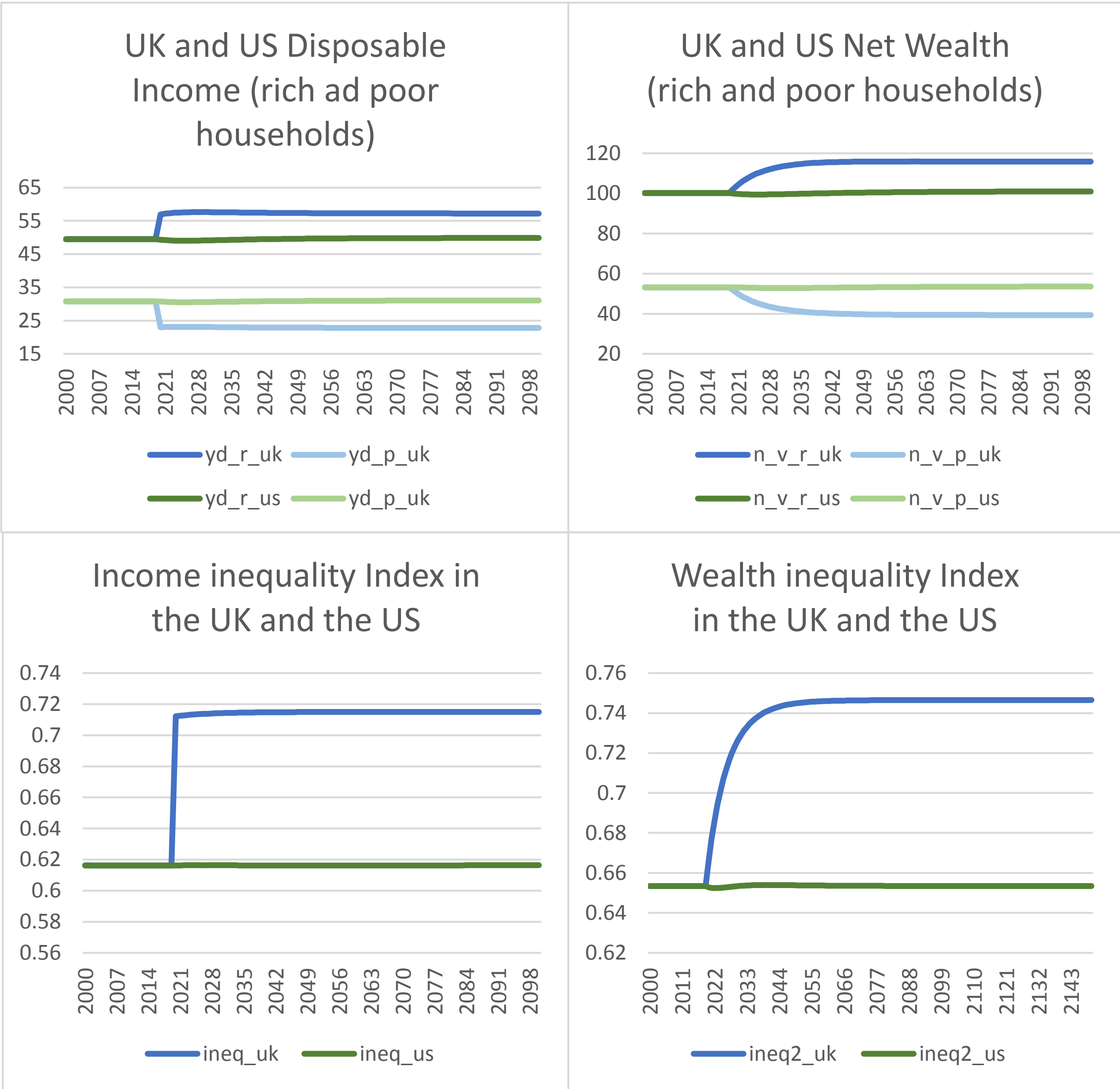
Finally, Graph 4.16 displays the evolution of rich and poor households' disposable income and of the indices of income and wealth distribution in the UK and in the US following the same shock to the inequality coefficient.

Despite the overall decline in total UK income, British rich households are better off at the end of the process, while the poor are worse off. Not only has the inequality of income increased[136], but also the inequality of wealth has significantly grown in the UK. By contrast, the distributional pattern of the trade partner (the US) has not been affected, while the overall level of US income has benefited from the rise of inequality in UK.

These dynamics also help to understand phenomena that took place in recent years on the world level and are often described as a paradox. On the one hand, we experienced a marked increase in the level of inequality *within* rich countries. On the other hand, international inequality *between* countries has decreased when the convergence of per capita income is considered (Darvas 2016). Not only are these conflicting forces actually at work simultaneously, but they could even be strictly related, in the sense that the first one could be among the pushing factors behind the second one.

[136] This comment is actually less trivial than how it looks like at first sight. It is true that income inequality has been exogenously increased. However, this only relates to the primary distribution of wages, being bank profits and interest rates of bonds related to stocks determined endogenously. Consequently – as in Cardaci and Saraceno (2016) – even if the level of inequality is 'shocked' exogenously, stocks "might allow income distribution to change endogenously" (Cardaci and Saraceno 2016, p. 19). Tracking the evolution of inequality in disposable incomes makes sense precisely because this second endogenous component is incorporated.

Graph 4.16: Disposable Income and Net Wealth (rich and poor), Index of income distribution and Index of wealth distribution in the UK and in the US following a shock in the UK inequality coefficient.



4.4 CONCLUSIONS

In the first part of this chapter a new two-county SFC 'benchmark' model with flexible exchange rates (the OPENSIME model) has been presented.

