The Impact of Monetary Policy on Bank Credit and Trade Credit for the UK's SMEs: A Disequilibrium Model of Credit Rationing

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The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others.

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Abstract

This thesis aims to examine the extent to which the UK's SMEs face credit rationing and to examine the impact of monetary policy on the availability of bank credit to the UK's SMEs, and the substitution relationship between bank credit and trade credit. The estimation is based on a large dataset between 1991 and 2010. Using disequilibrium model of credit rationing to estimate the impact of monetary policy is able to detangle the effect of demand from the supply and it overcome the identification problem in the previous studies of credit channel of monetary transmission. An index of monetary condition (MCI) that incorporated both interest rate and exchange rate in the estimation has been used as a measure of monetary condition in the UK.

The results show that the demand for bank loans for small and medium sized firms increases when they have stronger needs of working capital and investment, lower level of internal cash flow and trade credit, and larger firm size. This is compared to micro sized firms in the sample which their demand for bank loans increase when they have more internal cash flow and trade credit, lower needs of working capital but stronger for investment, and firm size. The supply of bank loans for UK's SMEs was determined by firm risk, size, collateral, trade credit, and if it belongs to the manufacturing industry. The result also confirms that lower proportion of medium firms were borrowing constraint than micro and small firms.

Based on the fixed effect panel data estimation method, the results show that small and medium sized firms that are borrowing constraint use more trade credit than unconstraint, and those borrowing unconstraint tend to extend more credit to other firms when they have access to bank credit. The results provide practical knowledge for policymakers regarding the financing of the UK's SMEs, which plays a key role in the UK economy.

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1. Introduction

1.1 Introduction

The recent financial crisis in the mid of 2007 has spread to the real economy in countries around the world (Adair et al., 2009; King, 2011). The financial crisis has resulted in wealth destruction of US$50 trillion, which is equivalent to one year of the world GDP associated with a fall in the value of stocks, bonds, property, and other assets (Aisen and Franken, 2010). In the UK, the GDP has dropped by 5.5% between 2008 Q1 and 2009 Q2 (Astley et al., 2009). The International Monetary Funds (IMF) reported that banks in advanced countries have suffered losses of over US$4 trillion between 2009 and 2010 (Aisen and Franken, 2010). The huge losses in the banking sector have caused banks lowering their capacity to lend and willingness to take on risk, thus tighten the credit policy and being more selective in their credit granting (Duchin et al., 2010). As a result, a credit crunch emerged – a reduction in the general availability of loans or a sudden tightening of the conditions required for borrowers to acquire loan from banks.

The on-going credit crunch problem is crucial because bank credit plays an important role in amplifying and propagating initial shock of the financial crisis to the real economy, recently termed as ‘financial accelerator’. During the financial crisis, the fall in asset prices negatively affect the economy activity. The firms’ cash flow and net worth declined, in turn increasing their financial needs. However, the credit crunch problem reduces the ability of these firms in the access to bank credit to finance their

needs of working capital and investment. This credit restriction reinforces the initial real effect of the financial crisis. This situation where borrowers are unable to acquire the desired amount of bank loans, known as credit rationing, is the direct result of the credit crunch.

Increasing difficulty in the access to bank credit is especially significant for small and medium enterprises (SMEs), which tend to be informational opaque due to a lack of credit history (Atanasova and Wilson, 2004). For SMEs, bank credit has been suggested as a preferable source of external finance because banks specialise in collecting credit information and better identify the credit quality of the prospective borrowers. The UK's SMEs are greatly depending on bank credit to fund working capital needs and investment (Hall, 2001; OECD, 2006).

The recent financial distress in the banking industry and the adverse credit market condition as indicated above have been widely recognised as the causes of the intense depression in the worldwide economy. Both policy makers and researchers have attributed the slow economy recovery to substantial corporate debt liabilities and tight credit policies by the undercapitalised banking system (IMF, 2009; Allen et al., 2009). Therefore, it becomes important to understand the credit conditions in the corporate sector, especially SMEs that are crucial to the economy recovery. However, the analysis of credit rationing on corporate bank loans in the UK were less examined in the literature. Although there has been an increasing amount of literature that estimate the existence of credit rationing to identify the impact of the credit crunch, the majority of them emphasise on the US and other European countries. The analysis of credit rationing in the UK has not been updated since Atanasova and Wilson (2003). This

creates inspiration to the thesis to examine the extent of credit rationing in the access of the UK's SMEs to bank credit.

There are a few interesting questions arise from the credit crunch and the credit rationing in the financial crisis. For example, how do the borrowing constrained firms fund their working capital and investment needs when they face restriction in the access to bank credit. Although trade credit is a less desirable alternative to corporate borrowing, the borrowing constrained firms may use more interfirm credit offered by their suppliers in order to alleviate financial problem (Atanasova and Wilson, 2003; Danielson and Scott, 2004). Another question arise is that whether firms are willing to extend more interfirm credit as others are likely to have greater default risk and at the same time they are also likely to be affected by the shocks in the business cycle. The redistribution theory of trade credit suggests that the unconstrained firms with better access to external finance will extend the credit they receive to firms with less capability in the access to external finance (Garcia-Appendini and Montoriol-Garriga, 2013).

In response to the intensified financial crisis, the Bank of England (BoE)'s Monetary Policy Committee (MPC) implemented a loosening monetary policy using both conventional and unconventional measures to recover the UK economy from recession. The conventional measure of loosening monetary policy is related to the series of interest rate cut by the MPC, with a decrease of 3 percentage points during Q4 2008 and reduce to 0.5% that close to zero bound in early March 2009 (Joyce et al., 2011). The interest rate cut following a loosening monetary policy can improve the credit conditions as it decreases borrowing costs to encourage corporate borrowing to fund

investment and spending, therefore stimulates economic output. However, this transmission mechanism of monetary policy becomes more complicated during financial crisis because banks generally tighten the credit policy, restricting the corporate sector in accessing to bank credit, which cause the interest rate cut becomes ineffective to boost spending and to stimulate economy. This raises question about the effectiveness of the conventional measure of monetary policy in steering the economic activities through its impact on corporate borrowing.

The MPC also announced an unconventional measure in March 2009 that it would ease the monetary policy further through a programme of large scale asset purchase, known as quantitative easing. The purpose of the quantitative easing is to inject money directly into the economy in order to boost spending in order to stimulate economy into sustainable recovery, and to achieve the 2% inflation target (Joyce et al., 2011). Under the quantitative easing programme, the BoE has purchased a total amount of £200 billion of assets between March 2009 and January 2010, which mostly focus on medium and long-term UK government gilts. That was equivalent to 30% of the amount of outstanding gilts held by the private sector at the time, or 14% of the annual nominal GDP (Joyce and Spaltro, 2014). Several studies have examined the impact of quantitative easing, including Bernardo et al. (2013), Joyce et al. (2012), and Churm et al. (2015). However, these studies have focused on the impact on economic growth and financial markets, the effect of quantitative easing on bank credit has received little attention in the literature. Policymakers in the UK anticipated the quantitative easing to affect the output demand mainly through its impact on asset prices (i.e., the portfolio rebalancing channel). The bank credit channel works in a way that when assets are purchased from non-bank firms, banks gain additional reserves and a

corresponding increase in deposits. This increases banks' liquid assets and encourage banks extending more loans to corporate sector (Joyce and Spaltro, 2014). However, the policymakers anticipated little effect through bank credit channel because banks tend to deleverage during financial crisis. Nonetheless, it appears implausible that it has no effect through bank lending channel at all if compared to counterfactual of no quantitative easing.

1.2 Contribution of the Thesis

This thesis attempts to describe the contributions by explaining the significance of credit crunch and corporate financing for SMEs in the UK given the importance of SMEs in the UK economy, plus to generate knowledge based on a large unique panel dataset. Indeed, the analysis of credit rationing and impact of monetary policy in the UK has not been implemented since Atanasova and Wilson (2003) that examined the period between 1989 to 1999. This thesis also used the credit rationing model to detangle the supply and demand effect and thus is better than previous studies in examining the impact of monetary policy. These issues are further discussed in the following paragraphs.

During the financial crisis, credit crunch emerged as banks generally tightened their credit policy, restricting the corporate sector in accessing to bank credit. The credit restriction is crucial to the UK's SMEs, which plays a key role in the UK economy and they are greatly depending on bank credit to fund their working capital and investment needs. Both policymakers and researchers have attributed the slow economy recovery to substantial corporate debt liabilities and tight credit policies by

the undercapitalised banking system (IMF, 2009; Allen et al., 2009). In response to the intensified financial crisis, the BoE's MPC implemented loosening monetary policy by cutting interest rate close to zero bound and inject money directly to the economy through a large scale asset purchases. The impact on the corporate borrowing of the credit crunch and the effectiveness of loosening monetary policy in the UK remain unknown. Questions also arise about whether trade credit has been used by UK's SMEs as alternative to bank credit to fund their working capital and investment needs when they face restriction in accessing to bank credit. Also, it is unknown if the UK's SMEs are willing to extend more trade credit to the firms that face borrowing constraint.

This thesis contributes to the literature by addressing the above problems concerning the external financing of the SMEs in the UK. This thesis aims to generate knowledge based on a large unique panel dataset of the UK's SMEs between 1991 and 2010. The scope of this thesis is not limited to the recent financial crisis, but the overall borrowing conditions of the SMEs in the UK between 1991 and 2010, and to review the credit channel in the monetary policy transmission. Indeed, the analysis of the credit rationing in the UK has not been updated since Atanasova and Wilson (2003).

This study is targeted at the small and medium enterprises (SMEs) in the UK from 1991 to 2010. This study is targeted at SMEs because they play a key role in the UK economy. They make up the majority of jobs in the UK and account for a significant proportion of the UK GDP. In the 'SME Statistics for the UK and Regions 2009', BIS (2010) reported that 99.9% of all the 4.8 million private businesses in the UK are SMEs, and accounting for 59.8% (or 13.64 million people) of the private sector

employment and 49% (or £1,589 billion) of the private sector turnover. Mark Hoban, the financial secretary to the Treasury, highlighted the importance of SMEs as the drivers of economy recovery, innovation and growth from the perspectives of the UK and European policymakers (Crawley-Moore, 2011).

This thesis is mainly divided into three major parts. First, this thesis constructs man index of monetary condition (MCI) for the UK, which is used as a measure of the monetary condition to examine the impact of monetary policy on the corporate borrowing in the UK. The MCI is a leading indicator measuring the degree of tightness of monetary condition in an economy. The MCI is used because the interest rate itself is not a good indicator of the monetary policy stance because the monetary condition of a nation is also affected by some other factors, including the exchange rate. In fact, the MCI has been widely estimated and used by central banks, financial institutions, and governmental institutions as the indicator of the stance of monetary policy (Batini and Turnbull, 2002).

The second part of this thesis is to estimate the extent of credit rationing and to examine the impact of monetary policy and quantitative easing on the corporate borrowing. In order to estimate the extent of credit rationing, this thesis uses the disequilibrium model, which comprises of a demand and a supply equation, each containing the determinants of demand and supply of bank credit, respectively. The demand equation and the supply equation are used to estimate the firms' quantity of loan demand and loan supply. The credit rationed firms are those with the quantity of loan demand exceeds the quantity of loan supply. By using the disequilibrium model to estimate credit rationing, it is able to capture and to detangle the factors affecting

the demand and supply of bank loans. For example, it is able to capture not only the shocks to firms' balance sheet that banks used as a signal of creditworthiness such as collateral and credit risk, but also the shocks to the firm's demand for bank finance. Indeed, firms may reduce their purchases and investment in such deteriorating market demand and thus a drop in the demand for bank loans (Kremp and Sevestre, 2011). It is not possible to infer credit rationing by looking at the patterns of aggregate bank loans because a fall of bank loans may not be necessarily driven by restriction in bank credit but may be demand driven.

In order to examine the impact of monetary policy and quantitative easing on the credit supply to SMEs in the UK, the MCI (as a measure of monetary policy stance) that estimated in the first part of this thesis, and a measure of quantitative easing are included in the supply equation of the disequilibrium model. This thesis follows Morais et al. (2015) to use the change in the balance sheet of the BoE as ratio to nominal GDP as a measure of quantitative easing. Previous studies that examined the effect of monetary shocks to corporate sector face challenges in separating effect of firm-specific demand shock from supply shock (i.e., identification problem). For example, Bernanke and Blinder (1992) and others cited by Hulsewig et al. (2006) examined the credit channel of monetary policy transmission using the vector autoregression (VAR) analysis on the aggregate data. The results of these VAR analysis generally showed an obvious reduction of bank loans following a tighten monetary policy. However, it has been largely criticised for failing to identify whether the loans reduction is caused by a shift in loan supply or loan demand (e.g., Kashyap and Stein, 1995; Hulsewig et al., 2006; Brissimis and Delis, 2009). If the reduction in bank loans is solely driven by a fall in loan demand, then their analysis should not

form evidence showing the impact of monetary shock to banks' capital on corporate borrowers. By including a measure of monetary condition in the supply equation of the disequilibrium model, the identification problem can be solved because it disentangles the effect of firm-specific demand shock from supply shock.

The third part of the thesis is to examine the substitution relationship between trade credit and bank credit, i.e., whether SMEs in the UK that are subject to credit rationing use more trade credit as an alternative to bank credit. This part of thesis also examines if the SMEs in the UK are willing to extend credit to credit rationed firms that are likely to have greater default risk. This thesis uses the result of disequilibrium model that classifies the sample firms into borrowing constrained and unconstrained (in the second part) and then compares the trade credit behaviour between them. The substitution relationship between bank credit and trade credit are examined by estimating the determinants of trade creditors (i.e., accounts payable). The willingness of unrationed firms to extend credit to rationed firms can be examined by estimating the determinants of trade debtors (i.e., accounts receivable). In order to examine the effect of monetary policy and quantitative easing on the trade credit behaviour, the MCI and the measure of quantitative easing are also included in both the equations of trade creditors and trade debtors.

There is a considerable amount of prior literature providing analysis of trade credit as a source of fund substitute for bank credit in the UK, including Atanasova and Wilson (2004), Mateut et al. (2006), Guariglia and Mateut (2006), Mateut and Mizen (2003), Mateut et al. (2010), and Paul and Guermat (2009). These studies commonly use the fixed effect panel data method to estimate the substitution relationship between bank

credit and trade credit. This analysis remains minimal since then. Moreover, the majority of empirical papers that investigate the trade credit channel of monetary policy transmission focus only on the trade credit demand, but ignore the firms' willingness to offer trade credit. If firms are not willing to extend credit to customers, then firms might not able to use trade credit as a source of funds substitute for bank credit. The thesis contributes by estimating the equation of trade debtors, which contains the determinants affecting firms' willingness to supply interfirm credit.

In sum, the thesis contributes to an understanding of the extent of credit rationing in the access of the UK's SMEs to the bank credit, the impact of monetary policy on corporate borrowing, and whether firms use and able to use more trade credit as substitute for bank credit when they face restriction in accessing to bank credit. The thesis uses a large panel data of the UK's SMEs between 1991 and 2010. The analysis of credit rationing and financial behaviour of SMEs in response to a change in the monetary policy are important as references for the policy makers in order to make an adequate and effective decision to tackle with the economy recession.

1.3 Structure of the Thesis

The thesis is organised as follows:

Chapter 2 reviews the theories related to the credit rationing and the findings of previous studies of credit rationing. It includes defining the credit rationing and explaining the existence of credit rationing from the perspective of the New Keynesian school of economics, including the credit market imperfection, the model of bank-dependent borrowers, and the role of collateral in mitigating the credit market

imperfection. The perspectives of the Post Keynesian economics are also reviewed in this chapter. Moreover, this chapter also evaluates the empirical methodologies used by prior studies to examine the credit rationing and discusses the findings of these empirical studies.

Chapter 3 reviews the transmission mechanism of how monetary policy affects the economy through corporate borrowing, i.e., the money view versus the credit channel of monetary policy transmission. The two specific credit channels of monetary policy transmission are balance sheet channel and bank credit channel. Moreover, this chapter also reviews the transmission channels of quantitative easing that is designed to inject money directly into the economy in order to stimulate spending and economic activities, including portfolio rebalancing and bank lending channel. Moreover, this chapter evaluates the empirical methodologies used by prior studies to examine the existence of bank lending channel and bank credit channel of monetary policy transmission. as well as the findings of these empirical studies. A major challenge to these empirical studies is to separate the effect of demand shock from the supply shock of the monetary policy on the corporate borrowing. The result of this chapter is used in Chapter 5 to construct the empirical strategy to examine the impact of monetary policy and quantitative easing on the economy through corporate borrowing.

Chapter 4 constructs and estimates the monetary condition index (MCI) for the UK, which will be subsequently included in the supply equation of the disequilibrium model in order to examine the impact of monetary condition on the loan availability to the UK's SMEs. Instead of using official rate, MCI has been suggested as a better measure of monetary policy tightness of a nation because it takes into account other

factors such as exchange rate that might affect the monetary condition of a nation. This chapter includes an evaluation of the methodologies used by previous empirical studies to examine the monetary condition of a nation. This chapter also presents and discusses the estimated MCI for the UK.

Chapter 5 discusses the estimation methodology (i.e., disequilibrium model) used by this thesis to examine the impact of monetary policy on corporate borrowing and the extent of credit rationing targeted at SMEs in the UK. It includes a description of the construction and set up of the disequilibrium model, all variables included in the demand and supply equations, and the data used in the estimation of the disequilibrium model. It followed by the presentation of the result of the disequilibrium model and the extent of borrowing constraint among the UK's SMEs. This chapter also provides a discussion of the estimated results of the disequilibrium model and compare the differences of financial variables between constrained and unconstrained firms.

Chapter 6 further examine the implication of the credit rationing in the UK, whether SMEs in the UK that are borrowing constrained uses trade credit as a substitute fund for bank credit to alleviate the financial problem. This chapter uses the results in chapter 5 that classifying the sample into borrowing constrained and unconstrained and compares their behaviours in trade credit by examining the determinants of trade creditors. This chapter also estimates the determinants of trade debtors in order to examine the redistribution theory of trade credit, which suggests that borrowing unconstrained firms with better access to bank credit will extend the credit they receive to firms with less capability to access to bank credit.

Chapter 7 provides a summary of the empirical findings, concludes the contribution of this thesis, and to explain the problems encountered during the research process and limitations of this thesis.

2. Credit Rationing

2.1 Introduction

The major aims of this thesis include examining the credit rationing and the impact of monetary policy on the availability of bank credit to the UK's SMEs. It is important to gain an understanding on how firms might be credit rationed and how this differs between the SMEs and large firms, as well as the underlying mechanism of monetary policy transmission. This chapter is to provide a review of the theories and evaluate previous studies related to the credit rationing. This chapter begins with defining the credit rationing and briefly explaining the difference between credit rationing and credit crunch. This chapter also reviews the theories that explain the existence of credit rationing, including credit market imperfection, information asymmetry from the perspective of the New Keynesian economics, as well as the arguments of credit rationing from the perspective of the Post Keynesian economics. These theories of the credit market will be explained in the context of microeconomics. The model of bank-dependent borrowers is also discussed to explain the significance of credit crunch to the SMEs compared with large firms. This chapter also discusses the role of collateral in mitigating the credit market imperfection.

2.1 Definitions of Credit Rationing

There are several definitions have been developed by researchers to explain the meaning of credit rationing. The earlier definitions of credit rationing can be traced

back to Hodgman (1960), which described that credit rationing happens if there is greater demand for credit than supply in a given interest rate. Hodgman (1960) differentiated the traditional rationing and the credit rationing. Traditional rationing is the situation in which the borrower offers to pay higher interest rate to compensate for the risk that the lender assumes but the interest rate is overly high for the borrower (Hodgman, 1960). Credit rationing is related to behaviour of the lender who determines the maximum amount of payment that the lender will receive (principal and interest) based on its assessment of the borrower's credit quality and willingness to pay, and credit rationing occurs when the lenders believe that the interest rate charge based on the borrowers' credit demanded cannot compensate for the risk of default (Hodgman, 1960).

Besides that, credit rationing has also been broadly defined in the literature as a situation in which corporate borrower has excess demand for credit; cannot acquire a desired amount of credit from banks; and would like to increase borrowing but unable to do so (Martin, 1990). Bellier et al. (2012) provided a clearer definition by specifying that those face credit rationing are unsatisfied borrowers that are unable to borrow at the prevailing interest rate. Elwood (2010) described the credit rationing as the existence of excess demand for credit and that more funds being wanted by borrowers at market interest rate than are provided by lenders. The key to the definitions developed by Martin (1990), Elwood (2010), and Bellier et al. (2012) is that the excess demand for loans in the market cannot be cleared by increasing the interest rate.

Adair and Fhima (2014) divided the credit rationing into credit volume rationing and rationing of borrower. Credit volume rationing refers to the situation when lenders

provide a smaller amount of credit than the borrower's demand, while the rationing of borrower refers to the situation when the credit applicants are rejected (Adair and Fhima, 2014). The credit volume rationing was described by Kremp and Sevestre (2011) as partially rationing, which refers to the situation where only a fraction of loan the borrower apply for was rejected. The rationing of borrower was also described by Kremp and Sevestre (2011) as full credit rationing, which means that the credit application was fully rejected.

Stiglitz and Weiss (1981) presents a very important study of credit rationing and it provided a more comprehensive explanation of credit rationing. Stiglitz and Weiss (1981) defined credit rationing as a situation where a borrower is restricted from obtaining the amount of loans demanded even the borrower if willing to pay higher interest rate, and/or even the bank held an excessive loanable supply. Similarly, Brown (2011) described credit rationing as a situation in which the bank does not use interest rate to allocate funds. This implies that credit rationing occurs when the bank denies to provide any loan to certain groups of borrowers or to limit the size of loans granted, despite or because the borrowers are willing to pay higher interest rate. We will explain why banks denies to lend when the borrowers are willing to pay higher interest rate later in section 2.3.

In addition, credit rationing is also known as borrowing constraints (Atanasova and Wilson, 2003) and credit constraint (Hayashi, 1987; Grant, 2007; Helsen and Chmelar, 2014). Grant (2007) described that borrowers face credit constraint or rationing if they face some quantity constraint on the amount of borrowing. Studies such as Atanasova

and Wilson (2003) used borrowing constraint, credit constraint, and credit rationing interchangeably throughout their discussion.

Credit Rationing and Credit Crunch

Some may confuse credit crunch with credit rationing. Credit crunch refers to the reduction in the general availability of loans or a sudden tightening of the conditions required for borrowers to acquire loan from banks (Korab and Pomenkova, 2017). Credit crunch indicates a decline in the supply of credit that is unusually large for a particular stage of the business cycle, i.e., economy recession (Bernanke and Lown, 1991). When a credit crunch occurs, there is a leftward shift of the credit supply curve at at specified level of interest rate (Costa and Margani, 2009). Large number of borrowers may not able to obtain the desired quantity of credit demanded independently of interest rates due to tighten credit policy. However, during credit crunch period, it does not mean all companies must be credit rationed. Companies are still able to obtain bank credit during credit crunch period but the condition required is higher. Banks are only tightening their credit policy and set a higher condition for loan approval during credit crunch period. Credit rationed borrowers are those who not given the amount of credit demanded or credit application are rejected.

For example, in the recent financial crisis 2007-2010, the banking sector has suffered huge losses and caused banks to lower their capacity to lend and willingness to take on risk. Banks generally tightened their credit policy and being more selective in the loan approval. This circumstance implies the emergence of credit crunch, which indicates a reduction in the general availability of loans or sudden tightening of the conditions required for borrowers to acquire loans from banks. During the credit

crunch period, companies find it harder to obtain bank loans (although the central bank strives to loosen the monetary condition), but it does not mean all companies are credit rationed. Banks may require borrowers to have a lower debt to equity ratio, larger asset base, and better industrial experience.

Up to this point, it provides an understanding of the meaning of credit rationing. However, a question may arise is that why banks refuse to provide loans to certain borrowers, at least not the full amount of credit demanded. A possible explanation is that a bank might refuse to provide the amount of credit the borrower desire – because the bank does not want to make a loss as the borrower has a too high probability of default. It might be a bit more confusing that the bank rejects to offer loans when the borrower offers to pay higher interest rate for the loan. All these questions can be fully explained by the credit market imperfection theory developed in the New Keynesian and Post Keynesian economics, which will be explained in detail in the section 2.3.

2.2 Why Credit Rationing Exists?

As discuss in section 2.2, credit rationing can be defined as a situation in which a borrower desires to obtain a specific amount of bank loan but the bank reject to supply, at least not the full amount, despite or because the borrower offer to pay higher interest rate, even if the bank has excessive loanable supply. There are several questions arise here about the existence of credit rationing. First, why banks may reject to supply the amount of loans the borrower desires. Second, why banks may reject even if the borrower offered to pay higher interest rate. Third, why banks may reject because the borrower offered to pay higher interest rate. This section is to evaluate these questions

using the concepts and assumptions of the credit market imperfection theories. To explain the credit market imperfection, it is necessary to start by discussing the perfect and frictionless credit market from the perspective of the Neoclassical economics theory, which has been widely criticised for its unrealistic assumptions. The credit market imperfection theory suggests a possibility of a firm being credit rationed and the existence of credit rationing can be viewed from the perspectives of the New Keynesian economics and the Post Keynesian economics. Both New Keynesian economics and the Post Keynesian economics suggest a possibility of credit rationing. However, the proponents of the New Keynesian economics emphasise on the information asymmetry between lenders and borrowers. In contrast, the proponents of the Post Keynesian economics argue that the concept of information asymmetry is not important because even the borrowers themselves should also uncertain about the future returns and risks associated with the investment projects. These concepts will be discussed in the following subsections.

2.2.1 Assumptions of Perfect, Frictionless Credit Market

From the perspective of the Neoclassical economics, the credit market is perfect and frictionless based on the assumptions that lenders and borrowers in the credit market are have equal access to information about risks and returns to the lending and incur no transaction cost (Hubbard, 1995). The credit market is perceived as frictionless when there is no cost and restraint incurred associated with transactions in the credit market. The Neoclassical theory of rational choice assumes that lenders have complete and precise knowledge of the effects on outcomes of all potential competitor's choices of action (Crotty, 1993). In such a perfect and frictionless credit market, the capital

structure of a firm does not influence the real decisions of both the borrowers and the lenders, as described by Modigliani and Miller (1958) as the capital structure irrelevance (Hubbard, 1995). If this is the case, then the credit market should always achieve its equilibrium through the price adjustment mechanism. The price adjustment mechanism refers to the role of interest rate that always adjust upward to clear the credit market, i.e., the borrowers' demand for credit should always be fulfilled. The price adjustment mechanism works in a way that in the case of excess demand for loans over supply, there will always be an upwards adjustment in the level of interest rates (i.e., the price of bank loans). The upward adjustment of the interest rate will lead to a fall in the credit demand and/or increase in the credit supply until they are equated at a new equilibrium interest rate (Stiglitz and Weiss, 1981; Cowling, 2010). In other words, when a borrower demands an amount of loans more than the bank is willing to supply, the bank always offer more loans by increasing the interest rate up to a point the borrowers can accept.

Under the assumptions of perfect and frictionless credit market, both the banks and the borrowers will always able to make a loan deal by either the bank increasing the interest rate or the borrower reduces the credit demand at the interest rate they can accept. If the credit market works in this way, then the borrowers' demand for credit should always be fulfilled and the credit rationing should not exist. However, the assumptions of perfect and frictionless credit market have been widely criticised that do not exist in reality (e.g., Stiglitz and Weiss, 1981; Cowling, 2010).

It has been cited that the assumptions of the neoclassical model of perfect credit market are incorrect according to numerous empirical studies and there is no direct evidence

to show they are true (Crotty, 1993). Stiglitz and Weiss (1981) present an important study explaining that the credit market frictionless is not always happened in real world based on the asymmetric information of principal-agent model to describe the lender-borrower relationship. The credit rationing model developed by Stiglitz and Weiss (1981) has been widely agreed and documented in the corporate finance and microeconomics literature as a major perspective of the New Keynesian economists. The credit rationing model of the New Keynesian and Post Keynesian economists will be explained in the next section.

2.2.2 The New Keynesian Theory: Credit Market Imperfection

The New Keynesian theory suggests that the credit market is imperfect, in that means the borrowers' demand for bank loans is not always being fulfilled and the interest rate is not always used to clear the market. In this section, there are three questions sought to be answered in relation to the credit rationing using the perspective of New Keynesian theory. First, why does bank charges different interest rate to different borrowers? Second, why some borrowers are credit rationed? Third, why does bank reject to lend even if or because the borrower is willing to pay higher interest rate?

Why does bank charges different interest rate to different borrowers?

According to the New Keynesian economics theory, the credit market may not function perfectly because the lender (the principal) does not have sufficient information or knowledge of the borrower's (the agent) credit quality, known as the information asymmetry (Stiglitz and Weiss, 1981). The information asymmetry makes lenders challenging to produce accurate lending decisions. When making a loan

approval, the lenders concern the interest rate they receive and the associate riskiness of the loan. Borrowers who looks to obtain a loan is thought to have ex-ante private information about the potential return and risks associated with the investment project that is unknown by the lender (Crotty, 1996; Janda, 2006; Ekpu, 2016). The lenders may identify the expected mean return of an investment project, but it cannot determine the riskiness of a project (Ekpu, 2016). The information asymmetry between lenders and borrowers may give rise to the adverse selection and moral hazard problem. The adverse selection problem refers to the possible situation in which the borrower fails to pay back the loan, whereas the moral hazard problem arises when the borrower takes on riskier project to generate higher return than the originally stated in the loan contract that give rise to higher probability of default (Hall, 2001). In order to address the adverse selection problem and the moral hazard problem arising from the information asymmetry, rational lenders will incur agency costs to verify and monitor borrowers' claims. The agency cost will be translated to external finance premium (Stiglitz and Weiss, 1981; Janda, 2006; Jarrow, 2011). Moreover, the external finance premium also increase along with the riskiness of the borrowers because the lender incurs higher agency cost for higher-risk borrowers and to compensate the default risk associated with the borrower. Therefore, the interest rate banks charge must rise along with the default risk of the borrower. This explains why some borrowers are charged higher interest rate than some other borrowers.

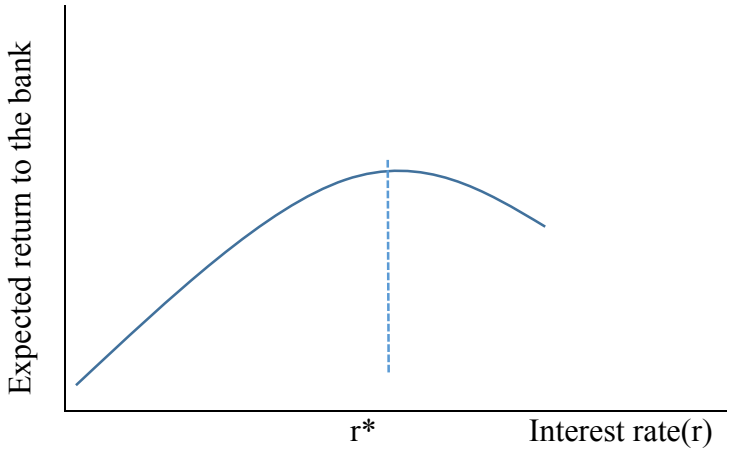
Why lenders are unwilling to lend to some borrowers, at least not the full amount that the borrower demanded?

Figure 1 in the next page helps to explain why lenders are not willing to lend to some borrowers, at least not the full amount that the borrower demanded. From the last paragraph, it showed why some borrowers are charged higher interest rate than others. Due to information asymmetry between lender and borrower that give rise to the adverse selection and moral hazard problem, the lender uses interest rate to compensate the default risk of the borrower resulted from the information asymmetry. The interest rate reflects the default risk of the borrowers. Higher interest rates are used to compensate the higher agency costs and higher default risk associated with the borrowers. Therefore, the interest rate the bank charges will increase along with the default risk of the borrower. Question arises is that why credit rationing exists when the higher interest rate can be used to compensate the higher risk borrowers? This can be explained by the idea that the expected returns to the bank depends on the probability of loan repayment or in other word the riskiness of the borrower. In other words, loans should be granted to those who offer the most reliable prospects that the loan will be repaid (Fioretti, 2005).

As shown in Figure 1, the expected return to bank will increase along with the interest rate but less rapidly than the interest rate because the probability of default associated with the borrower is higher along with the higher interest rates. At the interest rate lower than the optimal level of interest rate (indicated by r^*), the bank can make a higher expected profit because the implied default risk of the borrower is still low. However, the expected returns of the bank should reach its peak at the optimal level

of interest rate (r*), but started to reduce when the interest rate is beyond the optimal level (r*). This is due to the implied default risk above the optimal interest rate (r*) is too high that it will decrease the expected return to the bank. In other words, when it is perceived that the loan demand and supply are the functions of interest rate, the borrower's credit demand exceeds the supply if the implied interest rate is beyond the optimal level (r*) because the expected returns to bank decrease beyond the optimal level (r*). Therefore, the bank is not willing to lend to those borrowers with the probability of default beyond its optimal level implied by the interest rate.

Figure 2.1: Credit Rationing



r* indicates the optimal interest rate. This figure is used to help illustrating how credit rationing could happen. This figure is adapted from Stiglitz and Weiss (1981). This figure shows that the expected return to the bank increase along with the interest rate (i.e., the borrower's default risk), but less rapidly, up to the optimal level (r*). The bank can make a profit at the interest rate lower than r* as the implied default risk of the borrower is still low. However, the implied default risk above the optimal interest rate (r*) is too high that will decrease the expected return to the bank. The default risk can be explained by the adverse selection and moral hazard risk stemming from informational asymmetry between the bank and the borrower. Therefore, the bank is not willing to lend to borrower who offered to pay interest rate more than r*, and thus the borrower is credit rationed.

Why banks may reject to lend even if or because the borrower offers to pay higher interest rate?

From the last paragraph, it showed that lenders are not willing to lend to some borrowers because their default risks are too high that will reduce their expected returns. Question arises is that what if the borrowers offer to pay higher interest rate to compensate the default risks. Stiglitz and Weiss (1981) explained that banks may also not willing to lend to some borrowers if they offer to pay higher interest rate not only because higher interest rates indicate higher default risk, but also the interest rate itself may have an incentive effect on the behaviour of the borrowers after the signing of loan contract. The idea is that higher interest rates may induce the borrower to switch its funds to riskier project than originally stated with lower likelihood of success but higher returns when successful in order to cover the higher finance cost (Hall, 2001), which further increase the probability of default. Borrowers are willing to pay higher interest rate are perceived as higher risks because they believe that their likelihood of repaying the loan is low (Ekpu, 2016). This concept is known as the moral hazard or incentive problem, which is associated with the borrowers have ex-post private information over the lender (Ekpu, 2016). For the bank, the risk become higher than the case before it increases the interest rate. Therefore, rational lenders will not raise the interest rate to clear the credit market. This moral hazard or incentive problem explains why banks are not willing to lend to those borrowers with high default risk, even if or because they are willing to pay higher interest rates.

2.2.3 The Post Keynesian Theory of Credit Rationing

The New-Keynesian theory provides a sensible explanation of how the credit rationing may exist. It highlights the concept of information asymmetry between lenders and borrowers, in that the lender does not have complete information about the risk and returns of the borrower's investment project, and the borrower knows the risk and returns of the investment project better than the lender (Crotty, 1996). The information asymmetry between lenders and borrowers has led the lenders to use interest rate as a screening device to cope with adverse selection risk in the loan approval. It also highlights that interest rate itself may drive the borrower to take higher risk investment that is not originally stated in the loan contract and thus increase the default risk. The New-Keynesian theory suggests that banks' returns depend on the probability of loan repayment. When the interest rate charged on the borrower indicates the default risk is too high, it will decrease the overall bank returns. As a result, banks are reluctant to lend to borrowers with the level of default risk that is beyond its optimal level, and therefore credit ration.

However, it has been argued that the New-Keynesian theory ignored the fact that even the borrowers themselves are uncertain of the riskiness and returns of the investment projects. The Post-Keynesian theory takes into account this reality and argues that both lenders and borrowers do not have precise information about the riskiness and returns of the investment project (Ekpu, 2016). The Post-Keynesian theory argues that the information asymmetry is not important in practice because the borrowers, like the lenders, do not know with certainty about the riskiness and returns of the investment project. This is contrasted to the New-Keynesian theory, which assume that only the

lender is uncertain about the riskiness of the borrower. The proponents of the Post-Keynesian theory argue that both lenders and borrowers are subject to the fundamental uncertainty about the risk and possible outcomes of the investment project (Ramskogler, 2011).

The Post-Keynesian theory also enhances the New-Keynesian theory in explaining the existence of credit rationing by incorporating the effect of changes in macroeconomic condition on the borrowers' creditworthiness. According to the Post-Keynesian theory of credit rationing, banks assess the creditworthiness of the borrowers not only by evaluating the borrower's loan repayment history and financial condition, but also consider the prevailing macroeconomic conditions (Ekpu, 2016). The Post-Keynesian theory also argues that the economic environment of a new investment varies from the similar investments made in the past (Wofson, 1996). Moreover, the proponents of the Post-Keynesian theory also suggest that both the lender and the borrower will have different expectation about the future and therefore have asymmetric expectation about the future prospect of the investment returns (Ramskogler, 2011). In this case, the lender is perceived to be more risk-averse than the borrower because borrowers are more optimistic about the prospects of the investment and the value of collateral than the lender who are more objectively and carefully justified. Lenders will provide funds to fulfil the creditworthy loan demand, and ration all the loan demands that are not creditworthy. Lenders constantly review the borrower's financial condition and will alter their usual valuations of the lending risk.

Comments on the New Keynesian and Post Keynesian Theory

The above has discussed the theoretical framework of how the credit rationing may exist from the perspective of the New Keynesian and the Post Keynesian economics theory. It is now necessary to comment on these theories. First, the price mechanism as described by the Neoclassical economics must not be true in reality. Indeed, banks will not always raise the interest rate to fulfil the credit demand of borrowers along with the perceived riskiness of the borrower. When banks believe that the borrowers are overly risky, then rationally speaking banks will tend not to lend to them, at least not the fully amount demanded, due to the great chance of payment default.

The concept of information asymmetry highlighted by the New Keynesian theory is making sense, in that the borrower may have incentive not to fully disclose the real prospects of the investment project to the lender, motivated by its intention to obtain the desired quantity of loan, at least at minimum interest rate. The borrowers only present the favourable information that enable them to obtain bank loans successfully. As a result, lenders are likely to have only partial information about the creditworthiness of the borrowers, which give rise to adverse selection problem. In this case, lenders may not able to correctly assess the risk and returns associated with the borrower's investment. This is especially critical for the small, young SMEs, which tend to be informational opaque because they have limited business and credit history, compared to those larger, older SMEs.

However, the Post Keynesian economics theory argues that the information asymmetry is not important in explaining the credit rationing as it believes that even the borrowers do not have correct information about the risk and returns of the

investment project. In addition, it also depends on the future macroeconomic condition and business environment, in which the borrowers are uncertain. It also highlights that both lenders and borrowers should have different expectation about the risk and returns of the investment project, known as the asymmetric expectation. Nevertheless, it seems quite unreasonable to say that information asymmetry is not important in explaining the credit rationing. Indeed, the firm's managers should know better than the lender about the future prospects of the firm, the industry, and the business environment that affect them, simply because they are playing in the game. Lenders, on the other hands, are outsiders and they depend on reports generated by the corporate borrowers, as well as other similar investments and industrial reports by third party consultation firms. From this perspective, lenders should nevertheless face information asymmetry about the risk and returns of the borrower's investment project.

2.3 Credit Rationing, Credit Crunch, and SMEs

After explaining how credit rationing may occur, it is now necessary to discuss the relevance of the credit rationing to the SMEs. This section discusses why SMEs are depending on bank credit as an important source of external finance, and evaluates why SMEs are more subject to credit rationing by banks than large firms.

The credit market imperfection has strong influential implications to many important issues in economics through its significant effects in the corporate finance structure, especially those of small- and medium sized firms (SMEs). According to the perspective of New Keynesian economics, banks are preferable source of external finance than other debt finance because of their ability to better identification of

borrowers' quality and the cost advantage in monitoring the real ability of borrowers to repay loans, and thus reducing the agency costs incurred with overcoming the asymmetric information and incentive problems (Ramskogler, 2011). It is highly probable because banks specialise in collecting information about borrowers' ability to repay, including the patent of past loan repayment, income, and amount of present debt (Hall, 2001), obtained from the credit agencies/databases and the on-going relationships with customers. Moreover, banks as financial intermediaries may also be able to save searching and transaction costs that otherwise incur in the direct capital market. All these costs advantages have enabled banks to offer finance to their borrowers at a lower premium than in the direct capital market. This is especially important for smaller companies, which are particularly informational opaque and subject to these costs (Atanasova and Wilson, 2004; Atta-Mensah and Dib, 2008).

In contrast to larger firms, the fixed transaction cost of direct capital financing is likely to be a small proportion to their borrowing, and informational costs are likely to be lower due to their established reputations, bond ratings and published annual reports (Hall, 2001). Therefore, it is unlikely that large firms are highly dependent on bank finance but rather readily switch to finance from direct capital market. However, it is arguable that direct capital financing may be more costly for SMEs mainly due to asymmetric information problem (Hyytinen and Vaananen, 2006).

In the context of the SMEs, the consequence of credit rationing is that it might not only prevent the SMEs from having sufficient financial resource to fund profitable investment opportunities (Duchin et al., 2010), but also might seriously affect their ability to fund business operations, cause a dramatic surge in insolvencies and

bankruptcies, and eventually reflecting a failure in aggregate economy. Indeed, the perspective of New Keynesian economists suggests that SMEs have been largely dependent on bank credit as a major source of external finance in supporting their business activities. This has an important implication that any shock to banks' ability and willingness to lend may affect finance costs and availability of external finance to SMEs.

A number of studies have identified that bank credit is the main external source of finance for the SMEs (e.g., OECD, 2006; European Commission, 2011; European Commission, 2015; OECD, 2015). OECD (2006) reported that commercial banks are the main source of finance for the SMEs in most countries of the European Union. According to the Survey on the Access to Finance of Enterprises (SAFE) conducted by the European Central Bank (ECB) in 2011, half of all SMEs in Europe Union countries have applied for bank loans in the past two years (European Commission, 2011). The SAFE survey conducted by ECB in 2014 reported that bank loans is the main source of external financing for 62% of the SMEs in the European countries (European Commission, 2015). The latest report from OECD (2015) also indicated that bank credit is the most common source of external finance for the SMEs sector and entrepreneurs. Hall (2001) also indicated that small firms are more reliant upon bank finance than large firms, especially short-term loans including bank overdraft. Hall (2001) find that bank loans remain the most important source of external finance for small firms in the UK and bank loans represent about 60% of all external finance for small firms during 1997 to 1999. In contrast, for larger firms in the UK, equity issuance is main source of corporate external financing, partly as the results of a number of large equity-financed mergers and acquisitions (Hall, 2001).

This perspective of New Keynesian economists, with the support of empirical evidence, suggest that SMEs have been largely dependent on bank credit as a major source of external finance in supporting their business activities. This conclusion leads to an important implication that any shock to banks' ability and willingness to lend may affect finance costs and availability of external finance to SMEs.

2.4 Previous Studies of Credit Rationing

There is a growing amount of literature use disequilibrium model that developed by Maddala and Nelson (1974) to provide analysis on the extent of credit rationing. The disequilibrium model initially established to examine the existence and the extent of credit rationing at macroeconomic level and it has recently used to identify credit rationing using microeconomic data. Empirical papers that use microeconomic data to examine the extent of credit rationing endogenously include Ogawa and Suzuki (2000), Atanasova and Wilson (2004), Voordeckers and Steijvers (2008), Kremp and Sevestre (2011), and Carbo-Valverde et al. (2012), Adair and Fhima (2014), Farinha and Felix (2014), and Soana et al. (2015). They commonly assume that the quantity of credit demanded does not always being supplied or fulfilled due to credit market imperfection. Basically, the disequilibrium model consists of separate equations for demand, supply, and transaction equation, which allows estimation of proportion of firms facing credit rationing, that is, their demand for bank credit were not fulfilled by banks. An important advantage of using disequilibrium model to estimate credit rationing is that it is able to identify and isolate the effect of both demand and supply shocks to the credit condition of the sample firms. Their studies endogenously classified sample firms into borrowing-constrained and unconstrained using firm-

specific variables such as sales turnover, size, internal cash flow, trade credit, collateral, and riskiness. Their studies emphasise the advantage of using endogenous variables for classification over exogenous that based on dividend policy and relationship characteristics. Their studies argued that using exogenous variables to estimate credit rationing restrict the sample firms from switching between between credit rationed and non-credit rationed (Atanasova and Wilson, 2004; Voordeckers and Steijvers (2008), while some proxies of exogenous variables such as dividend policy and capital structure are the outcome of management decisions, and are not appropriate measures to estimate the credit rationing (Voordeckers and Steijvers, 2008).

Atanasova and Wilson (2004) present an important paper examine the extent of credit rationing and the impact of monetary policy on credit supply in the UK using disequilibrium model. A measure of monetary condition is included in the supply equation to estimate the credit channel of monetary policy through corporate borrowing. Their result show that collateral can mitigate borrowing constraints and firms' demand for bank credit rises but credit supply decreases during monetary policy tightening, whereas the proportion of credit-constrained firms is significant greater during recession. These results confirm the theoretical prediction of credit channel of monetary policy transmission. Moreover, the study also find that internal generated cash flow and trade credit are important substitutes for bank credit. A similar empirical strategy and specification has been used by other researchers to evaluate the credit rationing, including Ogawa and Suzuki (2000) in Japan, Voordeckers and Steijvers (2008) in Belgium, Kremp and Sevestre (2011) in France, and Carbo-Valverde et al. (2012) in Poland, Adair and Fhima (2014) in Tunisia, Farinha and Felix (2014) in

Portugal, and Soana et al. (2015) in Italy. These studies generally confirm the findings of Anatasova and Wilson (2004) that collateral significantly mitigate borrowing constraints, while internal generated cash flow and trade credit are important sources of funds substitutes for bank credit.