In the OPENSIME model the value of the main exchange rate is directly derived from the balance of payments. And the symmetry in the equations of the two countries is fully respected, even in the treatment of the financial assets' supply.

The advantages of this approach are twofold: the mechanism to determine the exchange rate is more 'transparent'; the comprehension of the drivers of the adjustment when a 'disequilibrium' of the external position of a country occurs is simpler. Consequently, the model reveals itself more 'readable' when it is shocked.

The behaviour of the OPENSIME model is qualitatively the same as the OPENFLEX model presented by Godley and Lavoie (2007 b: same reactions after the same kind of shock). These results are obtained despite a considerable reduction in the number of equations and variables in the OPENSIME model in comparison to the OPENFLEX.

The simplicity and the flexibility of the new benchmark have proved to be very useful in order to address complex themes, such as the relationship between financialization and inequality, with an open economy SFC framework.

The second part of the chapter included a brief literature review covering the most recent studies on inequality and financialization. Then the capability of the OPENSIME model to incorporate additional building blocks was practically tested. In particular, three additional modules have been embedded into the original structure: 1. Households have been divided into two different groups in each country (poor and rich. This gives a total of four 'consumption agents', hence the name of OPENTWOFOUR model). 2. Two different patterns of consumption have been considered; the second incorporates the possibility of imitative behaviour in line with the relative income hypothesis (Duesenberry 1949, Frank, Levine and Dijk 2014). 3. A completely new financial sector has been added: no financial sector made of private banks was included both in the OPENSIME and in the OPENFLEX model.

The computer simulations conducted via the OPENTWOFOUR model have shown that an increase in the emulative behaviour of the poorer portion of the population of a country has mid-long-term negative consequences not only on the economy as a whole, but also on the total disposable income both of the poorer *and the richer* part of the population of that country.

Furthermore, a new ‘primary income distribution’ pattern characterised by a higher level of inequality in a country is beneficial to the rich of that country but not to the economy as a whole. By contrast, a trading partner can benefit – in the long-run – from a more uneven income distribution of the neighbour.

The very interesting aspects of all these results are that they are produced by the impact on the economy of the variables that capture the links of a country with its ‘external world’, first of all the exchange rate and the stock of foreign assets held by households. In other words, the same results would not come out from an ‘equivalent’ closed economy model.

To sum up, given the importance of addressing topics such as the relationship between inequality and financialization within an open economy SFC framework, the chapter has been primarily devoted to provide the basic structure of this framework and to build tools that could also be used in more complex models. Indeed, the goal of the present work was to contribute to the development of a method rather than to add new evidence to an already rich literature on these topics. From this point of view, the OPENSIME and the OPENTWOFOUR seem to offer promising perspectives for further research. In particular, one or more of the following elements could be explored:

1. The inclusion of an Agent-Based sector in order to describe the behaviour of households in both countries with a much higher level of heterogeneity of the agents themselves (not limited by the dichotomy ‘rich and poor’).
2. The introduction of economic growth (in this case the steady state achieved by the model would not be a stationary state as in the OPENSIME and the OPENTWOFOUR).
3. The introduction of a more sophisticated and realistic representation of the credit constraints faced by the consumers.
4. The change of the emulative parameter into an endogenous variable linked with the differences in the consumption levels of the agents.
5. A more robust empirical foundation of the model.

APPENDIX I: SENSITIVITY TESTS EXPERIMENTS 1 AND 2

Table A: Multivariable sensitivity test for experiment 1 (increase of the emulation parameter in the UK).

Size of the shock	Parameters of the OPENTWOFOUR model						Pre-shock steady state values			Post-shock steady state value			Change after the shock		
$emu^£$	$\alpha_{1p}^£$	$\alpha_{1r}^£$	ε_1	μ_1	λ_{20}	$\alpha_2^£$	$Y^£$	$YD_r^£$	$YD_p^£$	$Y^£$	$YD_r^£$	$YD_p^£$	$\Delta Y^£$	$\Delta YD_r^£$	$\Delta YD_p^£$
0.15	0.77	0.73	0.5	0.5	0.25	0.13	96.31	49.49	30.82	92.67	47.42	29.25	-3.77%	-4.18%	-5.07%
0.15	0.77	0.73	0.7	0.7	0.27	0.13	96.40	49.55	30.85	92.82	47.51	29.30	-3.71%	-4.12%	-5.02%
0.2	0.77	0.73	0.5	0.5	0.25	0.13	96.31	49.49	30.82	91.21	46.59	28.63	-5.29%	-5.86%	-7.11%
0.15	0.77	0.73	0.5	0.5	0.25	0.09	107.34	57.03	34.35	100.36	52.98	31.37	-6.50%	-7.10%	-8.68%
0.3	0.7	0.7	0.5	0.5	0.25	0.14	98.60	51.05	31.55	90.32	46.39	27.94	-8.39%	-9.12%	-11.45%
0.15	0.8	0.7	1	1	0.25	0.13	97.25	50.13	31.12	93.65	48.07	29.56	-3.70%	-4.11%	-4.99%

Table B: Multivariable sensitivity test for experiment 2 (increase in the UK inequality coefficient).