Carbo-Valverde et al. (2012) examine the impact of securitisation in the credit supply and the study finds that both asset and mortgage backed securities (ABS) and covered bonds as measures of securitisation can reduce credit constraints in normal period but can intensifies credit rationing in crisis period. Kremp and Sevestre (2011) based on data of French SMEs found that firms do not strongly affected by credit rationing even during the financial crisis since 2008, caused by a decreasing firms' demand for bank credit due to a significant fall in turnover and investment activities. Farinha and Felix (2014) examine on Portuguese SMEs found that a large proportion of firms was affected by credit rationing especially smaller and younger firms.

2.5 Collateral and Access to Finance of SMEs

As indicated in section 2.3, the credit markets may not function perfectly because lenders concern the adverse selection and moral hazard problem stemming from information asymmetry between lenders and borrowers. The credit market imperfection explains that a firm is credit rationed when its demand for bank loans more than the amount that bank is willing to supply. It is caused by the information asymmetry between lenders and borrowers that give rise adverse selection problem. If the bank believes that the default risk associated with the borrower is too high, it would refuse to lend to the borrower even if the borrower offers to pay higher interest rate. It

has to highlight that smaller and younger SMEs are more subject to credit rationing than large firms because they tend to be more information opaque, due to a lack of trading and credit history (Helsen and Chmelar, 2014). For smaller and younger SMEs, lenders face greater adverse selection and moral hazard problem arising from information asymmetry. The uncertainty about the creditworthiness of smaller and younger SMEs lead them to more likely be credit rationed. There are a number of studies suggested that collateral can be used to mitigate the credit rationing for under the information asymmetry (e.g., Cowling, 2007; Steijvers and Voordeckers, 2009; Vlieghe, 2010; Berger et al., 2011; Berger and Udell, 1995; Gama and Duarte, 2015). A number of surveys have identified the importance of collateral in obtaining loans from banks in the real business world. For example, the National Survey of Small Business Finance (NSSBF) reports that nearly one third of business loans in 1998 were granted with collateral provided, and this figure has increased to 45% in 2003 (Steijvers and Voordeckers, 2009). Recently, the Survey on the Access to Finance of Enterprises (SAFE) conducted by the European Central Bank (ECB) in 2011 reported that one in five of the SMEs managers indicated that insufficient collateral was the key factor preventing from getting bank loans (European Commission, 2011). The SAFE survey conducted in 2013 identified an increasing collateral requirement for German and French SMEs (Helsen and Chmelar, 2014).

Collateral plays a key role in mitigating the credit rationing arising from the problems of information asymmetry. For the smaller and younger SMEs that are particularly information opaque, it can be difficulty for the lender to assess their creditworthiness and the general viability of the economy. As a result, SMEs are more subject to credit rationing. In this case, collateral become an important assurance that allow the lender

to fix the interest rate more precisely, to the extent that the loan is covered by the value of the collateral (Helsen and Chmelar, 2014). From this perspective, it is able to justify that collateral is important sorting device for informational opaque SMEs (Steijvers and Voordeckers, 2009).

Collateral has been suggested as a sorting device (Cowling, 2009). The idea is that good borrowers are willing to provide collateral because they are confident that they will not make default payment as they do not want to lose their assets (Cowling, 2007). Bad borrowers are unwilling to provide collateral because they know they are risky and more likely to lose their collateral. Moreover, collateral can be used to align the incentive of borrowers with the interests of the lender. The borrower only concerns about own profits when the project is successful but does not suffer the losses because they can eliminate the losses by bankruptcy. Instead, the lender only earns the interest rate if the project is successful but will lose the entire loans if the project fails. In this case, it argues that high interest rate will not deter borrowers with high risky project but will screen out low risk borrowers who cannot afford high interest rates. Requiring collateral allows borrowers to suffer some losses on default, decreasing the asymmetry in the returns and in turn strengthening the sorting of borrowers (Helsen and Chmelar, 2014).

There are a number of studies in the literature have empirically examined the effect of collateral in the corporate borrowing. For example, Atanasova and Wilson (2003) and Ogawa and Suzuki (2000) incorporated the collateral assets as a variable in the credit supply equation and they found that it is an important determinant of loan availability for SMEs in the UK and Japan, respectively. These studies found that firms with more

collateral assets are offered more bank loans. These studies also concluded that collateral asset is an important factor in mitigating the credit rationing. Moreover, Bandt et al. (2008) test the role of collateral assets by comparing the results with and without collateral assets in the supply equation, using a large firm-level panel dataset in the European countries. Bandt (2008) found that collateral assets take an important role in the credit supply and is especially significant for small companies in their sample.

Berger et al. (2011) is a more recent paper to test whether the reduction in ex-ante information gaps between borrowers and lenders is associated with a lower incidence of collateral. In other words, it is to test whether collateral assets can mitigate the informational asymmetry between borrowers and lenders. Based on a dataset of 14,000 newly issued small business loan obtained from large US banks, Berger et al. (2011) finds a strong evidence suggesting that the need for collateral assets was lessened when banks can reduce the asymmetric information problem using credit scoring system to screening their borrowers.

2.6 Summary

The credit market imperfection has strong influential implications to many important issues in economics through its significant effects in the corporate finance structure, especially those of SMEs. The New Keynesian economics suggests that banks are preferable source of external finance than other debt finance because of their ability to better identification of borrowers' quality and the cost advantage in monitoring the real ability of borrowers to repay loans, and thus reducing the agency costs incurred

with overcoming the asymmetric information and incentive problems (Ramskogler, 2011). In contrast to larger firms, the fixed transaction cost of direct capital financing is likely to be a small proportion to their borrowing, and informational costs are likely to be lower due to their established reputations, bond ratings and published annual reports (Hall, 2001). Therefore, it is unlikely that large firms are highly dependent on bank finance but rather readily switch to finance from direct capital market. In the context of the SMEs, the consequence of credit rationing is that it might not only prevent the SMEs from having sufficient financial resource to fund profitable investment opportunities (Duchin et al., 2010), but also might seriously affect their ability to fund business operations, cause a dramatic surge in insolvencies and bankruptcies, and eventually reflecting a failure in aggregate economy. Indeed, the perspective of New Keynesian economists suggests that SMEs have been largely dependent on bank credit as a major source of external finance in supporting their business activities. This has an important implication that any shock to banks' ability and willingness to lend may affect finance costs and availability of external finance to the SMEs.

3. The Transmission Mechanism of Monetary Policy

3.1 Introduction

As discussed in Chapter 2, the credit market imperfection from the perspective of the New Keynesian economics provides an explanation of the existence of credit rationing and the SMEs are largely depending on bank loans as a source of external finance. The existence of credit rationing and credit crunch has important implications on the transmission mechanism of monetary policy. The transmission mechanism of monetary policy explains how a relatively small effect in interest rates following a change in monetary policy can result in a large volatility in the economic output of a nation. The debate lies on the role of credit market, i.e., money view versus credit view. The credit view emphasises the role of bank lending in the amplification and propagation of the initial effect of monetary shock on corporate sector.

The purpose of this chapter is to discuss the transmission mechanism of monetary policy and how it is related to the SMEs. This chapter starts with a discussion of how the transmission mechanism of monetary policy works from the money view and credit view. After that, this chapter discusses the excess sensitivity hypothesis, which describes how the credit market imperfections amplify and propagate the effects of monetary policy. This chapter also discusses the disturbance on the monetary policy transmission during the credit crunch period.

3.2 Monetary View: The Textbook IS/LM Model

In the money view of monetary policy transmission, banks offer no special services on the asset side of their balance sheet, but only on the liability side of their balance sheet. In other words, it creates money by issuing demand deposits (Hubbard, 1995; Peek and Rosengren, 2010). As specified in many textbooks, the idea of money view can be depicted in the typical IS/LM model, where there are two assets: money and bonds. The money view assumes that the capital structure does not affect the real decisions of the borrowers and lenders, and assumes that loans are perfect substitutes for bonds (Cavusoglu, 2002; Gambacorta, 2005). The proponents of money view suggest that in the event of monetary tightening, the rising interest rate will increase the cost of capital for the corporate sector, which will reduce the profitability of the firms' prearranged spending and investment activities. As a result, rational investors would reduce interest-sensitive investment activities and consumptions, in turn, deteriorate domestic demand and will lead domestic prices to drop (Huang, 2003; Gambacorta, 2005). Moreover, rising cost of capital will also likely to result in firms to reduce number of employees in order to cut operating costs thus having an income effect on households, and further adversely impacting consumption demand and declining sales and profitability of firms (Ferreira, 2007). In short, the money view focuses a shift in loan demand following a change in the interest rate implied by the policy shocks (Hulsewig et al., 2006).

Bernanke and Gertler (1995) present an important paper to analyse the transmission mechanism of monetary policy. Bernanke and Gertler (1995) tested the responses of GDP output and commodity prices to an unanticipated monetary policy tightening

using the US monthly data between January 1965 and December 1993 based on a vector autoregression (VAR) model. The results revealed three puzzles in the monetary policy transmission. The first puzzle is related to the monetary shock that induce only a small movement in open-market interest rates, but has a strong impact on the real economy. This was tested by examining the elasticity of interest rates against different components of GDP and empirical studies have not found relatively strong influence of the cost of capital on the private spending. The second puzzle concerns with the poor timing correspondence between interest rates changes and movement in some components of spending. The money view predicts that the effect of interest rate should stop once it goes back to normal. However, the empirical study discovered that some key components of spending do not begin to react until most of the interest rate effect is past (Bernanke and Gertler, 1995). The third puzzle concerns with the monetary policy that supposed to have significant short-term effect on the spending on assets with shorter lives such as inventories and consumer durables. Bernanke and Gertler (1995) found that most rapid effect has been reflected on residential investment, which is perceived as long-lived and should be most reacted to long-term real interest rates.

3.3 Credit View of Monetary Policy Transmission Mechanism

The puzzles shown in Bernanke and Gertler (1995) suggested that the impact of monetary policy shock is insufficient to be explained solely by the money view, and that has induced researchers to examine the role of the banking system in explaining the monetary policy transmission, known as the credit view or the credit channel. The credit view complements the conventional interest rate channel by emphasising the

role of banks that amplify and propagate the initial monetary shocks to firms' investment and consumption activities (Atta-Mensah and Dib, 2008; Fountas and Papagapitos, 2001).

In contrast to money view, the credit view recognises the presence of credit market imperfection, which posits that some corporate borrowers may have limited access to the capital market and rely on the banks credit as a source of external financing and thus they are not able to easily substitute to bonds issuance (Brissimis and Magginas, 2005; Gambacorta, 2005; Bolton and Freixas, 2006; Diaz and Olivero, 2010). As a result, it is predictable that any shock that either change the ability of firms to obtain bank credit or the ability of banks to supply finance would have significant impact on their spending and investment activities.

The key of credit view is that monetary policy innovation affects not only the interest rate, but also size of external finance premium, which is a premium associated with the agency costs of asymmetric information incurred by lenders as discussed earlier (Bernanke and Gertler, 1995). The credit channel specifies that the effect of monetary policy shock on firms is amplified and propagated by changes in cost and availability of credit over and above the standard impact on finance costs implied by change in official rates (Atanasova and Wilson, 2003; Freixas and Rochet, 2008). The ways that the effect of monetary policy can be transmitted to corporate sector under the credit view can be divided into balance sheet channel and bank lending channel.

3.3.1 Balance Sheet Channel

The balance sheet channel emphasises that the monetary shocks to firms' balance sheet that affect their ability to obtain external finance, further amplify and propagate the effects of initial monetary shocks to firms' investment activities and consumptions (Auel and Mendonca, 2010; Disyatat, 2010). Banks use the information of the firms' balance sheet as a signal of creditworthiness, including existing debts and debt to equity ratio, revenue and trends of growth, present and future cash flows, and many other measures derived from the firms' balance sheets that indicate the firms' ability to pay back their debt. Therefore, the external finance premium banks charge varies inversely with the firms' financial positions (Hubbard, 1995). The higher the borrowers' net worth (i.e., sum of liquid assets and marketable collateral), the lower the external finance premium charged. This is making sense because a stronger financial position implies a lower default risk borne by the lenders, and higher value of collateral assets can be used to secure loan liabilities, further reducing default risk, and thus a lower agency cost. Conversely, a higher external finance premium will be charged if the borrowers' net worth decreased as a higher default risk incurred.

The balance sheet channel works in a way that rising interest rates following a tightening monetary policy reduces firms' net worth and cash flows, thus a negative impact on firms' financial health. This increases loan premium that banks have to charge, and in turn affect borrowers' investment and spending (Brissimis and Delis, 2009; Florio, 2006). A tight monetary policy can affect the firms' balance sheets in two ways. First, higher interest rate increases burdens of firm's debt-service or finance costs, to the extent that borrowers have outstanding short-term or floating rate debt,

decreasing cash flows and profitability, thus weakening financial position (Hubbard, 1995). The impact of monetary policy on firm's operating cash flows is relatively significant because many firms greatly depend on short-term borrowing to fund business operations and investment. A fall in cash flows might increase proportion of firm's investment project must be financed externally and thus increase needs for external finance. Second, a tighten monetary policy could lead to a fall in asset value (Bernanke and Gertler, 1995). The implied rising cost of purchasing assets is likely to reduce the market demand and so a fall in asset price. A higher interest rate also discounts the cash flows generated from assets and thus a fall in the present value of collateral net worth (Hubbard, 1995). A declining net income and collateral value of assets affect its creditworthiness and as a result the firm only able to obtain external finance at higher premium, and even a reduction in the amount of loan (Freixas and Rochet, 2008).

3.3.2 Bank Lending Channel

The bank lending channel emphasises the amplification and propagation effects that generated by the banking sector, mainly through the impact of monetary policy on banks' balance sheet that influence the availability of loanable supply to their borrowers (Bernanke, 2007; Disyatat, 2010). The contraction in loan supply under the bank lending channel, in real business world, is often known as the credit crunch. The critical of credit crunch is that the impact of monetary tightening on external finance cost for some borrowers is beyond and over the increase in official interest rate, and may even reduce the amount of credit available to some borrowers. Loans spreads and quantities of lending are two key indicators of the cost and/or availability of finance

for borrowers to be impacted by credit crunch, as the results of the reduction in loan supply under the bank credit channel of monetary policy tightening (Hall, 2001).

Bernanke and Blinder (1988) is among the first paper to model the bank lending channel to enhance the money view in explaining the monetary policy transmission, by expanding the conventional IS-LM model to allow imperfect substitutability between bank loans and bonds. The fundamental idea of the bank credit channel is that monetary policy has additional effects on investment activities operating through adjustments to the assets side of banks' balance sheets, i.e., bank reserves (Bolton and Freixas, 2006; Diaz and Olivero, 2010). This is associated with the way that central bank can affect banks' loanable supply. The main method adopted by central bank is through open market operation, which either gives banks more reserves or takes reserves away from banks by buying or selling government securities in the open market (Baumol and Blinder, 2009; Peek and Rosengren, 2010). if central bank comes to a decision to pursue a loosening monetary policy, it increases banks' reserves by purchasing short-term government security/bond (known as Treasury bond or Gilt) from an institution or bank that want to sell them. Price of Treasury bond is an important factor to induce firms or banks to buy or sell them. That is, lower down bond price would encourage purchases, while increase the price would encourage sale.

Besides open market operations, central bank as the 'lender of last resort' can be important for monetary policy transmission to stabilise the investment activity (Baumol and Blinder, 2009). In the event of crisis that made banks unwilling to lend due to the general risky business environment, or the crisis itself hurts the ability of

banks to lend, central bank can intervene by lending to banks at lower rate, creating new reserves to banks, which encourage them to extend credit to firms.

To sum up, the interest rate channel views that the rising interest rate following the monetary tightening that increases the cost of capital may reduce the firms' prearranged investment and spending activities, which would lead to a series of adverse impact on economy. The credit channel complement the explanation by focusing on the credit market friction, that is, the rising interest rate causes declining collateral value of assets and cash flows that adversely affect the creditworthiness of corporate borrowers (i.e., balance sheet channel), plus the open market operations of central banks in the monetary tightening that takes away the bank reserves and so the reduction in capacity to lend to their borrowers who need additional funds to support their business operations (i.e., bank lending channel), and therefore amplifying and propagating the effect of initial monetary shock to the borrowers.

3.4 Implications of Credit Market Imperfection on the Monetary Policy Transmission Mechanism for the SMEs

As discussed in Chapter 2, the credit market imperfection from the perspective of the New Keynesian economics provides an explanation of the existence of credit rationing and the SMEs are largely depending on bank loans as a source of external finance. The existence of credit rationing and credit crunch has important implications on the transmission mechanism of monetary policy.

The SMEs are strongly depending on bank credit as a source of external finance. The New Keynesian economics suggests that bank credit is preferable source of external

finance than other debt finance because banks are able to better identify borrowers' quality and the cost advantage in monitoring the real ability of borrowers to repay loans, and thus reducing the agency costs incurred with overcoming the asymmetric information and incentive problems (Ramskogler, 2011). This is because banks specialise in collecting information about borrowers' ability to repay, including the patent of past loan repayment, income, and amount of present debt (Hall, 2001), obtained from the credit agencies/databases and the on-going relationships with customers. Moreover, banks as financial intermediaries may also be able to save searching and transaction costs that otherwise incur in the direct capital market. All these costs advantages have enabled banks to offer finance to their borrowers at a lower premium than in the direct capital market. This is especially important for smaller companies, which are particularly informational opaque and subject to these costs (Atanasova and Wilson, 2004; Atta-Mensah and Dib, 2008). Therefore, it is predictable that any shock to either banks' capital or ability of corporate sectors to obtain loans from banks could have a serious impact on their ability to fund business operations and investment, and so economic output.

The importance of monetary policy transmission in the SMEs is that the credit channel emphasises the role of bank lending in the amplification and propagation of the initial effect of monetary shock on the SMEs. The rising interest rate not only induces SMEs to reduce interest sensitive spending due to higher cost of capital, but more importantly due to the ability to obtain loans from banks to support their spending and investment. Specifically, the rising interest rate causes declining collateral value of assets and cash flows that adversely affect the creditworthiness of corporate borrowers (i.e., balance sheet channel), plus the open market operations of central banks in the monetary

tightening that takes away the bank reserves and so the reduction in capacity to lend to their borrowers who need additional funds to support their business operations (i.e., bank lending channel), and therefore amplifying and propagating the effect of initial monetary shock to the borrowers. Therefore, it is able to predict that any shock to the monetary policy has a strong impact on the corporate financing of SMEs, which are strongly depending on bank credit as a source of external financing.

3.5 Previous Studies of the Credit Channel of Monetary Policy Transmission

After reviewing the prior literature regarding how the studies examining the extent of credit rationing and their findings, it is now to review the prior empirical studies of the credit channel of monetary policy transmission. This section starts with a review on the prior literature on the balance sheet channel before looking into the bank lending channel.

3.5.1 Balance Sheet Channel

The theoretical prediction of balance sheet channel is that rising interest rate following a tightening monetary policy will increase firms burden of debt-service or finance cost to the extent of existing outstanding debt and also a fall in the present value of investment and assets due to higher interest rate. This in turn reduce firm's cash flow and its value of collateral, decreasing the firm's net worth, which negatively affect its creditworthiness and in turn firms are only able to obtain loans at higher external finance premium that banks charge, and further amplify and propagate the effect of initial monetary shocks.

Bernanke and Blinder (1995) is an important paper to carry out an empirical study on the credit channel of monetary policy transmission. To test the balance sheet channel, it used time series vector autoregression (VAR) model to examine the relationship between interest rates and coverage ratio and different components of corporate cash flow following an unexpected tightening of monetary policy. Coverage ratio has been suggested as an important measurement of risk associated with the ability of a firm to pay back its debts. Based on the US data between 1965 to 1995, Bernanke and Gertler (1995) find strong and immediate positive responses of coverage ratio along with the movement in funds rates, confirming the prediction of the balance sheet channel because the rising funds rate increases the interest expenses (the numerator of the coverage ratio) and lower the profit (the denominator of the coverage ratio). The study also finds a declining corporate cash flows and profits following a monetary policy tightening. It finds an increasing interest costs following a monetary tightening have directly contributed to the profits reduction, and at the same time, the corporate income fell faster than the cost of employee compensation. Moreover, the result shows that the cash of firms squeeze reached its peak around 6 to 9 months after the monetary contraction, at the time when output, inventories, and investment of firms start to reduce. The empirical study is important as it provides evidence confirming that the innovation in monetary policy can have a significant impact on the ability of firms in obtaining bank credit, in terms of their creditworthiness that banks most concern in making a loan approval, as the balance sheet channel posits.

Bougheas et al. (2006) and Huang (2003) examined the balance sheet channel using panel data approach and their studies examine the impact of monetary policy tightening (i.e., rising interest rate) on the firm's ability to raise bank finance based on

the firm-specific characteristics, such as size, risk, and debt. Based on a panel data of 16,000 manufacturing firms in the UK from 1989 to 2001, Bougheas et al. (2006) finds that more financial vulnerable firms (i.e., those smaller, riskier, and younger firms) are more markedly affected the monetary tightening than larger, more secure, or older firms. They also found smaller firms with less profitability, higher level of debts, or lower level of collateral assets were heavily reliant on short-term loans. The result confirms the balance sheet channel because balance sheets of smaller, younger, and riskier firms are greatly affected by initial rising interest rate and at the same time they heavily dependent on short-term loans but banks are unlikely willing to extend loans to them, therefore amplifying and propagating the initial impact of interest rate.

Huang (2003) attempts to find evidence of the balance sheet channel by looking at how the impact of monetary policy tightening on firms varies with the bank-dependency and those listed or non-listed. Based on a panel of 1024 listed non-financial firms in the UK between 1975 and 1999, the study found a general reduction of bank loans to firms during monetary tightening, but more obvious to the small, bank-dependent firms than large, non-bank-dependent firms which can benefit more from the relationship banking.

3.5.2 Bank Lending Channel

There are several empirical methodologies that have been used by prior studies to examine the bank lending channel of momentary policy transmission, including VAR analysis, flight to quality model, using bank-level data, and using the disequilibrium model. These empirical methodologies are evaluated in this subsection and their findings are also discussed.

VAR Analysis

Bernanke and Blinder (1992) present an important paper providing evidence of bank lending channel by examining the impulse response of bank loans, deposits, and securities of the US economy to a tightening monetary policy using VAR analysis. Based on monthly aggregate data from the balance sheets of commercial banks between 1941 1970, Bernanke and Blinder (1992) found an obvious reduction in the amount of securities and deposits but no significant change in bank loans in short run following a monetary policy tightening. This result matches the predictions of bank lending channel because following a monetary tightening, there would be a reduction in deposit available to banks partly due to the higher reserve requirement, and so a decrease in securities holding as banks can immediately liquidate the securities hold to diminish the effect of decrease in deposit. The study found bank loans only started to drop significantly over a longer run. One explanation of the phenomenon is the loan commitments and other implicit arrangements that prevent banks from quickly shifting their portfolios in response to a monetary shock (Bernanke and Blinder, 1992; Kashyap et al., 1993). Hulsewig et al. (2006) cited that a number of studies have tested the existence of bank credit channel using the approach of Bernanke and Blinder (1992) and they generally found similar results.

However, the empirical strategy used in Bernanke and Blinder (1992) to examine on the aggregate data has been widely criticised for containing a severe identification problem that is, unable to identify whether the reduction in bank loans is driven by a shift in loan supply or loan demand (e.g., Kashyap et al., 1993; Kashyap and Stein, 1995; Hulsewig et al., 2006; Dell'Aricca et al., 2008; Brissimis and Delis, 2009). It

should be noted that the credit channel focuses on the monetary effect on the loan supply whereas interest rate channel focuses on loan demand. They argue that if the reduction in bank loans is driven solely by loan demand, then the credit channel should not exist.

In recognition of this identification problem, there is a number of empirical studies attempting to separate the effect of the firm-specific demand shock from the supply shock. For example Kashyap et al. (1993) examine the behaviour of bank loans and commercial paper issuance; Kashyap and Stein (1995), Kashyap and Stein (2000), Kishan and Opiela (2000) examine the monetary policy effect on the loan behaviour of commercial banks using disaggregate bank-level data and empirical surveys on bank loans rejection, and Atanasova and Wilson (2004) and Baek (2006) adopt the disequilibrium model of credit rationing that allows classification of firms into borrowing-constrained and unconstrained.

Flight to Quality: Commercial Papers

Kashyap et al. (1993) attempt to solve the identification problem by examining the behaviour of bank loans and commercial papers, and it explained that if monetary policy worked only through the interest rate channel, the monetary policy contraction lead to a reduction in bank loans that is caused by a reduction in credit demand (i.e., induced by increasing cost of capital). If this is the case, then demand for other non-bank sources of borrowing should also be shrinking at the same time. In contrast, if the credit channel exists when reduction in bank loans is caused by a shift in loan supply, some firms might switch their finance by issuing commercial paper. Their empirical study found an immediate dramatic increase in the issuance of US

commercial paper following a tight monetary policy, and the bank loans only began to drop in longer run, indicating that banks limitation in loanable supply have resulted in borrowers to switch finance by issuing commercial paper.

Atanasova and Wilson (2003) provide a further interpretation of the finding of flight to quality. Atanasova and Wilson (2003) suggested that firms generally demanded more for short-term credit because the rising interest rate deteriorating their cash flows following a tightening policy, but access to the commercial paper market depends on their credit quality. They argued that the rising commercial paper was mainly contributed by the high-grade borrowers who were turned away from bank loans, as many firms are not always accessible to the commercial paper issuance, especially for SMEs, which are particularly informational opaque and more subject to additional costs incurred in issuing commercial paper. Therefore, the analysis of bank loans and commercial papers may not able to clarify the situation for the SMEs.

Bank-level Data

Testing the bank credit channel using aggregate data has been criticised that not possible to identify whether the contraction in bank loans is induced by a shift in loan supply or loan demand (e.g., Kashyap and Stein, 1995; Hulsewig et al., 2006; Brissimis and Delis, 2009). This has prompted some studies to use bank-level data to find evidence of the bank credit channel. These studies examined the impact of monetary policy tightening on the lending behaviour, deposits, and securities holding of individual banks according to their specific characteristics such as size, liquidity, and capitalisation.

Based on disaggregated data on the balance sheet of banks in the European countries between 1976 and 1992, Kashyap and Stein (1995) find that a tighten the monetary policy (i.e., increase federal funds rate) lead to a drop in the deposits available to banks and adversely affect the lending of smaller banks significantly, but increases the lending of large bank in the short run. The study also discovers that securities holdings of banks have been affected by monetary policy, and small banks are more sensitive to monetary policy than larger banks. This confirms the theoretical predictions of the bank lending channel that the monetary policy tightening affects the capacity of banks to lend. Their later study that based on nearly a million quarterly data on the US commercial banks between 1976 and 1993 also found a similar result, confirming the effect of monetary policy on the banks' lending behaviour in the US region.

Kishan and Opiela (2000), Gambacorta (2005), and Jimborean (2009) followed the approach of Kashyap and Stein (1995), but added bank capital as an additional factor. They specified that bank capital can act as a role of absorbing the effect of monetary shocks to the assets and thus a signal of bank's creditworthiness and ability to raise alternative funds and maintaining loan growth during monetary tightening. Based on 13,000 data of commercial banks in the US between 1980 and 1995, Kishan and Opiela (2000) find a result similar to Kashyap and Stein (1995) that undercapitalised banks are significantly responsive to a change in federal funds rate. Kishan and Opiela (2000) find that for undercapitalised banks with assets less than $50 million, one percentage point growth in the federal funds rate causes over 7% drop in the growth rate of current period in the total loans over four periods. This is compared to well-capitalised banks with the same level of assets, the total loans respond by only 4.4%. Based on a panel of the commercial banks' balance sheet data from 10 Central and

Eastern European countries between 1998 and 2006, Jimborean (2009) also confirms that smaller, high liquid banks strongly affected by the monetary policy tighten compared to larger and/or low liquid banks. Brissimis and Delis (2009) applied a similar approach to six OECD countries over 1996 to 2003 and it finds a strong evidence of bank credit channel in Japan and Greece, mainly due to the financial distress of 1990s in Japan and the recent financial deregulations that have not been absorbed in Greece during the sample period.

These empirical studies that use panel data approach generally find a negative impact of monetary policy tightening on banks' balance sheets, which affect their ability and willingness to lend, including deposits to banks, securities holdings, and their lending behaviour based on their characteristics such as size, liquidity, and bank capital. These studies provide evidence of the impact of monetary shocks on banks and it is predictable that banks affected by the monetary tightening shocks would tighten credit policy and therefore affect credit or financing condition of corporate borrowers. Nonetheless, it is criticised that these studies do not provide direct evidence of the impact on their corporate borrowers.

3.5.3 The Disequilibrium Model of Credit Rationing

Previous studies that examined the effect of monetary shocks to corporate sector face challenges in separating effect of firm-specific demand shock from supply shock of monetary policy. In other words, previous studies were not able to identify and isolate the effect of monetary policy on the supply side of the bank loans. For example, Bernanke and Blinder (1992) examined the credit channel of monetary policy transmission using the vector autoregression (VAR) analysis on the aggregate data.

The results of these VAR analysis generally showed an obvious reduction of bank loans following a tighten monetary policy. However, it has been largely criticised for failing to identify whether the loans reduction is caused by a shift in loan supply or loan demand (e.g., Kashyap and Stein, 1995; Hulsewig et al., 2006; Brissimis and Delis, 2009). If the reduction in bank loans is solely driven by a fall in loan demand, then their analysis should not form evidence showing the impact of monetary shock to banks' capital on corporate borrowers.

Atanasova and Wilson (2004) attempted to solve the identification problem encountered by the prior empirical studies by using the disequilibrium model of credit rationing to examine the credit channel of monetary policy transmission. By including a measure of monetary condition in the supply equation of the disequilibrium model, the identification problem can be solved because it disentangles the effect of firm-specific demand shock from supply shock. The advantage of using disequilibrium model to estimate the credit channel of monetary policy is that it is able to identify and isolate the effect of monetary policy on the demand and supply of bank credit to the sample firms. The disequilibrium model contains separate equations for the demand and the supply of bank loans. Therefore, it is able to capture the impact of monetary shocks to firms' balance sheet that banks used as a signal of creditworthiness such as collateral and credit risk. On the other hand, it is also able to capture the shocks to firm's demand for bank finance. Their result generally confirms the theoretical prediction that banks reduce their supply of loans to SMEs in the UK when the monetary policy is tight.

3.6 Impact of Macroeconomic Real Shocks on Borrowing

In recent empirical literature, there is a considerable amount of literature provide an analysis of how credit market plays an important role in amplifying and propagating the effect of macroeconomic real shocks on corporate sector and economy. In an important paper, Bernanke et al. (1999) developed a financial accelerator model, which they incorporate the assumptions of credit market imperfection into the standard macroeconomic model to demonstrate the role of credit market friction in the business fluctuation. Bernanke et al. (1999) is a very influential model that many studies provided analysis on the implication of the model. Bernanke et al. (1999) considers that a firm's demand for capital depends on the potential borrower's net worth that act as a negotiation of terms of external finance with banks. The general setup of the model involves incorporating these relationships into the Dynamic New Keynesian (DNK) model in order to illustrate how variations in borrower's net worth can amplify and propagate exogenous shocks to the system. In the model simulation, they studied on the shocks of technology, government expenditure, and the redistribution of wealth from households to entrepreneurs. The results strongly support the theoretical prediction of financial accelerator, which posit that credit market can amplify and propagate technology and demand shocks. Moreover, the results also indicate that the transfer of wealth from households to entrepreneurs does not show relevant effect in the system without financial accelerator, but show significant propagation effects when credit market frictions exist.

However, Gerali et al. (2009) argued that the model developed by Bernanke et al. (1999) does not incorporate the role of banks but assume that credit transaction makes

through the market. They improve the empirical model and test it using data from European Central Bank over the period between 1999 Q1 and 2008 Q3. Their estimated impulse response has confirmed the findings of Bernanke et al. (1999), and also found that the presence of banks has widens the spread between loan rates and policy rate and that should responsible for amplification and propagation effect on initial shocks. The empirical study also finds evidence of financial accelerator in the recent financial crisis where firms and banks were hit by macroeconomic shocks (i.e., correction of asset price bubble) and further amplified and propagated by credit crunch problem. Similarly, Christiano et al. (2007) and Goodfriend and McCallum (2007) also recognised the importance of banks in amplification and propagation of the initial shock to real economy, and thus incorporate banks in their DSGE model. However, for simplicity they assume the banks work under perfect competition and do not set interest rates, and therefore may not be realistic.

Cavalcanti (2010) tests the model of Bernanke et al. (1999) on a panel data for 62 countries between 1981 and 1998 to examine the relationship between credit market imperfections and financial accelerator. The empirical model is based on linear regression method to estimate the impact of monetary shock (measured by standard deviation of real interest rate), volatility of GDP and terms of trade, and volatility of GDP growth in the country's main trade partner, on the business fluctuation (measured by standard deviation of GDP growth per capita). The results indicate that for countries with low levels of credit market frictions, financial reform that intended to lower such frictions would result in a falling macroeconomic volatility, irrespective of the type of friction directed. In contrast, for countries with substantial high level of credit market friction, macroeconomic volatility would not change significantly due to the decrease

in contract enforcement costs, but could rise when the anti-creditor bias in judicial system decreases.

Diaz and Olivero (2010) is another paper that study the implication of Bernanke et al. (1999), i.e., the cyclical price-cost margin in credit markets as an amplifier of business fluctuation, based on quarterly data on banks' balance sheets between 1984 to 2005 in the US. The study treats the banks' price-cost margins as the external finance premium, measured by the difference between interest rate on loans and banks' marginal cost of funds. Four types of margins have been used in the test and they are the ratio of the difference between interest income and expenses to banks' assets; the ratio of difference between interest income and expenses to loans; the spread between bank prime and federal funds rate; and the spread between lending rate taken from business lending survey and federal funds rate. GDP and total loan as proxy of business cycles. Based on a VAR forecast error-based methodology, they find that economy activity is negatively and significantly correlated with all the margins, and therefore supporting the existence of financial accelerator.

Vijverberg (2002) attempts to test the impact of financial accelerator on small firms in the US industrial and commercial machinery and computer equipment sector between 1972 and 1991. The empirical model is based on a multi-equation switching regression model with the unit transaction cost of debt and rationed credit as measures of balance sheets and credit market conditions. In respect to the impact of a change in balance sheet on corporate investment behaviour, the result shows that a riskier firm with a higher debt-asset ratio tend to have higher transaction costs and so a lower investment, plus that a credit-constrained firm is not able to borrow as much as they desired for

inventory and therefore a decreasing corporate investment. Regarding the impact of a change in credit market situation on small firms, the study finds that a shock to credit has affect both capital and inventory investment, and more specifically, a larger impact on the inventory investment.

3.7 Quantitative Easing

3.7.1 Portfolio Balance Channel

There are several problems and challenges faced by researchers when carrying out empirical study on the impact of QE, including attribution issues and counterfactual problem. The first problem is attribution issues, which refers to the challenges in isolating the impact of QE on economic and financial development as there are many other monetary and fiscal policy interventions and shocks at the same time (Joyce et al., 2012; Bernardo et al., 2013). Those interventions include reduced interest rate, banks' capital requirement, a significant increased government spending and reduced taxation (i.e., fiscal policy to boost demand), injection of money to support market liquidity, as well as spillover effects from other countries such as US and Euro area taking the similar measures. Second, the counterfactual problem arises when it is not possible to truly answer the question whether the QE programme is effective in driving economic and financial development unless a counterfactual about what would have happened if QE intervention had not been carried out (Joyce et al., 2012).

There is a considerable amount of literature in the UK carried out studies on providing empirical evidence to support the portfolio balance channel of the transmission of quantitative easing to the economy. However, most empirical studies have inferred the

transmission of quantitative easing from the changes in financial market such as government bond prices or yields and other asset prices and risk spreads rather than from direct evidence on investors' behaviour (Joyce et al., 2014). Moreover, Bernardo et al. (2013) also suggest that it might take longer time lags for the QE to come to effect on the wider macroeconomic impact and as a result another factor that has to be controlled for in empirical study.

Bernardo et al. (2013) attempt to overcome the attribution and counterfactual problems by examining the impact of QE-related variables on nominal GDP growth using quarterly data from 1990 to 2012. It includes 4 lags of each variable and dummy variables in 2000 Q2 as structural break and in 2008 Q2 to 2009 Q2 to adjust for the effect of financial crisis. Bernardo et al. (2013) use bank rate (a main instrument of monetary policy), quantity of reserves in the banking system, total assets of BoE (a measure of portfolio rebalancing effect), ratio of long-term assets to assets held on BoE's balance sheet (a measure of qualitative easing), M4 broad money, and M4LREx bank credit to the real economy excluding effects of securitization (a measure of credit creation by banks). Using Hendry's 'general to specific' econometric methodology, the results show that disaggregated bank credit to the real economy (both households and corporate sector) has the most significant impact on nominal GDP growth. However, their results show that the changes in interest rate, reserves, and total central bank assets ratio do not have significant impact on GDP growth.

Using vector autoregression (VAR) model, Churm et al. (2015) found that the second round of the Bank's QE purchases during 2011-2012 and the initial phase of the FLS each boosted GDP in the UK by nearly 0.5% to 0.8%, whereas the effect on inflation

was broadly positive 0.6 percentage points at its peak. Joyce et al. (2012) documented an evidence showed a rise in the price of substitute assets for government gilt and a significant fall in corporate bond yield in 2009 after the QE programme was implemented. Moreover, Joyce et al. (2012) also found an improved capital market borrowing conditions in the UK as a dramatic increase in corporate bond and equity issuance in 2009.

Joyce et al. (2014) enhance the evidence of portfolio balance channel of QE by comparing the net investment behaviour of insurance companies and pension funds before and during the financial crisis, which allows estimation of the sectors that sold gilts to the Bank of England and where they reinvested the proceeds. Based on unique data on insurance companies and pension funds, Joyce et al. (2014) find that these insurance companies and pension funds reduce their investment in gilts but increase investment in corporate bonds. This finding is consistent with prediction of the portfolio balance channel, which posit that sellers of gilts will use the proceeds to invest in riskier, higher return assets and that will increase the asset prices and reduce yield, in turn increase net wealth of the asset holders, and as a result encourage spending and investment in the economy.

3.7.2 Bank Lending Channel

Joyce et al. (2011) specified that MPC anticipated a little effect through banking lending channel due to disruption in the financial system and consequent pressures on banks to extend more credit that might shrink the size of their balance sheets. Nonetheless, Bernardo et al. (2013) believed that the £200 billion of assets purchases

in the first round of QE programme in 2009 might have at least prevented a further decrease in credit creation but the effect may be limited.

Joyce and Spaltro (2014) test the bank lending channel of QE by examining the historical bank-level relationship between deposits and bank lending. Based on quarterly balance sheet data from 30 financial institutions in the UK, Joyce and Spaltro (2014) found the QE between 2009 and 2010 may have resulted in small but statistically significant increase in bank lending growth. Their results show the effect through bank lending channel are likely to be limited the estimated marginal effects through deposits are small and they suggest this might due to a low level of bank capital. In addition, they found that lending by small banks are more responsive to changes in deposits than larger banks and this implied the level of bank capital is an important factor in explaining the role of bank lending channel in the transmission of QE. This is consistent with the finding of Gambacorta and Marques-Ibanez (2011), which found banks with weaker capital positions and more reliance on market funding are likely to reduce their lending than banks with better capital positions during the financial crisis.

In contrast, Butt et al. (2014) used different empirical strategy found no statistical significant evidence on the effect of QE in increasing bank lending in the UK based on a unique dataset available combining the balance sheet and market operation data of financial institutions between 1990 and 2013. Using a different-to-different approach, Butt et al. (2014) separated banks into one with large share of funding from other financial corporations (OFCs) and another without, and they found no evidence that banks have used the deposits generated from OFC to increase lending. Moreover,

Butt et al. (2014) also test whether rises in OFC deposits realised during QE were correlated with improved lending by using the exogeneity of gilt sales by customers. After controlling for bank specific effects and system-wide changes in credit provision, they found the changes in OFC deposits were not correlated with changes in lending. In addition, Butt et al. (2014) found evidence of flighty deposits that both reserves and OFC deposits increased in banks that participated in gilt sales but only a portion of the money left at the end of the month. This suggests that banks are less likely to have used the deposits to extend lending but implies that the transmission of QE worked through portfolio rebalancing channel.

3.8 Summary

One major challenge to the empirical studies to examine the impact of macroeconomic shocks to the corporate borrowers is to separate the effect of firm-specific demand shocks from the supply side shock. For example, Bernanke and Blinder (1992) examined the credit channel of monetary policy transmission using the VAR analysis on the aggregate data. The results of these VAR analysis generally showed an obvious reduction of bank loans following a tighten monetary policy. However, it has been largely criticised for failing to identify whether the loans reduction is caused by a shift in loan supply or loan demand. One strand of empirical researchers that suggested that examining the effect of monetary shocks to the banks' balance sheets is a useful evidence to predict the effect on the corporate borrowers. However, it is argued that this is indirect evidence and so should not form the main evidence to determine the effect of macroeconomic shocks to the corporate borrowers. Instead, the adoption of disequilibrium model of credit rationing is able to eliminate this identification problem

by setting up separate equations containing factors determining the credit demand and supply. Its endogenous regime switching allows better classification of firms into borrowing-constrained and unconstrained without restriction once assigned.

4. Monetary Condition Index (MCI) for the UK

4.1 Introduction

One of the aims of this thesis is to examine the impact of monetary policy on the availability of bank loans for the UK's SMEs over the sample period between 1991 and 2010. In Chapter 3, it has provided a discussion of the roles played by banks in amplifying and propagating the initial effect of interest rate shock in the monetary policy transmission. It is now necessary to produce a measure of monetary policy stance for the UK. This chapter aims to develop an index of monetary policy as the indicator of monetary policy stance in the UK between 1991 and 2010. The estimated MCI will be used in the supply equation of the disequilibrium model in the Chapter 5 to estimate the impacts of monetary policy on the availability of bank loans to the UK's SMEs. In addition, this chapter also provides an analysis of the monetary policy stance in the UK based on the results of the estimated MCI. The analysis of monetary policy stance in the UK is important for policymakers to determine the direction to steer the economy. The analysis of the monetary condition is more than the direct influence of the central bank intervention in the market operations, but it summarises the outcomes of development in the overall monetary sphere on the economic activities (Gottschalk, 2001).

In section 4.2, the rationale for estimating the MCI as an indicator of monetary policy tightness in the UK is explained. This is to show the benefits for using MCI as an indicator of monetary policy tightness rather than using the official interest rate. In

section 4.3, the methodologies that used by previous studies to estimate the MCI are evaluated. In section 4.4, the estimation of the MCI is presented with a description of the data used in the estimation. The estimated MCI will be discussed In section 4.5.

4.2 The MCI as an Indication of the Monetary Policy Tightness

This section provides the rationale for estimating the MCI as an indication of the monetary policy tightness rather than using the official interest rate. This section starts with a summary of the monetary policy transmission and discuss how the monetary condition of a country can also be influenced by the exchange rate. This section also provides justification of why estimating the MCI is superior to the interest rate by discussing the importance of exchange rate in affecting the monetary condition.

4.2.1 A Summary of Interest Rate and Bank Credit Channel

The monetary policy affects the economy activity and inflation through multiple channels. Interest rate is the immediate instrument of monetary policy used by central banks to affect the overall level of economic activity and inflation. It can be perceived from the traditional interest rate channel and credit channel. The interest rate channel works in a way that changes in the official interest rate affects the market interest rate affects the firms' investment and borrowing decisions through its impact of the cost of capital (Gambacorta, 2005). The credit channel suggests that bank credit plays an important role in monetary policy transmission through its influence on the balance sheets of the corporate sector (i.e., balance sheet channel) and banks (i.e., bank lending channel). The balance sheet channel suggests that changes in the interest rate affect the value of collateral assets hold by the firms and their cash flows, which in turn

influence the borrowers' creditworthiness. The bank lending channel suggests that the interest rate changes affect the banks' balance sheets, which affect their capacity to lend. The impact of interest rate on the balance sheets of both firms and banks would affect the corporate borrowing, and therefore their spending and investment activities. This is particularly important for SMEs, which has been suggested that are informational opaque and depending on bank credit as a source of external financing.

4.2.2 The Influence of Exchange Rate on Monetary Condition

Besides the interest rate, the monetary condition of a country is also affected by the domestic exchange rate, which has an effect on the consumer price inflation and economic activity (Dennis, 1997; Batini and Turnbull, 2000). For example, an appreciation in the exchange rate makes import less expensive but makes export more expensive. The appreciation in exchange rate improves the foreign competitiveness and adversely affect the demand of domestic products. Conversely, a depreciation in the exchange rate makes import more expensive and makes export less expensive, which decreases the competitiveness of foreign products, thus improve the demand for domestic products. The exchange rate can thereby reinforce the effect of the official interest rate on the economy activity. From this perspective, in addition to the official interest rate, the exchange rate also affects the monetary policy stance (Dennis, 1997).