Size of the shock	Parameters of the OPENTWOFOUR model						Pre-shock steady state values			Post-shock steady state value			Change after the shock		
$ic^{£}$	$\alpha_{1p}^{£}$	$\alpha_{1r}^{£}$	ε_1	μ_1	λ_{20}	$\alpha_2^{£}$	$Y^{£}$	$YD_r^{£}$	$YD_p^{£}$	$Y^{£}$	$YD_r^{£}$	$YD_p^{£}$	$\Delta Y^{£}$	$\Delta YD_r^{£}$	$\Delta YD_p^{£}$
0.7	0.77	0.73	0.5	0.5	0.25	0.13	96.31	49.49	30.82	95.92	57.23	22.81	-0.40%	15.65%	-25.97%
0.7	0.77	0.73	0.7	0.7	0.27	0.13	96.40	49.55	30.85	95.99	57.29	22.83	-0.42%	15.62%	-25.99%
0.72	0.77	0.73	0.5	0.5	0.25	0.13	96.31	49.49	30.82	95.85	58.77	21.22	-0.48%	18.76%	-31.14%
0.7	0.77	0.73	0.5	0.5	0.25	0.09	107.34	57.03	34.35	106.95	65.84	25.32	-0.36%	15.45%	-26.27%
0.73	0.7	0.7	0.5	0.5	0.25	0.14	98.60	51.05	60.99	97.53	60.99	20.72	-1.09%	19.47%	-66.03%
0.7	0.8	0.7	1	1	0.25	0.13	97.25	50.13	31.12	97.35	58.30	23.19	0.11%	16.31%	-25.49%

APPENDIX II: VARIABLES, EQUATIONS AND INITIAL VALUES OF MODEL OPENSIME

Macroeconomic Variables

$YD_r^£$ = Regular disposable income UK

$YD_r^\$$ = Regular disposable income US

$YD_{hs}^£$ = UK households Haig-Simons disposable income

$YD_{hs}^\$$ = US households Haig-Simons disposable income

$V^£$ = UK households' private wealth

$V^\$$ = US households' private wealth

$T^£$ = Taxes paid by UK households

$T^£$ = Taxes paid by US households

$Y^£$ = UK GDP

$Y^\$$ = US GDP

$C^£$ = Value of consumption in the UK

$C^\$$ = Value of consumption in US

$X^£$ = UK exports

$X^\$$ = US exports

$IM^£$ = UK imports

$IM^\$$ = US imports

$B_{£d}^£$= Demand for UK bills by UK households

$B_{£d}^\$$= Demand for US bills by UK households

$B_{\$d}^\$$= Demand for US bills by US households

$B_{\$d}^£$= Demand for UK bills by US households

$H_h^£$ = Money held by UK households

$H_h^\$$ = Money held by US households

$B_{£s}^£$ = UK bills held by UK households

$B_{£s}^\$$ = US bills held by UK households

$B_{\$s}^\$$ = US bills held by US households

$B_{\$s}^£$ = UK bills held by US households

$B_{cb£s}^£$ = UK bills held by UK central bank

$B^{\$}_{cb\$s}$ = US bills held by US central bank

$H^{£}_{s}$ = UK money supply

$H^{\$}_{s}$ = US money supply

$F^{£}_{cb}$ = UK Central Bank's profits

$F^{\$}_{cb}$ = US Central Bank's profits

$B^{£}_{s}$ = UK public debt (total UK bills issued)

$B^{\$}_{s}$ = US public debt (total US bills issued)

$xr^{£}$ = UK exchange rate (value of the pound in US dollars)

$xr^{\$}$ = US exchange rate (value of the dollar in the UK)

Variables not in the model, but used for the demonstrations in the chapter

$CAB^{£}$ = UK current account balance

$CAB^{£}$ = US current account balance

$FA^{£}$ = UK financial account balance

$FA^{\$}$ = US financial account balance

Exogenous variables

$G^{£}$ = UK government expenditure

$G^{£}$ = UK pure government expenditure

$r^{£}$ = Interest rate on UK bills

$r^{\$}$ = Interest rate on US bills

Model Parameters

$\theta^{£}$ = US Tax rate

$\theta^{\$}$ = US Tax rate

ε_0 = Constant of the UK export equation

ε_1= Elasticity of UK exports with respect to UK exchange rate

ε_2 = Elasticity of UK export with respect to US output

μ_0 = Constant of UK import equation

μ_1 = Elasticity of UK imports with respect to UK exchange rate

μ_2 = Elasticity of UK import with respect to UK output

$\alpha_1^{£}$ = UK propensity to consume out of income

$\alpha_1^{\$}$ = US propensity to consume out of income

$\alpha_2^{£}$ = UK propensity to consume out of wealth

$\alpha_2^{\$}$ = US propensity to consume out of wealth

λ_{ij}= Portfolio equations parameters

Equations

$$YD_r^{£} = Y^{£} + r_{-1}^{£} B_{£s-1}^{£} + r_{-1}^{\$} B_{£s-1}^{\$} xr^{\$} - T^{\$}$$

$$YD_{hs}^{£} = YD_r^{£} + \left(\Delta xr^{\$}\right) B_{£s-1}^{\$}$$

$$\Delta V^{£} = YD_{hs}^{£} - C^{£}$$

$$YD_r^{\$} = Y^{\$} + r_{-1}^{\$} B_{\$s-1}^{\$} + r_{-1}^{£} B_{\$s-1}^{£} xr^{£} - T^{£}$$

$$YD_{hs}^{\$} = YD_r^{\$} + (\Delta xr^{£}) B_{\$s-1}^{£}$$

$$\Delta V^{\$} = YD_{hs}^{\$} - C^{\$}$$

$$T^{£} = \theta^{£}(Y^{£} + r_{-1}^{£} B_{£s-1}^{£} + r_{-1}^{\$} B_{£s-1}^{\$} xr^{\$})$$

$$T^{\$} = \theta^{\$}(Y^{\$} + r_{-1}^{\$} B_{\$s-1}^{\$} + r_{-1}^{£} B_{£s-1}^{£} xr^{£})$$