The effect of exchange rate is particularly important in the UK because it is an open economy emphasising on free flow of export and import goods across the border. In the UK where it is open economy with a floating exchange rate regime, exchange rate plays an important role in the monetary policy transmission (Gottschalk, 2001). Previous studies have suggested that it is best to assess the extent of monetary

tightening or easing relative to prior periods by examining both the exchange rate and interest rate channel of monetary transmission (Gerlach and Smets, 2000; Gottschalk, 2001). In fact, in the UK, the SMEs has a significant contribution to the UK export. It has been reported that the SMEs accounted for more than half of the value of goods of the UK exports, which is equivalent to €135 billion (the Authority of the House of Lords, 2013).

4.2.3 Possible Uses of MCI

The MCI is a leading indicator that measure the degree of tightness of the monetary condition in an economy. It has been widely used and published by central banks and governmental institutions as an indicator of the stance of monetary policy, including the central banks of Canada, New Zealand, Norway, and Sweden (Ericsson et al., 2000). The MCI has also been estimated by financial institutions and international organisations such as International Monetary Fund (IMF), Organisation for Economic Cooperation and Development (OECD), Deutsche Bank, Goldman Sachs, JP Morgan, and Merrill Lynch to investigate the monetary conditions in certain countries (Ericsson et al., 2000).

There are three possible uses of the MCI: operational target, indicator, and monetary policy rule. The MCI is an important indicator of monetary condition and it shows whether the central bank loosen or tighten monetary policy (Siklar and Dogan, 2015). However, it has been criticised the MCI as an operational target tool, which is restricted because the choice of weights for interest rate and exchange rate varies on its comparative value on inflation and aggregate demand (Siklar and Dogan, 2015).

It has been criticised that the estimation of MCI's weights is highly sensitive to the chosen model of economy and therefore implying some degree of uncertainty in the MCI estimation (Costa, 2000). Moreover, it has also been argued that movement in MCI does not directly associated with the changes in monetary policy. Instead, the monetary condition of a nation should also be affected by other financial variables other than interest rates and exchange rates. As a result, MCI appears inappropriate as an operational target for monetary policy but merely as indication of tightness of monetary condition in a country compared with previous period (Costa, 2000). This is consistent with the purpose of this thesis to use MCI in the disequilibrium model, as an indication of the tightness of monetary condition.

4.3 A Review of the Methodologies to Estimate the MCI

Section 4.2 provides explanation of why the MCI should be a better measure of monetary policy stance of a nation than using the official interest rate alone. As a summary, the official interest rate also affects the domestic exchange rate, which also tend to change the economic activity and inflation rate. From this perspective, the exchange rate can reinforce the effect of the official interest rate on the economic activity. Therefore, it should take into account both the interest rate and exchange rate in the calculation of the MCI. This idea forms the underlying construction of the MCI.

MCI is commonly constructed as 'a weighted average of the percentage point change in the interest rate and the exchange rate relative to their values in a base period' (Batini and Turnbull, 2000; Peeters, 1999; Hyder and Khan, 2007; Toroj, 2008; Shinkai and Kohsaka, 2010; Osborne-Kinch and Holton, 2010). The key of calculating

the MCI is the estimation of the weight of the interest rate and the weight of the exchange rate. The MCI's weights reflect the extent to which the changes in the interest rate and exchange rate affect the economy output. To derive the MCI, the weights of the interest rate and exchange rate will first be estimated and then inserted into the MCI equation.

There are several ways to estimate the MCI's weights, rather than simply select the weights arbitrary. There are three main methods for deriving the MCI's weights, namely the single equation method, trade share method, and multiple equation method (Batini and Turnbull, 2002; Osborne-Kinch and Holton, 2010; and Siklar and Dogan, 2015). Using the *single equation method*, the MCI's weights are computed by estimating the aggregate demand equation. It reflects the relative effect of the interest rate and the exchange rate on the aggregate demand (Siklar and Dogan, 2015). The single equation method has been used by IMF, OECD, and Merrill Lynch for computing the MCI's weights for the UK (Batini and Turnbull, 2002). Using the *trade share method*, the weight on the exchange rate is derived by estimating the long-run exports to the GDP ratio equation, while the weight on the interest rate is equivalent to the weight of exchange rate deducted by one (Batini and Turnbull, 2002). The trade share method has been used by JP Morgan to derive the MCI's weights. The estimation of MCI's weights using the *multiple equation method* involves estimating the vector autoregression (VAR) model (Siklar and Dogan, 2015). The multiple equation method has been used by Goldman Sachs to estimate the MCI's weights for the UK. The MCI's weights are obtained from the impulse response functions (IRFs) of the GDP to a shock in the interest rates and the exchange rate.

After describing the three possible estimation methods of the MCI's weights, it is now to evaluate them. The single aggregate demand equation and the trade share method have been criticised that they could not reflect the dynamic response of the real economy to the shocks in the interest rate and the exchange rate (Siklar and Dogan, 2015). This is because they derive the MCI's weights using the average values of financial effects on the real economy (Batini and Turnbull, 2000). However, the multiple equation method, i.e., the VAR model, is able to reflect the dynamic responses of real economy to the shocks in the interest rate and exchange rate because the weights are estimated using the impulse responses of the economy output to the shocks in the interest rate and the exchange rate (Shinkai and Kohsaka, 2010). The dynamic response is particularly important in this thesis, which involves estimating on panel dataset.

Moreover, both the single equation method and the trade share method have also been criticised that they contain variables that are correlated with the residuals, known as the exogeneity problem (Hyder and Khan, 2007; Shinkai and Kohsaka, 2010). To explain why the MCI's weight must not be considered as exogenous, it is necessary to discuss the uncovered interest parity (UIP) that links up the real interest rate and real exchange rate. The uncovered interest parity holds that free capital flows would cause the positive interest rate inconsistent with the rest of the world into appreciation with expectation of future depreciation (Toroj, 2008). However, it has been suggested that the equilibrium rarely holds in the short-term. The monetary conditions cannot be considered as exogenous, at least not in the mid to long-term, because the central bank is responding to macroeconomic development with its policy rate and exchange rate as two major equilibrating mechanisms (Toroj, 2008). If financial variables in the

estimation model of MCI are assumed to be exogenous, the estimators will be biased. The VAR model is able to avoid the exogeneity problem.

In addition, the single equation method also contains variables that are not parameter constant. The coefficients acquired to derive the MCI weights are sensitive to the selected sample period for the estimation. With nonconstant parameters, estimation over different sample periods would result in different estimates of weights, and thus different choices of weights. Several studies have confirmed that the MCI's weights estimated using the VAR model do not have the parameter constancy problem (Batini and Turnbull, 2000; Hyder and Khan, 2007).

To sum up, both the single equation method and the trade share equation have been criticised for unable to reflect the dynamic responses and incur exogeneity and parameter constancy problem. The MCI's weights must reflect its dynamic response of real economy to the shocks in the interest rate and exchange rate, and must not have exogeneity and parameter constancy problem. The multiple equation method that use the VAR model is able to estimate the dynamic responses of economy output to the shocks of interest rate and exchange rate, and do not have exogeneity and parameter constancy problem. Therefore, in this thesis, the MCI's weights will be estimated using the multiple equation method, i.e., the VAR model.

4.4 Estimation of the MCI for the UK 1990-2010

This section describes how the MCI for the UK between 1991 and 2010 are estimated in this thesis. The results of the estimated MCI are also presented in this section. This section first describes the MCI equation. The data that used to estimate the MCI are

then be discussed. The discussion includes the implications of the UK's joining and withdrawal from the European Exchange Rate Mechanism (ERM) on the exchange rate regime and monetary policy, as well as the implications in deriving the MCI for the UK between the sample period in this thesis. After that, this section describes how the MCI's weights are estimated and then presents the results of the estimated MCI.

4.4.1 Construction of the MCI

The MCI is constructed as 'a weighted average of the percentage point change in the interest rate and the exchange rate relative to their values in a base period' (Batini and Turnbull, 2000; Peeters, 1999; Hyder and Khan, 2007; Toroj, 2008; Shinkai and Kohsaka, 2010; Osborne-Kinch and Holton, 2010). This MCI construction can be expressed in real terms as in equation 4.1.

$$MCI_t = w_r(r_t - r_b) + w_e(e_t - e_b) \quad (4.1)$$

where r_t is the real interest rate expressed in level, e_t is the logarithm of the real exchange rate, and r_b and e_b are the level of the interest rate and exchange rate in a given base period, respectively. w_r and w_e are the MCI's weights of real interest rate and exchange rate, respectively.

According to the equation 4.1, the MCI can be divided into two part. The first can be expressed as the change in the interest rate relative to its base value $(r_t - r_b)$. The second part can be expressed as the change in the exchange rate relative to its base value $(e_t - e_b)$. w_r and w_e are the weights of the real interest rate and the exchange rate, respectively. The ratio of w_r/w_e reflecting the relative effect of interest rate and

exchange rate on a policy goal such as output or inflation rate. The MCI is scaled such that its weights sum to unity, i.e., $w_r + w_e = 1$.

The key of calculating the MCI is the estimation of the weights of the interest rate (w_r) and weights of the exchange rate (w_e). The MCI's weights reflect the extent to which the changes in the interest rate and exchange rate affect the economy output. The MCI's weights will be estimated in section 4.4.3. The estimated MCI's weights will be inserted into the MCI equation in order to compute the MCI (presented in section 4.4.4).

4.4.2 Data

The data that used in the MCI estimation include the interest rate, exchange rate, GDP, and consumer price index (CPI). The interest rate used in deriving the MCI is the 3-month interbank rate (LIBOR), which was obtained from the official website of the Bank of England deflated with the CPI-based inflation. The CPI was obtained from the website of the Office for National Statistics (ONS). The exchange rate used is the broad real effective exchange rate index of the sterling pound, which was gathered from the website of the Bank of England. The data of real GDP was obtained from the ONS website. The real GDP and the real effective exchange rate index are expressed in logarithm, while the real LIBOR rate is expressed in level. The data used are quarterly data between 1991 and 2010.

Over the sample period between 1991 and 2010, there are two important changes in the monetary policy regime in the UK, which is related to UK's participation and withdrawal from the Euro Exchange Rate Mechanism (ERM) between 1990 and 1992. During the participation in the ERM, the ERM required the UK to maintain a fixed

rate to DM 2.95 to Sterling Pound. However, due to the pressure of Sterling Pound sell out from major speculators in the currency market, the UK were forced to keep the interest rate high in order to keep the competitiveness of Sterling Pound currency. As a result, monetary condition in the UK at the time was very tight due to a high interest rate and the fixed exchange rate. The UK was forced out of the ERM in the third quarter of 1992. After the UK withdrawal from the ERM, the monetary policy framework in the UK has changed to emphasise on keeping the inflation low and to encourage economy growth. Therefore, it is expected to see a high interest rate before the third quarter of 1992 and a significant drop in the interest rate after the third quarter of 1992.

In addition, there was a financial crisis in the UK in the mid of 2007. In response to the intensified financial crisis in the UK, the monetary policy during the period is expected to be easing since the first quarter of 2008. The monetary policy easing is associated with a significant fall in the official interest rate and the exchange rate. The interest rate cut close to zero bound is aimed to encourage the corporate sector in the access of bank credit in order to boost the spending and investment activities.

In deriving the MCI, while recognising the importance of the changes in these regime in the UK, it is not intended to apply any restriction in these changes of regime in the estimation of the MCI. Indeed, the changes in the regime would be reflected in the calculated MCI later in this chapter. In addition, the estimation of the MCI in this chapter is merely an indication of the tightness of monetary condition in the UK.

4.4.3 Estimation of the MCI's Weights

To estimate the MCI, it involves estimating the weights of the interest rate and the exchange rate. As discussed in section 4.3, estimating the MCI's weights using the VAR model has several advantages over the single equation and the trade share method. First, the VAR model is able to analyse the dynamic responses of real economy to the shocks in the interest rate and the exchange rate because the weights are computed using the parameters of impulse responses functions (Shinkai and Kohsaka, 2010). The single equation and the trade share method are not able to reflect the dynamic response of the real economy to the shocks in the interest rate and the exchange rate (Siklar and Dogan, 2015). It is because they derive the MCI's weights using the average values of financial effects on the real economy (Batini and Turnbull, 2000). Second, estimating the MCI's weights using the VAR method can avoid the exogeneity problem that otherwise encountered if using the single equation or the trade share method. The monetary conditions cannot be considered as exogenous, at least not in mid to long-term because central bank is responding to macroeconomic development with its policy rate and exchange rate as two major equilibrating mechanisms. If financial variables in the estimation model of MCI are assumed to be exogenous, the estimators will be biased.

There are three steps involved to estimate the MCI's weights using the VAR model. First, all the three macroeconomic time series data used in the estimation of the MCI's weights must be stationary. Most of the macroeconomic time series are non-stationary (contain a unit root) since they are not going back to their mean and the variance is not constant (Maddala, 2001). Stationarity is crucial because if the series is non-stationary,

the regression results are spurious as it may easily result in incorrect conclusions. Moreover, shocks to a stationary series will be temporary and their effects will be eliminated over time when the series revert to their long-run mean values (Asteriou and Hall, 2007). In contrast, non-stationary data series comprise permanent components and so its mean and/or variance will rely on time and will approach infinity as time goes infinity. Therefore, it needs to ensure that the data series are stationary. Second, it involves testing the time series data for cointegrating relation. If there is no cointegration relation in the time series data, then the MCI's weights should be estimated using the unrestricted VAR model on the stationary time series data. However, if there is no cointegration relation in the time series data, then the MCI's weights should be estimated using the vector error correction (VEC) method.

1. Stationarity Test

A unit root test has to be carried out to assess the stationarity of each macroeconomic data series used in the estimation of the MCI. The time series data is believed to contain a unit root if the data series is not stationary. Otherwise, if the time series data is stationary, it does not contain a unit root.

To test the stationarity of the data series, the Augmented Dickey Fuller (ADF) test is used. ADF test is a dominant method of testing the stationarity of time series data. There are several steps involved in testing the stationarity of the time series data using the ADF test. First, the data series are tested using the ADF test at its level. If the data is not stationary or unit root exists at the level, then it should test the stationarity of the data using the ADF test on its first difference. If the data is not stationary at the first difference, then test the stationarity again at the second difference to ensure it is

stationary. The null hypothesis of ADF test is that it contains unit root and the time series is not stationary. The alternative is that there is no unit root and the time series is stationary.

The ADF test were carried out using the Eviews statistical software, which automatically takes the optimal number of lagged dependent variables. It needs to include just enough lags so that the residuals of the ADF regression are not autocorrelated. The decision rules for the unit root test are that if the value of t-statistics is greater than its critical value, then it should not reject the null hypothesis, i.e., unit root exists. If the value of t-statistics is less than its critical value, then it should reject the null hypothesis, i.e., unit root does not exist.

Table 4.1 in the next page summaries the results of the ADF test for all the three data time series, i.e., the log of real GDP, the log of real Sterling effective exchange rate index (£ERI), and the real LIBOR rate. The null hypothesis is that the data contains unit root and is not stationary. The alternative hypothesis is that the data does not contain unit root and it is stationary. According to Table 4.1, the results show that the null hypotheses of all the three data time series, i.e., the log of real GDP, the log of real £ERI, and the real LIBOR rate, are not rejected at the level. This indicates that the log of real GDP, the log of real £ERI, and the real LIBOR rate are not stationary at the level, regardless of whether their exogenous variable contains constant, linear trends, or none exogenous variable. However, the results show that the null hypotheses of all the three data time series, i.e., the log of real GDP, the log of real £ERI, and the real LIBOR rate, are rejected at the first difference. This indicates that the log of real GDP, the log of real £ERI, and the real LIBOR rate are stationary at the first difference,

regardless of whether their exogenous variable contains constant, linear trends, or none exogenous variable. Therefore, it is able to confirm that the MCI's weights have to be estimated on the first difference of these time series data.

Table 4.1 Testing for Data Stationarity Using the ADF Test

		Level	First Difference	Order of Integration
Constant				
	lnrgdp	-1.638286(1)	-3.531681(0) *	I(1)
	rlibor	-1.906181(4)	-3.508818(3)**	I(1)
	lnreer	-1.555457(3)	-6.153374(0)*	I(1)
Constant, linear trend				
	lnrgdp	-1.105638(1)	-3.806360(0)**	I(1)
	rlibor	-3.481520(4)	-4.043064(4)**	I(1)
	lnreer	-1.165423(1)	-6.207106(0)*	I(1)
None				
	lnrgdp	2.313499(1)	-2.572464(0)**	I(1)
	rlibor	-1.558222(4)	-3.382621(3)*	I(1)
	lnreer	-0.277103(1)	-6.186528(0)*	I(1)

This table reports the Augmented Dickey Fuller (ADF) test, which is used to test the stationarity of the time series data. lnrgdp is the log of real gross domestic production (GDP); rlibor is the real LIBOR rate, and lnreer is the log of real Sterling effective exchange rate index. The ADF tests are carried out with three different assumptions: with a constant, with a constant and linear trend, and no constant and no trend. The optimal lag length of the ADF test is shown in the parenthesis. * denotes rejection of null hypothesis of non-stationary at 1% significance level. ** denotes rejection of null hypothesis of non-stationary at 5% significance level. If the null hypothesis is not rejected, it indicates the time series data contain unit root or in other word the data is not stationary. If the null hypothesis is rejected, it means that the time series data does not contain unit root or in other word the data is stationary. The order of integration shows the minimum number of difference required to obtain a stationary series. E.g., I(0) indicates the time series data is stationary at its level, while I(1) indicates the time series data is stationary at its first difference.

2. Johansen's Cointegration Test

The results of the stationarity test show that the MCI's weights have to be estimated using the first difference of these time series data. It is now necessary to test if there is cointegrating relation in the time series data. A linear combination of two or more non-stationary series may be stationary and if this is the case, the non-stationary time series are perceived to be cointegrated (Engle and Granger, 1987). The stationary linear combination is termed as the cointegrating equation and may be interpreted as a long-run equilibrium relationship between the variables (Engle and Granger, 1987).

If there is no cointegrating relation in the time series data, then the MCI's weights should be estimated using the unrestricted VAR method on the first-difference of the time series data. If there is a cointegrating relation in the time series data, then the MCI's weights should be estimated using the vector error correction (VEC) model. The VEC model is a restricted VAR model and it has the cointegration relations built into the specification that is able to restrict the long-run behaviour of the endogenous variables to converge to their cointegrating relationships and permitting for short-run adjustment dynamics (Shaik and Miljkovic, 2008). The Johansen's cointegration test is used to test for the cointegrating relation in the time series data.

In order to carry out the Johansen's cointegration test, it is necessary to select the optimal lag length. This is because the Johansen procedure is sensitive to the selection of lag length to obtain a model that reflects true relationship between variables. Too few lags may cause the model unable to capture the relationship between over time, but too many lags may result in increasing forecasting error.

Table 4.2 reports the selection of the optimal lag length for the Johansen's cointegration test. The optimal lag length for the Johansen's cointegration test should be the one with the lowest information criteria. There are several types of information criteria: likelihood ratio (LR), final prediction error (FPE), Akaike information criteria (AIC), Hannan-Quinn information criteria (HQIC), and Schwarz's Bayesian information criteria (SBIC). According to Table 4.2, the LR, FPE, and AIC show that the optimal lag length selection for the Cointegration test is 5 lag length, while the HQIC and SBIC show that the optimal lag length selection for the Cointegration test is 4 lag length and 2 lag length, respectively. It has been suggested that the AIC and SBIC are the most widely used information criteria. Therefore, both 5 and 2 optimal lag length are selected for the Johansen's Cointegration test.

Table 4.2: Optimal Lag Length Selection for Cointegration Test

lag	LogL	LR	FPE	AIC	SBIC	HQIC
0	-2.69323	NA	0.00024	0.158	0.253	0.196
1	362.891	690.548	1.17e-08	-9.747	-9.367	-9.596
2	389.300	47.683	7.25e-09	-10.231	-9.566*	-9.966
3	401.524	21.052	6.65e-09	-10.320	-9.371	-9.942
4	419.720	29.822	5.19e-09	-10.575	-9.342	-10.084*
5	431.897	18.943*	4.80e-09*	-10.664*	-9.146	-10.059
6	437.888	8.820	5.30e-09	-10.580	-8.778	-9.863
7	440.008	2.944	6.56e-09	-10.389	-8.302	-9.558
8	446.003	7.827	7.35e-09	-10.306	-7.934	-9.361

This table shows the selection of the optimal lag length for the Johansen's cointegration test. LogL = log likelihood; LR = likelihood ratio; FPE = Final prediction error; AIC = Akaike information criteria; HQIC = Hannan-Quinn information criteria; SBIC = Schwarz's Bayesian information criteria. * denotes the lowest value of associated information criteria and as the lag order selected by the criterion.

Table 4.3 shows the results of the Johansen's cointegration test with the optimal lag length of 5. According to Table 4.3, it appears that the value of trace statistics is lower than its 5% critical value at zero maximum rank (i.e., no cointegrating relation). This indicates that the null hypothesis of no cointegrating relation cannot be rejected at 5% significance level. This suggests that there is no cointegrating relations in the time series data. Therefore, it should be able to confirm that the MCI's weights should be estimated using the unrestricted VAR model on the first difference of the time series data.

Table 4.3: Johansen's Cointegration Test with 5 lag length, No deterministic trend

maximum rank	parms	LL	eigenvalue	trace statistics	5% critical value
0	39	414.25937	.	27.3675*	29.68
1	44	423.11583	0.21036	9.6546	15.41
2	47	427.13658	0.10167	1.6131	3.76
3	48	427.94314	0.02128		

This table shows the result of the Johansen's cointegration test with 5 lag length and no deterministic trend. The null hypothesis is no cointegrating relation in the time series data. The alternative hypothesis is there is cointegrating relation in the time series data. If the value of trace statistics is lower than its 5% critical value, then the null hypothesis cannot be rejected at 5% significance level. If the value of trace statistics is not lower than its 5% critical value, then the null hypothesis is rejected at 5% significance level.

The above tests have shown that the data used to estimate the MCI's weights are stationary at their first difference and there is no cointegrating relation in the data series. Therefore, it is able to confirm that the MCI's weights should be estimated using unrestricted VAR model on the time series data at their first difference.

In order to estimate the MCI's weights using the VAR model, it has to select the optimal lag length for the VAR model. The Eviews statistical software has the built in routine to compute the optimal lag length for the VAR model. Table 4.4 shows the result of the optimal lag length for the VAR model. The decision for selecting the optimal lag length is the one with lowest value of the associated information criteria. According to Table 4.4, the FPE and the AIC show that the optimal lag length is 4, while the HQIC and SBIC show that the optimal lag length is 1. In this case, the optimal lag length is chosen based on the FPE and AIC because it has been suggested that FPE and AIC are superior than other information criteria when the sample size is small (Liew, 2004). Moreover, the sample size of the VAR model is small and therefore optimal lag length selected by the FPE and the AIC should be selected, i.e., 4 lag.