$$Y^{£} = C^{£} + G^{£} + X^{£} - IM^{£}$$

$$Y^{\$} = C^{\$} + G^{\$} + X^{\$} - IM^{\$}$$

$$C^{£} = \alpha_1^{£} YD_{hs}^{£} + \alpha_2^{£} V_{-1}^{£}$$

$$C^{\$} = \alpha_1^{\$} YD_{hs}^{\$} + \alpha_2^{\$} V_{-1}^{\$}$$

$$\boldsymbol{X}^{£} = \varepsilon_0 - \varepsilon_1 \boldsymbol{xr}_{-1}^{£} + \varepsilon_2 \boldsymbol{Y}^{\$}$$

$$\boldsymbol{IM}^{£} = \mu_0 + \mu_1 \boldsymbol{xr}_{-1}^{£} + \mu_2 \boldsymbol{Y}^{£}$$

$$X^{\$} = IM^{£} xr^{£}$$

$$IM^{\$} = X^{£} xr^{£}$$

$$B_{£d}^{£} = V^{£}(\lambda_{10} + \lambda_{11} r^{£} - \lambda_{12} r^{\$})$$

$$B_{£d}^{\$} = V^{£}(\lambda_{20} - \lambda_{21} r^{£} + \lambda_{22} r^{\$})$$

$$B_{\$d}^{\$} = V^{\$}(\lambda_{40} + \lambda_{41} r^{\$} - \lambda_{42} r^{£})$$

$$B_{\$d}^{£} = V^{\$}(\lambda_{50} - \lambda_{51} r^{\$} + \lambda_{52} r^{£})$$

$$H_h^{£} = V^{£} - B_{£s}^{£} - B_{£s}^{\$} xr^{\$}$$

$$H_h^{\$} = V^{\$} - B_{\$s}^{\$} - B_{\$S}^{£} xr^{£}$$

$$B_{£s}^{£} = B_{£d}^{£}$$

$$B_{£s}^{\$} = B_{£d}^{\$} xr^{£}$$

$$B_{\$s}^{\$} = B_{\$d}^{\$}$$

$$B_{\$s}^{£} = B_{\$d}^{£} xr^{\$}$$

$$B_{cb£s}^{£} = B_s^{£} - B_{£s}^{£} - B_{\$s}^{£}$$

$$B^{\$}_{cb\$s} = B^{\$}_{s} - B^{\$}_{£s} - B^{\$}_{\$s}$$

$$H^{£}_{s} = B^{£}_{cb£s}$$

$$H^{\$}_{s} = B^{\$}_{cb\$s}$$

$$F^{£}_{cb} = r^{£}_{-1} B^{£}_{cb£s-1}$$

$$F^{\$}_{cb} = r^{\$}_{-1} B^{\$}_{cb\$s-1}$$

$$\Delta B^{£}_{s} = G^{£} - T^{£} + r^{£}_{-1} B^{£}_{£s-1} - F^{£}_{cb}$$

$$\Delta B^{\$}_{s} = G^{\$} - T^{\$} + r^{\$}_{-1} B^{\$}_{\$s-1} - F^{\$}_{cb}$$

$$xr^{\$} = \frac{-X^{£} + IM^{£} + r^{£}_{-1} B^{£}_{\$s-1} - \Delta B^{£}_{\$s}}{r^{£}_{-1} B^{\$}_{£s-1} - \Delta B^{\$}_{£s}}$$

$$xr^{£} = 1/xr^{\$}$$

(redundant equations:

$$H^{£}_{h} = H^{£}_{s}$$

$$H^{\$}_{h} = H^{£}_{s})$$

Initial values of stocks

$V^{£} = 0$

$V^{\$} = 0$

$B^{£}_{£d} = 0$

$B^{\$}_{£d} = 0$

$B^{\$}_{\$d} = 0$

$B^{£}_{\$d}$= 0

$B^{£}_{£s}$ = 0

$B^{\$}_{£s}$ = 0

$B^{\$}_{\$s}$ = 0

$B^{£}_{\$s}$ = 0

$B^{£}_{cb£s}$ = 0

$B^{\$}_{cb\$s}$ = 0

$H^{£}_{s}$ = 0

$H^{\$}_{s}$ = 0

$B^{£}_{s}$ = 0

$B^{\$}_{s}$ = 0

Initial values for lagged endogenous variables

$xr^{£}$ = 1

$xr^{\$}$ = 1

Initial values for exogenous variables

$G^{£}$ = 16

$G^{£}$ = 16

$r^{£}$ = 0.03

$r^{\$}$ = 0.03

Model's parameters

$\theta^{£}$ = 0.2

$\theta^{\$}$ = 0.2

ε_0 = -2.1

ε_1= 0.7

ε_2 = 1.228

μ_0 = -2.1

μ_1 = 0.7

μ_2 = 1.228

$\alpha_1^{£}$ = 0.75

$\alpha_1^{\$}$ = 0.75

$\alpha_2^{£}$ = 0.13333

$\alpha_2^{\$}$ = 0.13333

λ_{10}= 0.7

λ_{11}= 5

λ_{12}= 5

λ_{20}= 0.25

λ_{21}= 5

λ_{22}= 5

λ_{40}= 0.7

λ_{41}= 5

λ_{42}= 5

λ_{50}= 0.25

λ_{51}= 5

λ_{52}= 5

APPENDIX III: VARIABLES, EQUATIONS AND INITIAL VALUES OF MODEL OPENTWOFOUR

Macroeconomic Variables

$YD_r^£$ = Regular disposable income UK rich households

$YD_r^£$ = Regular disposable income UK poor households

$YD_r^\$$ = Regular disposable income US rich households

$YD_p^\$$ = Regular disposable income US poor households

$YD_{hsr}^£$ = UK rich households Haig-Simons disposable income

$YD_{hsr}^\$$ = US rich households Haig-Simons disposable income

$V_r^£$ = UK rich households' private wealth

$V_p^£$ = UK poor households' gross private wealth

$NW_p^£$ = UK poor households' net private wealth

$V_r^\$$ = US rich households' private wealth

$V_p^\$$ = US poor households' gross private wealth

$NW_p^\$$ = US poor households' net private wealth

$T^£$ = Taxes paid by UK households

$T^£$ = Taxes paid by US households

$C_r^£$ = Value of consumption of UK rich households

$C_p^£$ = Value of consumption of UK poor households

$C_r^\$$ = Value of consumption of US rich households

$C_p^\$$ = Value of consumption of US poor households

$Y^£$ = UK GDP

$Y^\$$ = US GDP

$Y_r^£$ = Share of UK GDP earned by UK rich households

$Y_p^£$ = Share of UK GDP earned by UK poor households

$Y_r^\$$ = Share of UK GDP earned by US rich households

$Y_p^\$$ = Share of UK GDP earned by US poor households

$X^£$ = UK exports

$X^\$$ = US exports

$IM^{£}$ = UK imports

$IM^{\$}$ = US imports

$B^{£}_{£d}$= Demand for UK bills by UK rich households

$B^{\$}_{£d}$= Demand for US bills by UK rich households

$B^{\$}_{\$d}$= Demand for US bills by US rich households

$B^{£}_{\$d}$= Demand for UK bills by US rich households

$DEP^{£}_{r}$ = Demand of bank deposits by UK rich households

$DEP^{£}_{p}$ = Demand of bank deposits by UK poor households

$DEP^{\$}_{r}$ = Demand of bank deposits by US rich households

$DEP^{\$}_{p}$ = Demand of bank deposits by US poor households

$H^{£}_{rh}$ = Cash held by UK rich households

$H^{£}_{ph}$ = Cash held by UK poor households

$H^{\$}_{rh}$ = Cash held by US rich households

$H^{\$}_{ph}$ = Cash held by US poor households

$H^{£}_{h}$ = Total cash held by UK households

$H^{\$}_{h}$ = Total cash held by US households

$B^{£}_{£s}$ = UK bills held by UK rich households (bills supply)

$B^{\$}_{£s}$ = US bills held by UK rich households (bills supply)

$B^{\$}_{\$s}$ = US bills held by US rich households (bills supply)

$B^{£}_{\$s}$ = UK bills held by US rich households (bills supply)

$DEP^{£}_{bank}$ = Total level of deposits in the UK

$DEP^{\$}_{bank}$ = Total level of deposits in the US

$g^{£}_{con}$ = Borrowing 'parameter' of UK poor households[137]

$g^{\$}_{con}$ = Borrowing 'parameter' of US poor households[138]

$L^{\$}_{p}$ = Demand for loans by UK poor households

$L^{\$}_{d}$ = Demand for loans by US poor households

$L^{£}_{s}$ = Supply of loans by UK banks

$L^{\$}_{s}$ = Supply of loans by US banks

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[137] We called it 'parameter' because it can only take the value of 1 or 0. However, its value is 'endogenous' – meaning that it depends on the dynamics of the model. That's why it must be treated as a variable and it has been put in the corresponding list.
[138] See note 137

$B^{£}_{bnot}$ = Notional level of domestic bills held by the UK banking sector

$B^{\$}_{bnot}$ = Notional level of domestic bills held by the US banking sector

$z^{£}$ = Trigger for notional UK bills bought by UK bank

$z^{\$}$ = Trigger for notional US bills bought by US bank

$B^{£}_{bank}$ = Actual level of domestic bills held by the UK banking sector

$B^{\$}_{bank}$ = Actual level of domestic bills held by the US banking sector

$A^{£}_{d}$ = Advances demanded by the UK banking sector to UK central bank

$A^{£}_{d}$ = Advances demanded by US banking sector to US central bank

$A^{£}_{s}$ = Advances supply by UK central bank

$A^{\$}_{s}$ = Advances supply by US central bank

$F^{£}_{bank}$ = Profits of the UK banking sector

$F^{\$}_{bank}$ = Profits of the US banking sector

$B^{£}_{cb£s}$ = UK bills held by UK central bank

$B^{\$}_{cb\$s}$ = US bills held by US central bank

$H^{£}_{s}$ = UK money supply

$H^{\$}_{s}$ = US money supply

$F^{£}_{cb}$ = UK Central Bank's profits

$F^{\$}_{cb}$ = US Central Bank's profits

$B^{£}_{s}$ = UK public debt (total UK bills issued)

$B^{\$}_{s}$ = US public debt (total US bills issued)

$xr^{£}$ = UK exchange rate (value of the pound in US dollars)

$xr^{\$}$ = US exchange rate (value of the dollar in the UK)

Exogenous variables

$G^{£}$ = UK government expenditure

$G^{£}$ = UK pure government expenditure

$r^{£}$ = Interest rate on UK bills

$r^{\$}$ = Interest rate on US bills

Model's parameters

$\alpha_{1r}^{£}$ = Propensity to consume out of income of UK rich households

$\alpha_{1p}^{£}$ = Propensity to consume out of income of UK poor households

$\alpha_{1r}^{\$}$ = Propensity to consume out of income of US rich households

$\alpha_{1p}^{\$}$ = Propensity to consume out of income of US poor households

$\alpha_{2}^{£}$ = UK propensity to consume out of wealth

$\alpha_{2}^{\$}$ = US propensity to consume out of wealth

$emu^{£}$ = Emulation parameter in the UK

$emu^{\$}$ = Emulation parameter in US

$\theta^{£}$ = US Tax rate

$\theta^{\$}$ = US Tax rate

ε_0 = Constant of the UK export equation

ε_1= Elasticity of UK exports with respect to UK exchange rate

ε_2 = Elasticity of UK export with respect to US output

μ_0 = Constant of UK import equation

μ_1 = Elasticity of UK imports with respect to UK exchange rate

μ_2 = Elasticity of UK import with respect to UK output

$\alpha_{1}^{£}$ = UK propensity to consume out of income

$\alpha_{1}^{\$}$ = US propensity to consume out of income

$\alpha_{2}^{£}$ = UK propensity to consume out of wealth

$\alpha_{2}^{\$}$ = US propensity to consume out of wealth

λ_{ij}= Portfolio equations parameters

$ic^{£}$= UK inequality parameter (portion of UK GDP earned by UK rich households)