Table 4.4: Optimal Lag Length Selection for the VAR Model

lag	LogL	LR	FPE	AIC	SBIC	HQIC
0	327.3300	NA	2.16e-08	-9.136057	-9.040451	-9.098037
1	373.3561	86.86611	7.62e-09	-10.17904	-9.796620*	-10.02697*
2	384.9105	20.83042	7.10e-09	-10.25100	-9.581756	-9.984862
3	398.9707	24.15982	6.18e-09	-10.39354	-9.437479	-10.01335
4	409.4324	17.09234*	5.97e-09*	-10.43471*	-9.191834	-9.940461
5	412.5605	4.846445	7.13e-09	-10.26931	-8.739612	-9.660998
6	417.2473	6.865091	8.18e-09	-10.14781	-8.331293	-9.425439
7	423.2660	8.307543	9.11e-09	-10.06383	-7.960495	-9.227401
8	429.7080	8.347412	1.01e-08	-9.991776	-7.601621	-9.041287

This table shows the selection of the optimal lag length for the VAR model for deriving the MCI. LogL = log likelihood; LR = likelihood ratio; FPE = Final prediction error; AIC = Akaike information criteria; HQIC = Hannan-Quinn information criteria; SBIC = Schwarz's Bayesian information criteria. * denotes the lowest value of associated information criteria and as the lag order selected by the criterion.

After selecting the optimal lag length for the VAR model, it is now able to estimate the MCI's weights by looking at the cumulative impulse response function of the GDP to a shock to the real LIBOR rate at the first difference (short-term interest rate) and real Sterling effective exchange rate index at the first difference (exchange rate) over a period of 8 quarters. The weights of the exchange rate and the interest rate should be summing up to one. A period of 8 quarters is chosen for estimating the MCI's weights because most studies in the prior literature suggests that the effects of monetary policy should last and there is only little effect after 8 quarters.

Table 4.5 below shows the results of impulse response function of the VAR model. The results will be interpreted in the next page.

Table 4.5 Impulse Response Function

Step	(1) IRF	(1) CIRF	(2) IRF	(2) CIRF
0	0	0	0	0
1	-0.000593	-0.000593	0.000551	0.000551
2	-0.000748	-0.001340	0.001154	0.001705
3	-0.000844	-0.002185	0.001443	0.003147
4	-0.000406	-0.002591	0.001384	0.004532
5	-0.000538	-0.003129	0.000963	0.005495
6	-0.000454	-0.003582	0.000364	0.005859
7	-0.000519	-0.004101	0.000014	0.005873
8	-0.000253	-0.004354	-0.000186	0.005687
9	-0.000211	-0.004565	-0.000155	0.005532
10	-2.2e-06	-0.004567	-0.000135	0.005397

This table shows the results of impulse response function of the VAR model over a number of quarterly period indicated by step. Step denotes the number of quarterly period. IRF denotes the impulse response function, while the CIRF denotes the cumulative IRF. (1) shows the response of the log real GDP to the impulse of real LIBOR rate at the first difference. (2) shows the response of the log real GDP to the impulse of the log real Sterling effective exchange rate index at the first difference. The MCI's weights are derived by looking at the CIRF of the log real GDP to the impulse in the real LIBOR rate and in the log real Sterling effective exchange rate over a period of 8 quarters.

The (1)IRF indicates the response of the log real GDP to the impulse of the real LIBOR rate at the first difference and the (1)CIRF indicates the cumulative response of the log real GDP to the impulse of the real LIBOR rate at the first difference. The (2)IRF indicates the response of the log real GDP to the impulse of the log real £ERI at the first difference and the (2)CIRF indicates the cumulative response of the log real GDP to the impulse of the log real £ERI at the first difference.

According to Table 4.5, the negative sign in the (1)IRF and (1)CIRF indicate a negative relationship between the real interest rate and the real GDP output. This suggests that increasing the interest rate would reduce the real GDP. For example, 1 percentage point increase in the real LIBOR rate would reduce the real GDP output by 0.000593% in the first quarter period. The impact of the real LIBOR rate on the real GDP output increases another 0.000748% in the second quarter and by 0.000844% in the third quarter but the impact become half started in the fourth quarter. The impact of the real LIBOR rate on the real GDP output has started to drop after eight quarters to 0.000253%. There is only very little effect of real LIBOR rate on the real GDP output after 10 quarters. The (1)CIRF in the eight quarter period indicates that the cumulative response of the real GDP output to the impulse of the real LIBOR rate for the eight quarters period is 0.004354%. This suggests that the total impact of 1 percentage point increase in the real LIBOR rate reduces the real GDP output by 0.004354% over the eight quarters period.

While the real LIBOR shows a negative correlation with the real GDP, the (2)IRF and (2)CIRF shows a positive sign, indicating a positive relationship between the real

Sterling effective exchange rate index (real £ERI) and the real GDP. This suggests that an appreciation in the domestic exchange rate vis-à-vis other currency will result in a growth in the real GDP output. More specifically, 1 percentage increase in the real £ERI increases the real GDP output by 0.000551% in the first quarter. The positive impact of the exchange rate on the real GDP continues to increase in the second quarter by 0.001154%, peak in the third quarter period by 0.001443%, and continue to increase by 0.001384% in the fourth quarter. The impact of the £ERI on the real GDP output has started to drop significantly in the sixth quarter period and nearly diminish after the seventh quarter period and even become negative after eight quarters. The (2)CIRF in the eight quarter period indicates that the cumulative response of the real GDP output to the impulse of the real £ERI for the eight quarters period is 0.005687%. This suggests that the total impact of 1 percent increase in the real £ERI increases the real GDP output by 0.005687% over the eight quarters period.

After interpreting the results of the impulse response function, it is now necessary to present the MCI's weights by looking at the cumulative impulse response function of the real GDP output to the impulse of the real LIBOR rate (the measure of short-term interest rate) and the real £ERI (the measure of exchange rate) at the first difference over eight quarters period. According to Table 4.5, the (1)CIRF denotes the cumulative response of the real GDP output to the impulse of the real LIBOR rate, and it shows the total impact of 1 percentage point increase in the real LIBOR rate reduces the real GDP output by 0.004354% over the eight quarters period. The (2)CIRF denotes the cumulative response of the real GDP output to the impulse of the real £ERI and it shows that the total impact of 1 percent increase in the real £ERI increases the real GDP output by 0.005687% over the eight quarters period. The weights of the exchange

rate and the interest rate should be summing up to one. Therefore, the estimated ratio of the MCI's weights is -0.7656.

The ratio is a negative figure because a negative response of log of real GDP to real LIBOR impulse. This can be interpreted as one percentage point change in real LIBOR has about the same effect on the economic output as a 0.7656 percentage change in the real exchange rate.

Validity Test

Several tests were carried out to assess the validity of the VAR model. First, the VAR model is tested for its stability. Second, the VAR model is tested for the autocorrelation of the residuals using the Lagrange Multiplier (LM) test. Third, in order to determine if the log of real GDP, the real LIBOR, and the log of real effective exchange rate at first difference affect one another over time, the Granger causality tests are carried out on the VAR model.

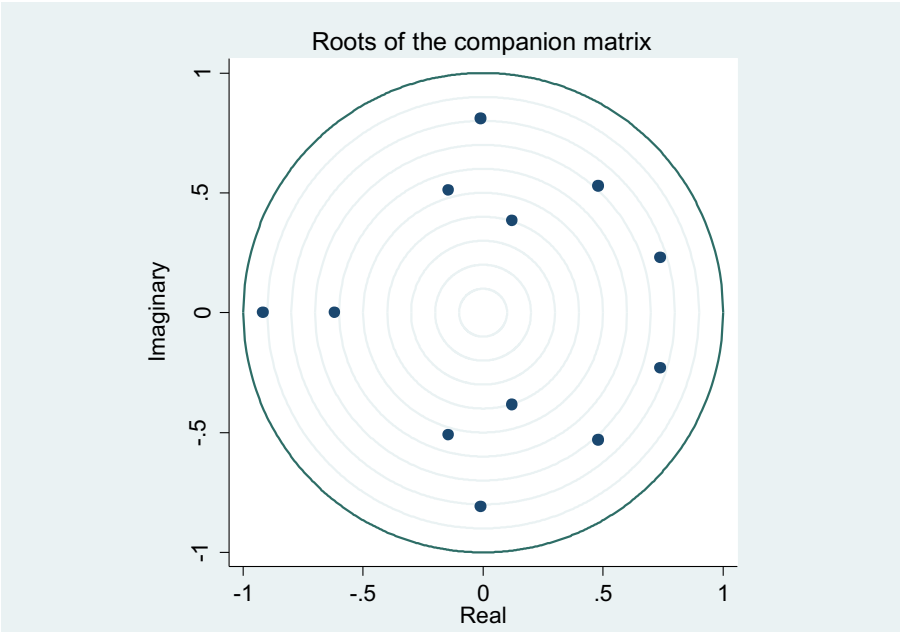
The results of the stability test are shown in Table 4.6 and Figure 4.1 (in the next page). Table 4.6 shows the Eigenvalue stability condition of the VAR model. If the estimated VAR model is not stable, then there should be an eigenvalue equal to 1. According to Table 4.6, none of the eigenvalues is equal to 1 and therefore able to confirm that VAR model is stable. Figure 4.1 plots the eigenvalues of the companion matrix. No eigenvalue is outside the circle, thus confirm the VAR model is stable.

Table 4.6 Eigenvalue Stability Condition

Eigenvalue			Modulus
-0.919282			0.919282
-0.010757	+	0.810046	0.810117
-0.107575	-	0.810046	0.810117
0.737811	+	0.230493	0.772977
0.737811	-	0.230493	0.772977
0.479512	+	0.529652	0.714467
0.479512	-	0.529652	0.714467
-0.618834			0.618834
-0.143885	+	0.509970	0.52988
-0.143885	-	0.509970	0.52988
0.119482	+	0.383527	0.401707
0.119482	-	0.383527	0.401707

This table shows the eigenvalue stability condition of the VAR model. It indicates whether the estimated VAR model is stable. If the estimated VAR model is not stable, then the eigenvalue should equal to 1.

Figure 4.1 Eigenvalue Stability Condition



This figure plots the eigenvalues of the companion matrix to show to the stability condition of the VAR model. If the VAR model is not stable, then dot should touch the circle.

After the stability test, the VAR model is tested for autocorrelation of the residuals using Lagrange Multiplier (LM) test. The null hypothesis of the LM test is no autocorrelation of the residuals in the equation. If there is autocorrelation in the residuals, it means that the number of lags in the VAR model is underspecified and this can significantly increase finite-sample bias in the parameter estimates and cause serial correlation. If this is the case, it should add more lags to the VAR model in order to eliminate the serial correlation. Table 4.7 displays the results of the LM test. The results show that the null hypothesis of no autocorrelation in the residuals cannot be rejected at 5% significance level at order 1 through 4. Therefore, it should have sufficient evidence to show that there is no autocorrelation of the residuals in the equations.

Table 4.7 VAR Lagrange Multiplier Test

lag	chi2	df	Prob > chi2
1	12.9228	9	0.16613
2	15.6585	9	0.07436
3	5.2707	9	0.81010
4	5.9315	9	0.74675

This table shows the result of the Lagrange Multiplier (LM) test of the VAR model. It is used to test whether the VAR model contains autocorrelation in the residuals at the lag order. The null hypothesis is no autocorrelation in the residuals of the equation at lag order. The alternative is there is autocorrelation in the residuals of the equation at lag order.

In order to determine if the log of real GDP, real LIBOR, and log of real effective exchange rate at first difference affect one another over time, the Granger causality tests are carried out on the VAR model. Table 4.8 in the next page reports the Granger causality test of the VAR model. The null hypotheses are the coefficient of the 4 lagged values of real LIBOR rate at first difference (D_rlibor) or the log of real Sterling effective exchange rate index at first difference (D_lnreer), or both are zero in the equation of the log of real GDP at first difference. There are several outcomes can be identified from the results of the Granger causality test. First, the null hypothesis that the coefficient of 4 lagged values of D_rlibor are zero in the D_lnrgdp equation cannot be rejected at 5% significance level. This indicates that there is not enough evidence to show that the first difference of real LIBOR Granger causes the first difference of log of real GDP with 4 quarters lags. Second, the null hypothesis that the coefficient of 4 lagged values of D_lnreer are zero in the D_lnrgdp equation can be rejected at 5% significance level. This indicates that there is enough evidence to show that the first difference of log of real effective exchange rate Granger causes the first difference of log of real GDP with 4 quarters lags. In addition, the null hypothesis that the coefficient of 4 lagged values of D_rlibor are zero in the D_lnreer equation can be rejected at 5% significance level. This indicates that there is enough evidence to show that the first difference of real LIBOR Granger causes the first difference of log of real effective exchange rate with 4 quarters lags.

Table 4.8 Granger Causality Wald Test

Equation	Excluded	chi2	df	Prob > chi2
D_lnrgdp	D_rlibor	4.6369	4	0.327
D_lnrgdp	D_lnreer	9.8252	4	0.043
D_lnrgdp	ALL	11.051	8	0.199
D_rlibor	D_lnrgdp	7.3751	4	0.117
D_rlibor	D_lnreer	25.585	4	0.000
D_rlibor	ALL	39.406	8	0.000
D_lnreer	D_lnrgdp	5.1595	4	0.271
D_lnreer	D_rlibor	12.385	4	0.015
D_lnreer	ALL	17.05	8	0.030

This table shows the results of the Granger Causality Wald test.

4.4.4 Estimation of the MCI

After estimating the MCI's weights using the impulse response function of the VAR model, it is now able to calculate the MCI for the UK between 1991 and 2010. The weights reflect the relative effect of the real LIBOR rate (a measure of interest rate) and the real Sterling effective exchange rate index (a measure of exchange rate) on the real GDP output. The MCI ratio of -0.7656 estimated in section 4.7 is used in estimating the MCI for the UK. As indicated in the equation 4.1, the MCI is constructed as a weighted average of the percentage point change in the interest rate and the exchange rate relative to their values in a base period. It can be written in real terms as follows:

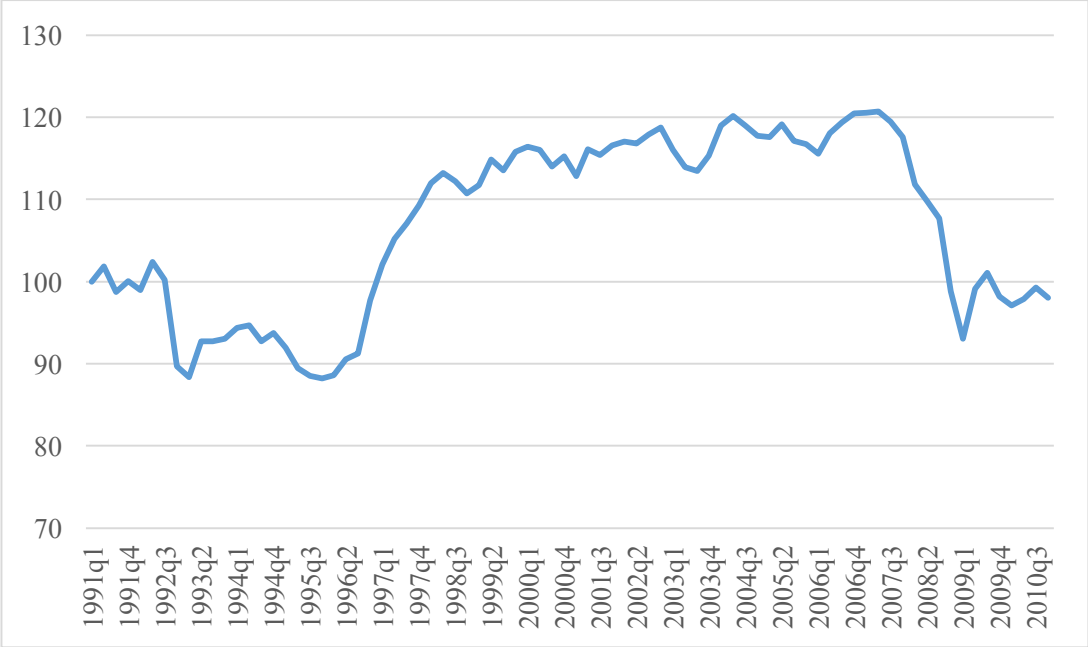
$$MCI_t = W_R(r_t - r_b) + W_E(e_t - e_b) \quad (4.1)$$

where r_t is the real interest rate expressed in level, e_t is the logarithm of the real exchange rate, and r_b and e_b are the level of the interest rate and exchange rate in

a given base period, respectively. W_R and W_E are the MCI's weights of real interest rate and exchange rate, respectively.

Figure 4.2 plots the estimated MCI for the UK from 1991 to 2010. The estimated MCI for the UK between 1991 and 2010 are interpreted in the next paragraph.

Figure 4.2 Estimated MCI for the UK



This figure shows the estimated MCI for the UK using quarterly data between 1991 and 2010. The MCI tells the degree of tightening and easing of the monetary condition compared to the previous period. An increase in the MCI indicates a tightening of the monetary condition. A fall in the MCI indicates an easing of the monetary condition.

At a particularly period, changes in the short-term interest rate and in the exchange rate may have an influence on the monetary condition in the same direction or in opposite direction. The estimated MCI for the UK is an indication of tightness of monetary condition compared with previous period. An increase in the estimated MCI is interpreted as a tightening of the monetary condition in the period. A fall in the MCI indicates an easing of the monetary condition. It should be noted that the change in the interest rate is interpreted as percentage points, but the change in the exchange rate is regarded as a percentage change because it is expressed in logarithm.

According to the Figure 4.2, the UK's MCI is ranging from 88 and 121 during the 20 years period between 1991 and 2010. The MCI starts at 100 in the first quarter of 1991 and there are some obvious changes in the MCI in the UK during the 20 years period. First, there is a significant drop in the MCI around the third quarter of 1992 to its lowest in the first quarter of 1993. This indicates a significant easing of the monetary condition in the UK between the third quarter of 1992 and the first quarter of 1993. After that, the MCI started to rise slightly from the first quarter of 1993 to the second quarter of 1994 but then dropped again to its lowest to around the fourth quarter of 1995. This indicates that the MCI in the UK was slightly tightened in 1993 but then loosened between 1994 and 1995.

There is a big rise in the MCI started in the first quarter of 1996 and reached its peak in the fourth quarter of 2002. This indicates that there was a tighten monetary policy stance or condition in the UK started around the first quarter of 1996 until the fourth quarter of 2002. After that, the MCI remained in the range between 110 and 120 until the fourth quarter of 2007.

The MCI started to drop since the first quarter of 2008 from 120 to its lowest point at 93 in the first quarter of 2009 but slightly higher then. This indicates that the easing in the monetary condition in the UK since the first quarter of 2008 until the first quarter of 2009. The monetary condition in the UK was slightly higher in the second quarter of 2009 and remain between 95 and 100 until the fourth quarter of 2010. This indicates that the monetary condition in the UK slightly tightened in the second quarter of 2009 and did not change much then up to the fourth quarter of 2010.

4.5 Discussion of the Estimated MCI

After interpreting the result of the estimated MCI for the UK between 1991 and 2010, it is now necessary to discuss the result. The discussion of the result includes to discuss whether it fits to what happen in the real world (in section 4.5.1) and comparing the estimated MCI with the official interest rate if using it as an indicator of monetary policy stance (in section 4.5.2). Moreover, it also includes a discussion of how the changes in the monetary condition has an implication on the availability of bank loans for the UK's SMEs (in section 4.5.3).

Since the index is constructed using differences between actual and arbitrarily chosen levels, it should be noted that no significance attached to the level of the index. The MCI simply tells the time change in the degree of tightening and easing of the monetary condition.

4.5.1 Important Events in the UK Economy During 1991 to 2010

This section starts with a discussion of whether the estimated MCI fits to some important events in the UK economy. There are some obvious changes in the estimated MCI in the UK between 1991 and 2010 and they are actually quite consistent to the economy facts in the UK. First, the results of the estimated MCI show that there is a significant drop in the MCI around the third quarter of 1992 to its lowest in the first quarter of 1993, indicating a significant easing of the monetary condition in the UK between the third quarter of 1992 and the first quarter of 1993 compared to the previous period. This changes in the monetary condition in the UK during third quarter 1992 and first quarter of 1993 was strongly relevant to the UK participation and withdrawal from the Euro Exchange Rate Mechanism (ERM) between 1990 and 1992. The story begins with the UK participation in the ERM between 1990 and 1992 in order to reduce the double digit inflation. The ERM required the UK to maintain a fixed rate to DM 2.95 to Sterling Pound. However, due to the pressure of Sterling Pound sell out from major speculators in the currency market, the UK were forced to keep the interest rate high in order to keep the competitiveness of Sterling Pound currency. As a result, monetary condition in the UK at the time was very tight due to a high interest rate and the fixed exchange rate. The UK was forced out of the ERM in the third quarter of 1992. Since then, the monetary policy framework in the UK has changed to emphasise on keeping the inflation low and to encourage economy growth. Therefore, since the third quarter of 1992, the interest rates in the UK were cut in order to recover the economy from the recession, i.e., an easing monetary policy.

There was a big rise in the MCI since the first quarter of 1996 suggests a significant tighten monetary policy stance or condition in the UK and remain a tight until around the fourth quarter of 2007. This reflects the a gradually growth in the UK economy during the period. However, the economy growth in the UK so rapid during the period that in fact created the credit boom that subsequently lead to the financial crisis in the mid of 2007. Consistent to this movement in the UK economy, the MCI started to drop since the first quarter of 2008 to its lowest point in the first quarter of 2009. This indicates that the easing in the monetary condition in the UK since the first quarter of 2008, in response to the intensified financial crisis in the UK. The monetary policy easing is associated with a significant fall in the official interest rate and the exchange rate. The interest rate cut close to zero bound is aimed to encourage the corporate sector in the access of bank credit in order to boost the spending and investment activities.

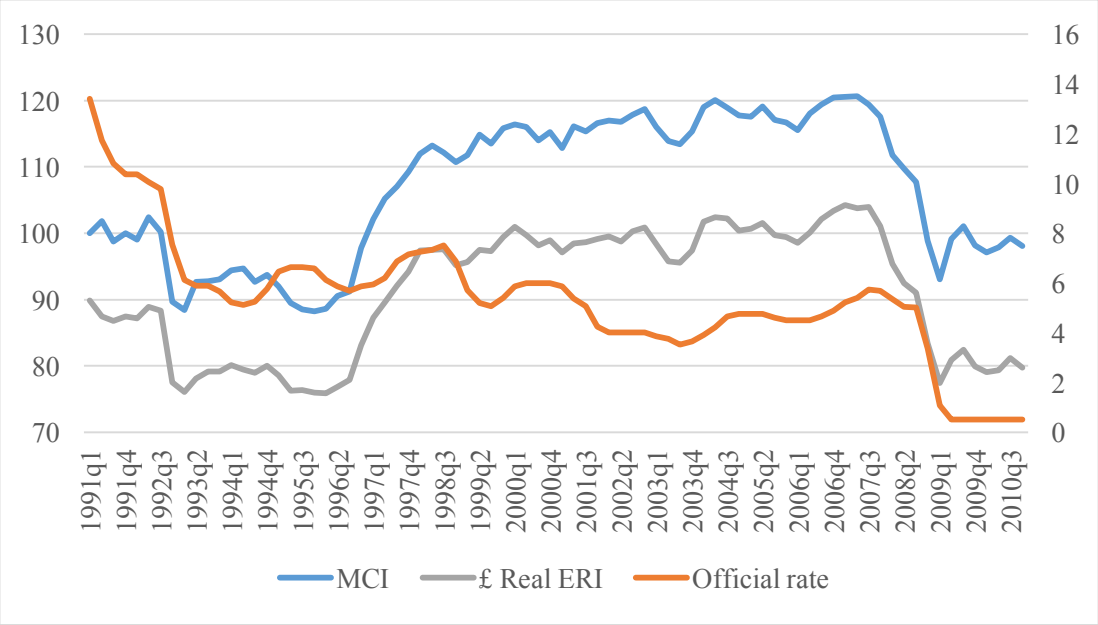
4.5.2 A Visual Comparison with the Official Interest and Exchange Rate

It appears that the estimated MCI is quite consistent with some major events in the UK economy. It is now to compare it with the official interest rate if it is used as an indicator of the monetary policy stance in the UK. The real Sterling effective exchange rate index (£ERI) is also added in the figure. The official interest rate is the quarterly average official rate, which was obtained from the official website of the Bank of England.

Figure 4.3 in the next page shows the comparison of the MCI, official rate, and £ERI between 1991 and 2010. As an overview, the movement in the MCI seems to be more consistent with the £ERI rather than the official interest rate. This seems to suggests

that the exchange rate have more impact on the monetary condition in the UK than the official interest rate. We will discuss further in the next paragraphs.

Figure 4.3 MCI vs. Official Rate and £ERI



This figure compares the estimated MCI and the official rate in the UK between 1991 and 2010. The estimated MCI for the UK is shown in blue colour and is related to the figure on the left vertical axis (ranging from 80 to 125). The official rate of the UK is shown in blue colour and is related to the figure on the right vertical axis (ranging from 0 to 16). The official rate is the quarterly average official bank rate obtained from the official website of the Bank of England.

According to the Figure 4.3, there are several obvious changes in the estimated MCI in the UK between 1991 and 2010 that we can compare with the interest rate and exchange rate. First, at the beginning of the sample period, there is a significant reduction in the official interest rate from 14% to the lowest 5% in the third quarter of 1994. It is noted that interest rate continues to drop in the first quarter of 1993 but it does not show a corresponding fall in the MCI. The MCI is not easing as much as represented by the fall in the official interest rate.

The MCI only started to fall significant around in the third quarter of 1992. This seems to indicate that the significant fall in the official interest rate only started come into effect in two or three quarters later. Then, it is worth noting that the further fall in the official rate around the second quarter of 1993, but the MCI appears to rise along with the exchange rate. A similar condition can be observed around the third quarter of 1998, where the fall in the official interest rate did not show a corresponding effect on the monetary condition. Again, these inconsistencies between the official interest rate and the monetary policy condition suggests that the official interest rate in certain circumstances, do not show a corresponding effect in the monetary condition index. Instead, the monetary policy stance in the UK, to certain extent, may be more affected by the exchange rate rather than the official interest rate.

The above comparison of the MCI with the interest rate and exchange rate have demonstrated that the exchange rate has placed more influence on the monetary condition in the UK than the interest rate. This is likely due to the stronger weight of exchange rate has placed on the estimation of MCI than the weight of interest rate.

4.5.3 The Implications of MCI on the Borrowing for the SMEs

To discuss the implications of the MCI on the SME's borrowing, it is necessary to discuss the transmission mechanism of monetary policy and the credit market imperfection. A tighten monetary condition will reduce the availability of bank credit to the SMEs while an easing monetary condition will increase the availability of bank credit to the SMEs. As overall, the credit market imperfection theory suggests that the SMEs greatly dependent on bank credit as a source of external financing and therefore any shock that affect their ability to obtain bank credit would cause SMEs to face

severe financing problem including monetary policy shock. These will be further discussed in the following paragraphs.

As discussed in Chapter 2, the credit market imperfection has strong influential implications to many important issues in economics through its significant effects in the corporate finance structure, especially those of the SMEs. According to the perspective of New Keynesian economics, banks are preferable source of external finance than other debt finance because of their ability to better identification of borrowers' quality and the cost advantage in monitoring the real ability of borrowers to repay loans, and thus reducing the agency costs incurred with overcoming the asymmetric information and incentive problems (Ramskogler, 2011). It is highly probable because banks specialise in collecting information about borrowers' ability to repay, including the patent of past loan repayment, income, and amount of present debt (Hall, 2001), obtained from the credit agencies/databases and the on-going relationships with customers. Moreover, banks as financial intermediaries may also be able to save searching and transaction costs that otherwise incur in the direct capital market. All these costs advantages have enabled banks to offer finance to their borrowers at a lower premium than in the direct capital market. This is especially important for smaller companies, which are particularly informational opaque and subject to these costs (Atanasova and Wilson, 2004; Atta-Mensah and Dib, 2008). These arguments are largely supported by previous empirical studies (OECD, 2006; European Commission, 2011; European Commission, 2015; OECD, 2015). Therefore, it is predictable that any shock to either banks' capital or ability of corporate sectors to obtain loans from banks could have a serious impact on their ability to fund business operations and investment, and so economic output.

The credit view emphasises the role of bank lending in the amplification and propagation of the initial effect of monetary shock on corporate sector. The rising interest rate causes declining collateral value of assets and cash flows that adversely affect the creditworthiness of corporate borrowers (i.e., balance sheet channel), plus the open market operations of central banks in the monetary tightening that takes away the bank reserves and so the reduction in capacity to lend to their borrowers who need additional funds to support their business operations (i.e., bank lending channel), and therefore amplifying and propagating the effect of initial monetary shock to the borrowers.

Besides the interest rate, the monetary condition of a country is also affected by the domestic exchange rate, which has an effect on the consumer price inflation and economic activity (Dennis, 1997; Batini and Turnbull, 2000). An appreciation in the exchange rate makes import less expensive but makes export more expensive. The appreciation in exchange rate improves the foreign competitiveness and adversely affect the demand of domestic products. Conversely, a depreciation in the exchange rate makes import more expensive and makes export less expensive, which decreases the competitiveness of foreign products, thus improve the demand for domestic products. The exchange rate can thereby reinforce the effect of the official interest rate on the economy activity. The effect of exchange rate is particularly important in the UK because it is an open economy emphasising on free flow of export and import goods across the border and with a floating exchange rate regime (Gottschalk, 2001). In fact, in the UK, the SMEs has a significant contribution to the UK export. It has been reported that the SMEs accounted for more than half of the value of goods of the UK exports.

The above discussions have suggested that the monetary condition index estimated in this chapter is highly relevant to the financing of the SMEs, which depends on bank credit as an important source of external financing. A tighten monetary condition will reduce the availability of bank credit to the SMEs while an easing monetary condition will increase the availability of bank credit to the SMEs.

4.6 Summary

In order to examine the credit channel of monetary policy transmission, this thesis needs a measure of the monetary policy stance. This chapter produced an indicator of the monetary policy stance, known as the monetary condition index (MCI). The estimated MCI in this chapter is quite consistent with the major events in the UK economy. For example, there is a significant fall in the estimated MCI since the first quarter of 2008, indicating a monetary policy easing. This is quite consistent with a series of monetary policy easing strategies implemented by the BoE's MPC during the financial crisis by cutting the official interest rate and introduced the quantitative easing programme to boost spending and investment activities. The estimated MCI will be included in the supply equation of the disequilibrium model of credit rationing in order to examine the impact of monetary policy on the corporate borrowing.

5. The Disequilibrium Model of Credit Rationing

5.1 Introduction

Inspired by the credit crunch issues emerged in the financial crisis, this thesis aims to examine the extent to which the SMEs in the UK face credit rationing and to examine the impact of monetary policy and quantitative easing on the corporate borrowing. Moreover, this thesis also aims to examine how those credit rationed SMEs fund their financing needs, whether they used trade credit as substitute for bank credit. Up to this chapter, the thesis has reviewed the theories underlying the credit rationing and the transmission of monetary policy through the credit channel and the empirical methodologies used by prior empirical studies to examine the credit rationing and the monetary policy transmission. The analysis of credit rationing and the credit channel of monetary policy transmission in the UK has not been updated since Atanasova and Wilson (2003), which examined the UK firms for the period between 1989 and 1999.

After a review of the empirical methodologies in chapter 3, this attempts to use the disequilibrium model to examine the extent to which the SMEs in the UK face credit rationing and the credit channel of monetary policy transmission. This thesis decided to use the disequilibrium model because it is able to capture and to detangle the factors affecting the demand and supply of bank loans. The disequilibrium model contains separate equations for the demand and the supply of bank loans, and the credit rationed firms are those demanded quantity of bank loans exceeds its supply. Moreover, the disequilibrium model can also be used to examine the credit channel of monetary

policy transmission. Similarly, the disequilibrium model is able to capture and isolate the shocks of monetary policy on the demand and supply of bank loans. As a result, it is able to better produce substantial evidence of the credit channel of monetary policy transmission. Indeed, prior empirical studies such as Bernanke and Blinder (1992) faced challenges in isolating the demand shocks from supply shocks and therefore has been criticised for whether the reduction in bank loans they found using VAR analysis is driven by a shift in loan supply or loan demand. By using the disequilibrium model, it is able to isolate the effect of monetary policy by including a measure of monetary policy in the supply equation of the disequilibrium model.

In order to examine the impact of monetary policy on the corporate borrowing, a measure of monetary policy stance, i.e., the MCI, is needed and it has been constructed in chapter 4. The estimated MCI will be included in the supply equation of the disequilibrium model to examine its impact on the corporate borrowing. This chapter will describe how the disequilibrium model is estimated in this thesis and presents the estimated results of the disequilibrium model.

This chapter is organised as follows:

Section 5.2 describes the underlying setup of the disequilibrium model to show how the credit rationing can be estimated using the disequilibrium model and the statistical procedure to implement the model.

Section 5.3 establishes the hypotheses related to the loan demand and loan supply in the context of SMEs. These variables are included in the demand and the supply equation.

Section 5.4 explains the variables that determine the loan demand and loan supply in the context of SMEs. These variables are included in the demand and the supply equation.

Section 5.5 describes the data and provide descriptive statistics to the data.

Section 5.6 provides an analysis to the corporate financing structure of the firms in the sample.

Section 5.7 reports the estimated results of the disequilibrium model. It is first reporting the estimated loan demand and loan supply in order to provide an understanding the factors that determine the loan demand and loan supply of the sample firms. It is then reporting the proportion of firms in the sample face borrowing constraint or credit rationing. Moreover, this section also compares the differences between borrowing constrained and unconstrained firms.

Section 5.8 provides a discussion on the estimated results of the disequilibrium model by comparing with the related theories and the prior literature.

5.2 The Underlying Disequilibrium Model of Credit Rationing

The underlying disequilibrium model was introduced by Maddala and Nelson (1974), and has been adopted by researchers to examine the extent of rationing in the credit market, including Atanasova and Wilson (2004), Voordeckers and Steijvers (2008), Kremp and Sevestre (2011), and Carbo-Valverde et al. (2012), Adair and Fhima (2014), Farinha and Felix (2014), and Soana et al. (2015). This section describes the underlying setup of the disequilibrium model to demonstrate how it can be used to

examine the credit rationing and investigate the impact of monetary policy on the availability of bank loans to the corporate sector. This section also describes the statistical process to estimate the disequilibrium model to examine the extent of credit rationing and the impact of monetary policy on the availability of bank loans to the corporate sector.

Basically, the disequilibrium model of credit rationing is built based on an assumption that the realised loan outstanding is the minimum of demanded bank loan and bank credit ceiling for the firm. If the realised loan outstanding belongs to the quantity of bank loans supplied, then it means that the firm's loan demand is not fulfilled but only limited to quantity of loans supplied, i.e., credit rationed. Otherwise, if the realised loan outstanding belongs to the quantity of bank loan demanded, then it means that the firm's loan demand is fulfilled, i.e., not rationed.

The disequilibrium model comprises of a demand equation (l_t^d), a supply equation (l_t^s), and a transaction equation (l_t), as indicated in the equation 5.1, 5.2, and 5.3, respectively.

$$l_t^d = \beta_1' x_{1t} + \mu_{1t} \tag{5.1}$$

$$l_t^s = \beta_2' x_{2t} + \mu_{2t} \tag{5.2}$$

$$l_t = min\left(l_t^d, l_t^s\right) \tag{5.3}$$

where the $\beta_1' x_{1t}$ contains variables determining the firms' demand for bank loans; $\beta_1' x_{1t}$ contains variables determining the supply of banks loans to the firms; μ_{1t} and μ_{2t} are the error terms of the demand and supply equations, respectively. The error terms are distributed with zero mean and covariance matrix $\sum = \{\sigma_{ij}\}$.

The quantity of loan demand and loan supply are unobserved. The only observed quantity is the quantity of the transaction equation (l_t), which is the actual quantity of loan received. The model assumes a voluntary transaction, that is, in a case of excess demand $l_t^d > l_t^s$, the lenders cannot be pushed to provide more than they want to so that in this case the observed l_t must always equal to the quantity the lenders want to supply, $l_t = l_t^s$. Likewise, in a case of excess supply $l_t^s > l_t^d$, the borrowers cannot be compelled to obtain loan more than they want to, and $l_t = l_t^d$.

To estimate the credit rationing using the disequilibrium model, it involves two general steps. The first step is to estimate the simultaneous equations as stated in 5.1, 5.2, and 5.3. In this step, the coefficients of the variables in the demand and supply equations are estimated to explain the impact of each variable in the credit supply and credit demand. The second step is to use the estimated coefficients obtained in the first step to estimate the quantity of credit demand and credit supply. Credit rationed firms are those with the excess demand ($l_t^d > l_t^s$,).

A number of previous studies in the literature use the full information maximum likelihood (FIML) method to solve the simultaneous equations stated in 5.1, 5.2, and 5.3. The FIML method involves estimating the log-likelihood function derived from the equation 5.1, 5.2, and 5.3. However, it involves complicated statistical coding to execute such estimation. Instead, this thesis opted for the three stage square (3SLS) method to estimate the demand equation and the supply equation. The 3SLS is a statistical estimation method that has been widely used to estimate the simultaneous equations of demand and supply in the economics models. The estimates of the 3SLS method are consistent and asymptotically normal for solving simultaneous equation

than the ordinary least square (OLS) and the two stage least square (2SLS). The 3SLS method takes into account the inter-temporal correlations between the error terms in the simultaneous equation, despite it is asymptotically less efficient than the FIML method.

After obtaining the estimated coefficients of the demand and supply equation using the 3SLS method, the second step is to use these estimated coefficients to calculate the fitted values of credit demand and supply for each firm in the sample and this allows to find the unobserved credit demand and supply. This can be examined using the post-estimation command of the 3SLS, called the *predict* command. After that, it is able to estimate the proportion of credit rationed firms for each year by comparing the fitted values of the credit demand and credit supply. A firm is credit rationed if the quantity of credit demand is more than the quantity of credit supply, or in other words, the fitted value of credit demand is greater than the fitted values of credit supply (i.e., $l_t^d > l_t^s$).

To estimate the impact of monetary policy on the availability of bank loans to the corporate sector, the monetary condition index (MCI) that was estimated in Chapter 4 is included in the supply equation of the disequilibrium model. By including the MCI as a variable in the supply equation, it is not only able to examine the impact of monetary policy on the availability of bank loans to the corporate sector, but also able to examine the impact of monetary policy on the extent of credit rationing in the country.

5.3 Formulation of Hypotheses

After describing the empirical methodology that used to examine the extent of credit rationing and the impact of monetary policy on the availability of bank loans to the corporate sector, it is now necessary to formulates the hypotheses regarding the demand and the supply of bank credit to the SMEs. The model specification, i.e., the measures or the variables, are be discussed in the section 5.4.

5.3.1 Hypotheses Regarding the Demand for Bank Credit

To establish the hypotheses regarding the demand for bank credit for the SMEs, previous studies that examined the factors affecting the corporate demand for bank credit were reviewed, including Ogawa and Suzuki (2000), Atanasova and Wilson (2004), Kremp and Sevestre (2011), Carbo-Valverde et al. (2012), Adair and Fhima (2014), Farinha and Felix (2014), and Soana et al. (2015). Other relevant factors stated in the theoretical literature were also used. Based on the works of these studies, the hypotheses regarding the demand for bank loans is modelled as a function of firm size, working capital needs, investment needs, internal generated cash flows, and trade credit.

a. Firm size

The demand for bank credit is determined by the size of a firm. The larger the size of a firm, the more the firm demand for bank loans to maintain financial and real transactions (Ogawa and Suzuki, 2000). Larger firms are expected to need for more

capital for business operations and investment. As a result, firm size should be taken into account when considering corporate demand for bank loan.

Hypothesis 1: The demand for bank credit for the UK's SMEs increases if the size of the firm is larger.

b. Working capital needs

Working capital is the business capital that is needed to ensure daily operation of the business. Higher working capital needs indicate the needs to fulfil its short-term liabilities. The examples of short-term assets include the cash in hand or in bank, accounts receivable, stocks, and prepayment. The short-term liabilities include accounts payable, accruals, and other short-term debts. Firms that have greater needs of working capital are expected to have higher demand for bank loans.

Hypothesis 2: The demand for bank credit for the UK's SMEs increases if the firm has a higher need for working capital.

c. Investment needs

Firms seeking for long-term growth are likely to incur more investment in the long-term assets. To support the long-term growth, they require more funds to finance the investment. Bank credit is one of the major sources of external financing, especially for the small, young SMEs that are particularly information opaque due to a lack of business and credit history. Therefore, firms with greater needs for investment should demand for more bank loans to finance.

Hypothesis 3: The demand for bank credit for the UK's SMEs increases if the firm has a higher financial need for investment.

d. Internal generated cash flow

The availability of alternative source of funds is an important factor determining corporate demand for bank loans. The pecking order theory of finance suggests that managers of the SMEs prefer internal finance to external finance but they will appeal to external finance the internal sources are insufficient to finance the capital needs for business expansion. Internal sources of finance are interest free and able to avoid underinvestment problem caused by asymmetric information between managers and investors (Cotei and Farhat, 2009; Frank and Goyal, 2002; Dang, 2005). Therefore, the internal generated cash flow is a source of funds substitute to bank loans (Atanasova and Wilson, 2004; Carbo-Valverde et al., 2009).

Hypothesis 4: The demand for bank credit for the UK's SMEs increases if the firm has less internal resources available.

e. Net trade credit

The prior literature has largely emphasised that trade credit is an important alternative source of funds for bank loans (Atanasova and Wilson, 2004; Mateut et al., 2006; Boissay and Gropp, 2007; Love et al., 2007; Gama et al., 2009; Cole, 2010; Fabbrini and Menichini, 2010; Huang et al., 2010; Love and Zaidi, 2010). In an attempt to expand the businesses with limited financial resources and without seeking external financing, the SMEs often manage their working capital by delaying the payment for

their purchases of input for businesses. In fact, Kohler et al. (2000) finds that as much as 55% of total short-term credit received by the UK firms over 1983 to 1995 was obtained from their suppliers. Moreover, other sources of equity financing are mostly not available to smaller firms.

Researchers suggested that suppliers may also be in a better position to finance SMEs because the frequent interactions between firms and suppliers allow suppliers to gather more information about firms' creditworthiness, and thus able to overcome information and enforcement problems of the SMEs (Fabbri and Menichini, 2009; Gama et al., 2009; Halsey, 2010; Love and Zaidi, 2010). For instance, suppliers can threaten to cut off supply if customers do not make payment on time, especially when there are only a few suppliers in the market and if customers are greatly relying on their suppliers (Garcia-Teruel and Matinez-Solano, 2010a).

Hypothesis 5: The demand for bank credit for the UK's SMEs increases if the use of trade credit increases.

5.3.2 Hypotheses Regarding the Supply of Bank Credit

To establish the hypotheses regarding the supply of bank credit for the SMEs, previous studies that examined the factors affecting the supply of bank credit for SMEs were reviewed, including Ogawa and Suzuki (2000), Atanasova and Wilson (2004), Kremp and Sevestre (2011), Carbo-Valverde et al. (2012), Adair and Fhima (2014), Farinha and Felix (2014), and Soana et al. (2015). Other relevant factors stated in the theoretical literature were also used. Based on the works of these studies, the hypotheses regarding the supply of bank loans is modelled as a function of collateral,

firm risk, manufacturing industry dummy, trade credit, monetary condition index (MCI), and the quantitative easing.

a. Firm risk

The risk of a borrowing firm is one of the most important factor for a bank to decide whether or not to approve the loan. Banks assess the credit risk of the borrowers, which determines the probability that the firm to make the loan repayment. An unquestionable fact is that the profitability of banks depends on the probability that the borrowers to repay the loan. The risk of a firm can be reflected in the financial ratios.

Hypothesis 6: The supply of bank loans for the UK's SMEs decreases if a firm is characterised by higher level of risk.

b. Collateral

The quantity of bank credit offered by banks can also be influenced by the value of collateral offered by the borrower. Collateral plays a key role in mitigating the credit rationing arising from the problems of information asymmetry (Steijvers and Voordeckers, 2009). For the smaller and younger SMEs that are particularly information opaque, it can be difficulty for the lender to assess their creditworthiness and the general viability of the economy. As a result, SMEs are more subject to credit rationing. In this case, collateral become an important assurance that allow the lender to fix the interest rate more precisely, to the extent that the loan is covered by the value of the collateral (Helsen and Chmelar, 2014). In the case of default, banks can liquidise

the collateral to recover the losses of the loan. Moreover, collateral has been suggested as a sorting device (Cowling, 2009). The idea is that good borrowers are willing to provide collateral because they are confident that they will not make default payment as they do not want to lose their assets (Cowling, 2007). Bad borrowers are unwilling to provide collateral because they know they are risky and more likely to lose their collateral.