$ic^{\$}$= US inequality parameter (portion of US GDP earned by US rich households)

$depsh^{£}$ = Portion of money held in the form of bank deposits by UK households

$depsh^{\$}$ = Portion of money held in the form of bank deposits by US households

$bo^{£}$ = Share of shortfall of UK poor households expenditure funded by loans

$bo^{\$}$ = Share of shortfall of US poor households expenditure funded by loans

Equations

$$YD_r^{£} = Y_r^{£} + F_{bank}^{£} + r_{-1}^{£}B_{£s-1}^{£} + r_{-1}^{\$}B_{£s-1}^{\$}xr^{\$} - T_r^{£}$$

$$YD_p^{£} = Y_p^{£} - r_{-1}^{£}L_d^{£} - T_p^{£}$$

$$YD_{hsr}^{£} = YD_r^{£} + \left(\Delta xr^{\$}\right)B_{£s-1}^{\$}$$

$$\Delta V_r^{£} = YD_{hsr}^{£} - C_r^{£}$$

$$\Delta V_p^{£} = YD_p^{£} - (C_p^{£} - \Delta L_p^{£})$$

$$NW_p^{£} = V_p^{£} - L_p^{£}$$

$$YD_r^{\$} = Y_r^{\$} + F_{bank}^{\$} + r_{-1}^{\$}B_{\$s-1}^{\$} + r_{-1}^{£}B_{£s-1}^{£}xr^{£} - T_r^{\$}$$

$$YD_p^{\$} = Y_p^{\$} - r_{-1}^{\$}L_d^{\$} - T_p^{\$}$$

$$YD_{hsr}^{\$} = YD_r^{\$} + (\Delta xr^{£})B_{\$s-1}^{£}$$

$$\Delta V_r^{\$} = YD_{hsr}^{\$} - C_r^{\$}$$

$$\Delta V_p^{\$} = YD_p^{\$} - (C_p^{\$} - \Delta L_p^{\$})$$

$$NW_p^{\$} = V_p^{\$} - L_p^{\$}$$

$$T^{£} = \theta^{£}(Y^{£} + r_{-1}^{£}B_{£s-1}^{£} + r_{-1}^{\$}B_{£s-1}^{\$}xr^{\$} + F_{bank}^{\$})$$

$$T^{\$} = \theta^{\$}(Y^{\$} + r_{-1}^{\$}B_{\$s-1}^{\$} + r_{-1}^{£}B_{£s-1}^{£}xr^{£} + F_{bank}^{\$})$$

$$C_r^{£} = \alpha_{1r}^{£}YD_r^{£} + \alpha_2^{£}V_{r-1}^{£}$$

$$C_p^£ = (1 - emu^£)\left(\alpha_{1p}^£ YD_p^£ + \alpha_2^£ NW_{p-1}^£\right) + \ emu^£ C_r^£$$

$$Y^£ = C_r^£ + C_p^£ + \ G^£ + \ X^£ - IM^£$$

$$Y_r^£ = ic^£ Y^£$$

$$Y_r^£ = Y^£ - Y_r^£$$

$$C_r^\$ = \alpha_{1r}^\$ YD_r^\$ + \alpha_2^\$ V_{r-1}^\$$$

$$C_p^\$ = \left(1 - emu^\$\right)\left(\alpha_{1p}^\$ YD_p^\$ + \alpha_2^\$ NW_{p-1}^\$\right) + \ emu^\$ C_r^\$$$

$$Y^\$ = C_r^\$ + C_p^\$ + \ G^\$ + \ X^\$ - IM^\$$$

$$Y_r^\$ = ic^\$ Y^\$$$

$$Y_r^\$ = Y^\$ - Y_r^\$$$

$$\boldsymbol{X}^£ = \ \varepsilon_0 - \varepsilon_1 \boldsymbol{xr}_{-1}^£ + \varepsilon_2 \boldsymbol{Y}^\$$$

$$\boldsymbol{IM}^£ = \ \mu_0 + \mu_1 \boldsymbol{xr}_{-1}^£ + \mu_2 \boldsymbol{Y}^£$$

$$X^\$ = \ IM^£ xr^£$$

$$IM^\$ = \ X^£ xr^£$$

$$B_{£d}^£ = V_r^£(\lambda_{10} + \lambda_{11} r^£ - \lambda_{12} r^\$)$$

$$B_{£d}^\$ = V_r^£(\lambda_{20} - \lambda_{21} r^£ + \lambda_{22} r^\$)$$

$$DEP_r^£ = (V_r^£ - B_{£d}^£ - \ xr^\$ B_{£s}^£)\, depsh^£$$

$$H_{rh}^{£} = V_r^{£} - B_{£s}^{£} - B_{£s}^{\$} xr^{\$} - DEP_r^{£}$$

$$DEP_p^{£} = V_p^{£}\ depsh^{£}$$

$$H_{ph}^{£} = V_p^{£} - DEP_p^{£}$$

$$H_h^{£} = H_{rh}^{£} + H_{ph}^{£}$$

$$B_{\$d}^{\$} = V_r^{\$}(\lambda_{40} + \lambda_{41} r^{\$} - \lambda_{42} r^{£})$$

$$B_{\$d}^{£} = V_r^{\$}(\lambda_{50} - \lambda_{51} r^{\$} + \lambda_{52} r^{£})$$

$$DEP_r^{\$} = (V_r^{\$} - B_{\$d}^{\$} - xr^{£} B_{\$s}^{£})\ depsh^{\$}$$

$$H_{rh}^{\$} = V_r^{\$} - B_{\$s}^{\$} - B_{\$s}^{£} xr^{£} - DEP_r^{\$}$$

$$DEP_p^{\$} = V_p^{\$}\ depsh^{\$}$$

$$H_{ph}^{\$} = V_p^{\$} - DEP_p^{\$}$$

$$H_h^{\$} = H_{rh}^{\$} + H_{ph}^{\$}$$

$$B_{£s}^{£} = B_{£d}^{£}$$

$$B_{£s}^{\$} = B_{£d}^{\$} xr^{£}$$

$$B_{\$s}^{\$} = B_{\$d}^{\$}$$

$$B_{\$s}^{£} = B_{\$d}^{£} xr^{\$}$$

$$DEP_{bank}^{£} = DEP_p^{£} + DEP_r^{£}$$

$$g^{£}_{con} = 1 \; iff \; \left(C^{£}_{p} - YD^{£}_{p}\right) > 0$$

$$\Delta L^{£}_{d} = \left(C^{£}_{p} - YD^{£}_{p}\right)(1 - bo^{£})g^{£}_{con}$$

$$L^{£}_{s} = L^{£}_{d}$$

$$B^{£}_{bnot} = DEP^{£}_{bank} - L^{£}_{s}$$

$$z^{£} = 1 \; iff \; B^{£}_{banknot} > 0$$

$$B^{£}_{bank} = z^{£}B^{£}_{bnot}$$

$$A^{£}_{d} = -B^{£}_{bnot}\,(1 - z^{£})$$

$$A^{£}_{s} = A^{£}_{d}$$

$$F^{£}_{bank} = r^{£}_{-1}B^{£}_{bank-1} + r^{£}_{-1}L^{£}_{s-1}$$

$$H^{£}_{s} = B^{£}_{cb£s} + A^{£}_{s}$$

$$DEP^{\$}_{bank} = DEP^{\$}_{p} + DEP^{\$}_{r}$$

$$g^{\$}_{con} = 1 \; iff \; \left(C^{\$}_{p} - YD^{\$}_{p}\right) > 0$$

$$\Delta L^{\$}_{d} = \left(C^{\$}_{p} - YD^{\$}_{p}\right)\left(1 - bo^{\$}\right)g^{\$}_{con}$$

$$L^{\$}_{s} = L^{\$}_{d}$$

$$B^{\$}_{bnot} = DEP^{\$}_{bank} - L^{\$}_{s}$$

$$z^{\$} = 1 \; iff \; B^{\$}_{banknot} > 0$$

$$B^{\$}_{bank} = z^{\$} B^{\$}_{bnot}$$

$$A^{\$}_{d} = -B^{\$}_{bnot}\,(1 - z^{\$})$$

$$A^{\$}_{s} = A^{\$}_{d}$$

$$F^{\$}_{bank} = r^{\$}_{-1} B^{\$}_{bank-1} + r^{\$}_{-1} L^{\$}_{s-1}$$

$$H^{\$}_{s} = B^{\$}_{cb£s} + A^{\$}_{s}$$

$$B^{£}_{cb£s} = B^{£}_{s} - B^{£}_{£s} - B^{£}_{\$s}$$

$$B^{\$}_{cb\$s} = B^{\$}_{s} - B^{\$}_{£s} - B^{\$}_{\$s}$$

$$F^{£}_{cb} = r^{£}_{-1} B^{£}_{cb£s-1}$$

$$F^{\$}_{cb} = r^{\$}_{-1} B^{\$}_{cb\$s-1}$$

$$\Delta B^{£}_{s} = G^{£} - T^{£} + r^{£}_{-1} B^{£}_{£s-1} - F^{£}_{cb}$$

$$\Delta B^{\$}_{s} = G^{\$} - T^{\$} + r^{\$}_{-1} B^{\$}_{\$s-1} - F^{\$}_{cb}$$

$$xr^{\$} = \frac{-X^{£} + IM^{£} + r^{£}_{-1} B^{£}_{\$s-1} - \Delta B^{£}_{\$s}}{r^{£}_{-1} B^{\$}_{£s-1} - \Delta B^{\$}_{£s}}$$

$$xr^{£} = 1/xr^{\$}$$

(redundant equations:

$H^{£}_{h} = H^{£}_{s}$ (OPENTWOFOUR 4.58)

$H^{\$}_{h} = H^{£}_{s}$ (OPENTWOFOUR 4.59)

Initial values of stocks

$V_r^{£} = 0$

$V_p^{£} = 0$

$V_r^{\$} = 0$

$V_p^{\$} = 0$

$NW_p^{£} = 0$

$NW_p^{\$} = 0$

$B_{£d}^{£} = 0$

$B_{£d}^{\$} = 0$

$B_{\$d}^{\$} = 0$

$B_{\$d}^{£} = 0$

$B_{£s}^{£} = 0$

$B_{£s}^{\$} = 0$

$B_{\$s}^{\$} = 0$

$B_{\$s}^{£} = 0$

$B_{cb£s}^{£} = 0$

$B_{cb\$s}^{\$} = 0$

$H_s^{£} = 0$

$H_s^{\$} = 0$

$B_s^{£} = 0$

$B_s^{\$} = 0$

$B_{bank}^{£} = 0$

$B_{bank}^{\$} = 0$

$L_d^{£} = 0$

$L_s^{£} = 0$

$L_d^{\$} = 0$

$L_s^{\$} = 0$

Initial values for lagged endogenous variables

$xr^{£}$ = 1

$xr^{\$}$ = 1

Initial values for exogenous variables

$G^{£}$ = 16

$G^{£}$ = 16

$r^{£}$ = 0.03

$r^{\$}$ = 0.03

Model's parameters

$\theta^{£}$ = 0.2

$\theta^{\$}$ = 0.2

ε_0 = -2.1

ε_1= 0.5

ε_2 = 1.228

μ_0 = -2.1

μ_1 = 0.5

μ_2 = 1.228

$\alpha_{1r}^{£}$ = 0.73

$\alpha_{1p}^{£}$ = 0.77

$\alpha_{1r}^{\$}$ = 0.73

$\alpha_{1p}^{\$}$ = 0.77

$\alpha_2^{£}$ = 0.13333

$\alpha_2^{\$}$ = 0.13333

λ_{10}= 0.7

λ_{11}= 5

λ_{12}= 5

λ_{20}= 0.25

λ_{21}= 5

λ_{22}= 5

λ_{40}= 0.7

λ_{41}= 5

λ_{42}= 5

λ_{50}= 0.25

λ_{51}= 5

λ_{52}= 5

$emu^{£} = 0$

$emu^{\$} = 0$

$ic^{£}$ = 0.6

$ic^{\$}$ = 0.6

$depsh^{£}$ = 0.7

$depsh^{\$}$ = 0.7

$bo^{£}$ = 0.5

$bo^{\$}$ = 0.5

CONCLUSIONS: ECONOMICS AND THE OPEN SOCIETY

"What a monument of human smallness is this idea of the philosopher king. What a contrast between it and the simplicity of humaneness of Socrates, who warned the statesmen against the danger of being dazzled by his own power, excellence, and wisdom, and who tried to teach him what matters most — that we are all frail human beings".
Karl Popper, The Open Society and its Enemies, 1945

"It is as evident in itself, as any amount of argument can make it, that ages are no more infallible than individuals;
every age having held many opinions which subsequent ages have deemed not only false but absurd; and it is as certain that many opinions now general will be rejected by future ages, as it is that many, once general, are rejected by the present".
John Stuart Mill, On Liberty, 1859

This thesis has covered a wide range of topics, from the impact of the exchange rates on the trade balance to the relationship between financialization and inequality.
The unifying elements of these different pieces of research are essentially two: the 'context' and the methodology.
With respect to the 'context', all the problems addressed in this thesis are treated in an open economy environment. Different two-country open economy models have been analysed – or built from scratches. Most of the time a flexible exchange regime has been assumed, as this is the arrangement that mirrors more closely the actual relationship between the main currency of Western economies: dollar, sterling and euro. However, the counterfactual of a fixed exchange regime has been used (e.g. in chapter 3) to provide some element of analysis referred to particular historical periods (e.g. the Bretton Woods era) or specific economic area (the eurozone).
The choice of focusing on open economy models rests on the acknowledgement of the importance of the 'external position' of a country/economic area in the dynamics of its economy and in its influence on the impact of different economic policies. Both the financial crisis that in 2007-2008 engulfed the United States and the world economy, and the debt crisis that from the end of 2009 has hit in particular the 'periphery' of the eurozone (Greece, Italy, Spain, Portugal and Ireland), cannot be

fully explained without taking into consideration the ‘external imbalances’ that have characterised those economies in the years preceding the crisis.

With regard to the method, the thesis has concentrated on Stock-Flow Consistent (SFC) models, as one of the most promising strands of research that have recently challenged ‘mainstream’ macro modelling. The need to explore new routes in macroeconomics has been justified in chapter 1, which summarised the recent debate about the ‘state of macro’. The financial crisis has exposed the limits of conventional macroeconomics based on the neo-Walrasian theoretical framework which inspires the Dynamic Stochastic General Equilibrium models. However, this has not resulted in a ‘change of paradigm’, as it happened during the Great Recession with the “General Theory” by John Maynard Keynes.

This is not bad news. If one shares the opinion that economics is essentially a ‘moral science', the idea that is could be finally led to a ‘consensus' should not sound very appealing.

Economics is a moral science because every theory is inextricably tied to a *Weltanschauung*, or a vision of the world. Descriptive and normative aspects of economic theories are sometimes very difficult to distinguish. And this happens because every scholar is always, and inevitably, influenced by her ideological, political and, ultimately, moral convictions. For instance, even the most impartial description of how things work, how the economy works in a certain point of space and time, cannot overlook the institutional framework that contributes to those specific results. The question of whether that institutional framework is consistent with the idea of justice of a scholar cannot remain unaddressed when particular economic policy prescriptions are put forward by the scholar herself.

If economics is essentially a moral science, we should be suspicious of the very concept of a ‘consensus’. Moral ideas are, and always will be, different because individuals are different. Their background, their story, their attitude towards society, their capacity of empathy and capacity of reasoning, their languages (and the categories of thought that the languages incorporate), are and will always be different. Only totalitarian regimes have the ambition to declare an ‘official truth’ on what is right and wrong concerning the arrangements that men and women device and set up to live together.

For all these reasons, the struggle for a more pluralistic environment in economics is something more than a statement in an academic debate. It is part of the struggle for an open society as opposed to a closed society dominated by *one* truth, *one* nation, *one* religion or *one* ethnic group.

It is a quite surprisingly paradox that in the field of macroeconomics, in the last decades, so many scholars with a great passion for competition and the free market have shown so little passion for real competition in the 'market of ideas'.

This thesis would like to represent a little contribution to a more 'open economic society'.

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