Hypothesis 7: The supply of bank credit for the UK's SMEs increases if it can offer more assets as collateral.

c. Trade credit

The more recent literature has stressed the role of trade credit complement to bank credit because it may provide a signal to banks about a firm's credit quality (Alphonse et al., 2006; Huang et al., 2010; Cole, 2010; Ellingsen and Vlachos, 2009; Gama et al., 2009). The frequent interaction with customers allows suppliers to have informational advantage over banks about the firm's ability to repay its debt. The credit received from suppliers may therefore mitigate the information asymmetries between banks and borrowers and provide an update for banks about the firm's creditworthiness (Alphonse et al., 2006; Gama et al., 2009). Banks can use trade credit repayment history to justify borrower's credit quality. However, more trade credit outstanding in the balance sheet may implies the firm to have more short-term debt. Moreover, banks may perceive the trade credit as negative signal to indicate that the firm is not able to obtain cheaper credit from banks. Nonetheless, previous studies have commonly found that trade credit has a positive impact on the supply of bank credit to SMEs (e.g.,

Atanasova and Wilson, 2003; Ogawa and Suzuki, 2002). Therefore, the hypothesis is formulated based on the positive signal of trade credit.

Hypothesis 8: The supply of bank credit for the UK's SMEs increases if the firm uses more trade credit.

d. Monetary Condition

As discussed in Chapter 3, the credit channel of monetary policy transmission suggests that a small change in the monetary policy can have a large impact on the economy through corporate borrowing. Small and young SMEs are more informational opaque than large firms and they are more depending on bank credit as a source of external finance.

Hypothesis 9: The supply of bank credit for the UK's SMEs increases if the monetary condition in the UK is easing.

e. Quantitative Easing

In response to the intensified financial crisis, the Bank of England has launched a quantitative easing programme in March 2009 to purchase large amount of assets in the corporate sector. The purpose of the quantitative easing programme is to inject money directly into the economy in order to stimulate private sector spending and ultimately to meet inflation target. Including a measure of quantitative easing in the supply equation allows estimation of the bank lending transmission channel of quantitative easing, which posits that asset purchases will generate additional reserves at the BoE and a corresponding increase in customer deposits when the asset purchase

taken placed through banks, in turn that might increase banks' capacity to extend more loans.

Hypothesis 10: The supply of bank credit for the UK's SMEs increases if there is quantitative easing.

5.4 Measuring the Variables

Taking into account the size difference between firms in the sample, the demand and supply equations are expressed in terms of financial ratios and ratios to one year lagged total assets, except dummy variables. This alleviates the possibility of heteroskedasticity problem in the sample data.

5.4.1 The Dependent Variable

The dependent variable used in the supply equation and the demand equation is the quantity of outstanding bank credit in the balance sheet. Due to the fact that micro and small firms in the UK are not required to submit a full financial statement, the measure of bank credit has been suggested that would be best represented by the bank overdraft and long term liabilities.

5.4.2 Explanatory Variables in the Demand Equation

a. Firm size

Ogawa and Suzuki (2000) suggested that capital stock should represent firm size. However, Atanasova and Wilson (2003) justified that only capital stock itself is not sufficient to reflect the firm size. Instead, it must be take into account of the reserve and thus should be measured by total assets. Other studies that use total assets as

measure of firm size include Kremp and Sevestre (2011), Carbo-Valverde et al. (2012), Adair and Fhima (2014), and Soana et al. (2015).

b. Working capital needs

The working capital needs is proxied by the difference between current assets and current liabilities (Kremp and Sevestre, 2011; Farinha and Felix, 2014). It represents the ability of the firms to fulfil the short-term debts.

c. Investment needs

The investment needs of a firm has been suggested to be measured by the first difference of its tangible assets (Kremp and Sevestre, 2011; Farinha and Felix, 2014).

d. Internal generated cash flow

The internal generated cash flow can be measured by net profit plus depreciation during the year (Atanasova and Wilson, 2004; Carbo-Valverde et al., 2012). However, due to the limitation in the data availability, we use only the net profit as a proxy for internal cash flow.

e. Net trade credit

Net accounts payable has been suggested as a measure of the trade credit used for determining the demand for bank loans and it is defined as a difference between accounts payable and accounts receivable. (e.g., Steijvers, 2004; Atanasova and Wilson, 2004).

f. Control variable: year dummy

Year dummy variable is included in the demand equation to capture the effect of interest rates and the state of economy that affect corporate demand for bank loans (Atanasova and Wilson, 2004). Firms might have a lower demand for bank loans due to a decreasing need for business investment driven by a weak business condition. During economy boom, firms might have a higher demand for bank loans to support its investment activities. Moreover, the year dummy also captures the effect of interest rate of both the loan and substitutes that could impact the demand for bank loans. Higher interest rate of bank loan will likely to prevent firms to borrow from banks and thus a negative effect on demand for bank loans.

g. Control variable: industry

There are certain industries that require more external finance to support their business operations and investments (Rajan and Zingales, 1998). This may be due to differences between industries in terms of the capital needed for business operations, technology, and research and development. Dummy variable for each industry is included in the demand equation to capture the effect embedded by the specific characteristics of the industry the firm operates in, that might affect their demand for bank loans.

5.4.3 Explanatory Variables in the Supply Equation

a. Firm risk

Some empirical studies have suggested that interest cover is a useful measure of the firm risk (e.g., Atanasova and Wilson, 2004; Adair and Fhima, 2014). However, smaller firms in the UK are only required to submit abbreviated financial statements,

it is not possible to obtain information on the interest expenses to calculate the interest cover. Instead, we follow Carbo-Valverde et al. (2012) that use current ratio, which shows the firm's ability to pay short-term debts, as measure of firm risk.

Age of a firm is another risk measure considered by banks when making loan decision to corporate sector. A firm that already established for many years has a proven track record in terms of technical ability, quality and experience of management (Steijvers, 2004). A dummy variable is included in the supply equation that equal to one for firms less than or five years old (Kremp and Sevestre, 2011; Farinha and Felix, 2014).

Besides age, firm size also reflects the credit risk of a firm and it has been suggested that default risk and insolvency risk is higher for smaller firms than larger firms (Farinha and Felix, 2014).

b. Collateral

Previous studies suggested that tangible asset is the best measure of collateral available to a firm (e.g., Atanasova and Wilson, 2004; Berger et al. 2011; Steijvers and Voordeckers, 2009; Berger and Udell, 1995; Bandt et al., 2008).

c. Trade credit

Accounts payable is used as the measure of trade credit for supply equation (Adair and Fhima, 2014).

d. Manufacturing Industry

It has been recognised that the UK government has provided a number of policies to support manufacturing firms. More recently, in compliance with government policy, banks in the UK have provided credit policy to increase financial support to business

growth of manufacturers. The thesis includes an indicator variable equal to one if it belongs to the manufacturing sector, and zero otherwise, in order to measure whether manufacturing firms are able to obtain more loans than other industries.

e. Monetary Condition Index (MCI)

The MCI as an indicator of the monetary condition, which has been estimated in Chapter 4. The MCI is defined as 'a weighted average of the percentage point change in the domestic interest rate and percentage change in an exchange rate relative to their values in a base period' (Batini and Turnbull, 2000, p.4). According to this set up, an upswing in interest rate increases the MCI based on the assumption that an appreciation of sterling tends to reduce aggregate demand and inflation and thus a rise in the indices can be taken as a tightening of monetary conditions.

f. Quantitative Easing

This thesis follows Morais et al. (2015) to use the change in the balance sheet of the Bank of England as ratio to nominal GDP as a measure of quantitative easing. It should be a positive relationship between quantitative easing and credit supply.

Since the firm size is measured by the total assets, it is equal to one. The final form of equation set is shown as the following:

$$\frac{l_{it}^{d}}{a_{i,t-1}} = \beta_0 + \beta_1 \frac{cf_{it}}{a_{i,t-1}} + \beta_2 \frac{ntc}{a_{i,t-1}} + \beta_3 \frac{1}{a_{i,t-1}} + \beta_4 \frac{wc}{a_{i,t-1}} + \beta_5 \frac{inv}{a_{i,t-1}} + \sum_{j=1}^{T} \varphi_j \, DYEAR_j + \sum_{j=1}^{M} \varphi_j \, DIND_j \tag{5.4}$$

$$\frac{l_{it}^{s}}{a_{i,t-1}} = \gamma_0 + \gamma_1 \frac{cr}{a_{i,t-1}} + \gamma_2 \frac{1}{a_{i,t-1}} + \gamma_3 age_{it} + \gamma_4 \frac{col_{it}}{a_{i,t-1}} + \gamma_5 DMAN_{it} + \gamma_6 \frac{tc_{it}}{a_{i,t-1}} + \gamma_7 mci_t + \gamma_8 qe_t \tag{5.5}$$

$$l_{it} = Min\left(l_{it}^{d}, l_{it}^{s}\right) \tag{5.6}$$

5.5 Data and Descriptive Statistics

The disequilibrium model of the bank credit is estimated using a large panel dataset of UK's SMEs obtained from the Credit Management Research Centre (CMRC) of the Leeds University Business School. The initial sample contains 14,447,676 observations in the UK between 1980 and 2010. Several steps are used to clean the initial dataset.

- Only non-financial firms in England and Scotland between 1990 and 2010 with data period more than 40 weeks were selected. Since the variables are expressed in total assets of one-year lag, the data period 1990 was lost.
- Missing and duplicate data were removed.
- Gaps in the time series data of each firm were dropped and only select those with a minimum five consecutive observations in the dataset.
- The sample also excluded public listed firms, which only accounts for 2889 observations in the dataset.

After the data cleaning, the final sample is an unbalanced panel dataset contains contains 700,591 firms between 1991 and 2010, a total 6,187,473 observations. Observations in the dataset are classified into different sizes based on the Company Act 2012. According to Company Act 2012, a micro firm must not exceed 10 employees, £316,000 total assets, and £632,000 turnover; small firm must not exceed 50 employees, £3.26 million total assets, and £6.5 million turnover; medium firm must not exceed 250 employees, £12.9 million total assets, and £25.9 million turnover. It must at least fulfil two of those requirements. However, due to data limitation on the

number of employees and turnover as micro and small firms are only required to report abbreviated accounts, observations in the dataset are classified into micro, small, and medium based on the amount of total assets.

Table 5.1 provide the distribution of observations over years for all the sample firms and classified by the firm size into micro, small, and medium. According to Table 5.1, as many as two third of the sample firms are micro firms, 28.26% of them are small firms, and only 4% of them are medium firms. Most of the observations are between 2000 and 2008.

Table 5.1 Distribution of Observation Over Years

Year	Firm size classification			
	Micro	Small	Medium	Total
1991	724	1,161	274	2,159
1992	3,103	8,546	2,324	13,973
1993	24,728	17,228	3,360	45,316
1994	111,285	41,832	4,507	157,624
1995	130,587	49,577	5,475	185,639
1996	145,791	55,772	6,200	207,763
1997	177,418	71,588	9,019	258,025
1998	229,932	97,140	12,550	339,622
1999	249,732	103,332	13,864	366,928
2000	266,619	110,779	15,356	392,754
2001	282,781	118,801	17,078	418,660
2002	301,960	126,053	18,427	446,440
2003	320,405	133,598	19,413	473,416
2004	357,632	143,408	21,054	522,094
2005	388,237	151,101	22,182	561,520
2006	363,354	150,661	22,742	536,757
2007	337,499	148,361	23,309	509,169
2008	308,420	141,244	22,553	472,217
2009	188,466	78,170	10,087	276,723
2010	558	113	3	674
Total	4,189,231	1,748,465	249,777	6,187,473

This table shows the distribution of observation over the sample period. Observations are classified into micro, small, and medium sized by the total assets. Micro sized firms have total assets less than £316,000; small sized firms have total assets less than £3.26 million; medium sized firms have total assets less than £12.9 million.

Table 5.2 provides the industry breakdown of all the observations in the sample according to the firm size classification. The real estate industry has the largest proportion of firms in the sample, with around 1.8 million of micro firms, 0.58 million of small firms, and 0.86 million of medium firms. The education industry accounts for only 62,446 of the observations in the sample.

Table 5.2 Industry Breakdown

Industry	Micro	Small	Medium	Total
Agriculture, Hunting and Forestry	46,811	50,997	5,351	103,159
Mining and Quarrying	11,183	4,207	1,013	16,403
Manufacturing	392,887	281,232	49,481	723,600
Construction	450,518	186,523	17,025	654,066
Wholesale and Retail Trade	570,784	322,866	49,043	942,693
Hotels and Restaurant	93,709	50,439	7,160	151,308
Transport, Storage and Communication	132,192	73,936	10,639	216,767
Real Estate, Renting and Business Activities	1,797,325	582,661	86,215	2,466,201
Education	40,387	18,019	4,040	62,446
Health and Social Work	75,651	45,754	7,277	128,682
Other Community, Social and Personal Service	577,784	131,831	12,533	722,148
Total	4,189,231	1,748,465	249,777	6,187,473

This table shows the industry break down of the observations in the sample. Observations are classified into micro, small, and medium sized by the total assets. Micro sized firms have total assets less than £316,000; small sized firms have total assets less than £3.26 million; medium sized firms have total assets less than £12.9 million.

Table 5.3 (in the next page) reports the descriptive statistics of the variables used in the estimation of disequilibrium model for all firms in the sample. The mean reports the average value of all the firms in the sample. For example, the mean value of assets is £578,683 for all the firms in the sample, indicating that on average firms in the

sample have £578,683 total assets. The standard error of the mean reports the variability between the observations.

Table 5.3 Descriptive Statistics of Variables for All Firms

	Mean	S.E. in Mean	Median
All firms			
Assets (£)	578,682.9	(1,315,315)	128000
Bank credit/assets	0.2674	(10.773)	0
Internal cash flow/assets	0.0190	(44.630)	0.0137
Trade creditors/assets	0.6645	(12.923)	0.3120
Net trade credit/assets	0.2947	(12.566)	0.0369
Working capital needs	-0.1668	(55.870)	0.1045
Investment needs	0.0681	(6.489)	0
Current ratio	3.2656	(26.835)	1.1865
Collateral/assets	0.3389	(6.494)	0.1540

This table shows the mean and median of variables of all firms in the sample. The standard error of the mean is reported in parenthesis. Except the assets is expressed in £, all other variables are in ratio to one year lagged total assets.

Table 5.4 subsample of micro, small, and medium firms. The median company in the subsample of micro sized firms has total assets of £54,000; on average micro sized firms rely heavily on trade credit as main source of finance than bank credit, and less likely to rely on internal generated cash flow. A similar structure of corporate financing is found on small sized firms, which the median company in the subsample has total assets of £737,000. However, this corporate financing structure is contrasted to medium sized firms, which on average medium sized firms rely heavily on bank credit as source of funds than trade credit, and less likely to rely on internal generated cash flow. The median company in subsample of medium sized firms has total assets of £5,227,000.

Table 5.4 Descriptive Statistics of All Variables by Firm Size

	Mean	S.E. in Mean	Median
Micro sized firms			
Assets (£)	85957.39	(82927.84)	54000
Bank credit/assets	0.2517	(10.567)	0
Internal cash flow/assets	0.0175	(50.672)	0
Trade creditors/assets	0.7516	(6.134)	0.3684
Net trade credit/assets	0.3807	(6.037)	0.0714
Working capital needs	-0.3067	(66.182)	0.0842
Investment needs	0.0300	(0.958)	0
Current ratio	2.6506	(8.186)	1.1356
Collateral/assets	0.2529	(0.986)	0.1154
Small sized firms			
Assets (£)	994369.2	(692259.5)	737000
Bank credit/assets	0.2785	(8.877)	0.0376
Internal cash flow/assets	0.0173	(29.722)	0.0246
Trade creditors/assets	0.4986	(21.146)	0.2586
Net trade credit/assets	0.1342	(20.833)	0.0145
Working capital needs	0.1238	(22.533)	0.1413
Investment needs	0.1222	(6.224)	0
Current ratio	4.2495	(29.091)	1.2940
Collateral/assets	0.4863	(6.230)	0.2827
Medium sized firms			
Assets (£)	5932772	(2332220)	5227000
Bank credit/assets	0.4525	(21.228)	0.1117
Internal cash flow/assets	0.0553	(9.671)	0.0199
Trade creditors/assets	0.3645	(19.384)	0.1022
Net trade credit/assets	-0.0248	(16.169)	-0.0069
Working capital needs	0.1443	(17.571)	0.1011
Investment needs	0.3288	(27.504)	0.0003
Current ratio	6.6920	(103.760)	1.2200
Collateral/assets	0.7494	(27.503)	0.3796

This table shows the mean and median of variables of firms in the sample, classified into micro, small, and medium sized. Micro sized firms have total assets less than £316,000; small sized firms have total assets less than £3.26 million; medium sized firms have total assets less than £12.9 million. The standard error of the mean is reported in parenthesis. Except the assets is expressed in £, all other variables are in ratio to one year lagged total assets.

5.6 An Analysis of Company Finance Structure

This section provides an analysis of the financial structure of the firms in the sample over the sample period. First, this section describes how many firms in the sample used trade creditors, i.e., inter-firm credit provided by their suppliers. Table 5.5 (in the next page) shows the number of firms in the sample with trade creditors outstanding by the firm size. According to Table 5.5, there are more proportion of small firms used trade credit offered by their suppliers than micro and medium sized firms. In general, around 90% of small firms the sample used trade credit offered by their suppliers. Around 87% to 89% of the medium firms used trade credit offered by their suppliers during 1994 and 2008, while slightly more proportion of medium firms (92% to 94%) used trade credit as a source of financing.

Table 5.5 Number of Firms with Trade Creditors Outstanding

Year	Micro	Small	Medium
1991	604 (83.4%)	1060 (91.3%)	254 (92.7%)
1992	2732 (88.0%)	8090 (94.7%)	2186 (94.1%)
1993	20106 (81.3%)	15854 (92.0%)	3103 (92.4%)
1994	87329 (78.5%)	37817 (90.4%)	4022 (89.2%)
1995	101767 (77.9%)	44938 (90.6%)	4842 (88.4%)
1996	113096 (77.6%)	50546 (90.6%)	5459 (88.0%)
1997	137101 (77.3%)	64759 (90.5%)	7975 (88.4%)
1998	177686 (77.3%)	87549 (90.1%)	10975 (87.5%)
1999	193058 (77.3%)	93088 (90.1%)	12096 (87.2%)
2000	207343 (77.8%)	99855 (90.1%)	13410 (87.3%)
2001	222340 (78.6%)	107241 (90.3%)	14869 (87.1%)
2002	240398 (79.6%)	113951 (90.4%)	16096 (87.4%)
2003	258179 (80.6%)	121063 (90.6%)	16950 (87.3%)
2004	292557 (81.8%)	130461 (91.0%)	18490 (87.8%)
2005	321931 (82.9%)	136690 (90.5%)	19488 (87.9%)
2006	303651 (83.6%)	136853 (90.8%)	20192 (88.8%)
2007	285610 (84.6%)	135355 (91.2%)	20798 (89.2%)
2008	268297 (87.0%)	129740 (91.9%)	20278 (89.9%)
2009	166228 (88.2%)	71924 (92.0%)	9030 (89.5%)
2010	496 (88.9%)	107 (94.7%)	3 (100%)

This table shows the number of firms in the sample with trade creditors outstanding over the sample period, i.e., used inter-firm credit provided by their suppliers. Firms in the sample are classified into micro, small, and medium sized. Micro sized firms have total assets less than £316,000; small sized firms have total assets less than £3.26 million; medium sized firms have total assets less than £12.9 million. The percentage of firms with trade creditors outstanding are reported in the parenthesis.

Table 5.6 Number of Firms with Trade Debtors Outstanding

Year	Micro	Small	Medium
1991	612 (84.5%)	1073 (92.4%)	255 (93.1%)
1992	2714 (87.5%)	8084 (94.6%)	2190 (94.2%)
1993	20136 (81.4%)	15810 (91.8%)	3117 (92.8%)
1994	89048 (80.0%)	37739 (90.2%)	4036 (89.5%)
1995	103938 (79.6%)	44770 (90.3%)	4877 (89.1%)
1996	115596 (79.3%)	50294 (90.2%)	5502 (88.7%)
1997	139505 (78.6%)	64265 (89.8%)	8009 (88.8%)
1998	180015 (78.3%)	86711 (89.3%)	11003 (87.7%)
1999	193039 (77.3%)	91857 (88.9%)	12117 (87.4%)
2000	203978 (76.5%)	97969 (88.4%)	13390 (87.2%)
2001	216128 (76.4%)	104679 (88.1%)	14825 (86.8%)
2002	229690 (76.1%)	110502 (87.7%)	15949 (86.6%)
2003	244051 (76.2%)	117006 (87.6%)	16738 (86.2%)
2004	274008 (76.6%)	125454 (87.5%)	18210 (86.5%)
2005	297888 (76.7%)	132098 (87.4%)	19172 (86.4%)
2006	280749 (77.3%)	132307 (87.8%)	19759 (86.9%)
2007	261883 (77.6%)	131081 (88.4%)	20482 (87.9%)
2008	241409 (78.3%)	125662 (89.0%)	19993 (88.6%)
2009	147415 (78.2%)	69408 (88.8%)	8992 (89.1%)
2010	399 (71.5%)	100 (88.5%)	3 (100.%)

This table shows the number of firms in the sample with trade creditors outstanding over the sample period, i.e., offered inter-firm credit. Firms in the sample are classified into micro, small, and medium sized. Micro sized firms have total assets less than £316,000; small sized firms have total assets less than £3.26 million; medium sized firms have total assets less than £12.9 million. The percentage of firms with trade debtors outstanding are reported in the parenthesis.

Table 5.7 Number of Firms with Bank Credit Outstanding

Year	Micro	Small	Medium
1991	522 (72.1%)	979 (84.3%)	254 (92.7%)
1992	2167 (69.8%)	7297 (85.4%)	2101 (90.4%)
1993	13221 (53.5%)	13986 (81.0%)	2972 (88.5%)
1994	52565 (47.2%)	32314 (77.2%)	3905 (86.6%)
1995	58635 (44.9%)	37941 (76.5%)	4682 (85.5%)
1996	62167 (42.6%)	42232 (75.7%)	5221 (84.2%)
1997	71171 (40.1%)	53018 (74.1%)	7417 (82.2%)
1998	87872 (38.2%)	70424 (72.5%)	10187 (81.2%)
1999	88953 (35.6%)	73229 (70.9%)	11141 (80.4%)
2000	88972 (33.4%)	76642 (69.2%)	12242 (79.7%)
2001	91100 (32.2%)	81360 (68.5%)	13641 (79.9%)
2002	96596 (32.0%)	86828 (68.9%)	14794 (80.3%)
2003	101966 (31.8%)	91732 (68.7%)	15487 (79.8%)
2004	110411 (30.9%)	97217 (67.8%)	16777 (79.7%)
2005	115403 (29.7%)	100980 (66.8%)	17605 (79.4%)
2006	105603 (29.1%)	98576 (65.4%)	17886 (78.6%)
2007	95941 (28.4%)	95300 (64.2%)	18104 (77.7%)
2008	86011 (27.9%)	88837 (62.9%)	17411 (77.2%)
2009	51855 (27.5%)	48824 (62.5%)	7841 (77.7%)
2010	137 (24.6%)	67 (59.3%)	3 (100%)

This table shows the number of firms in the sample with bank credit outstanding over the sample period. Firms in the sample are classified into micro, small, and medium sized. Micro sized firms have total assets less than £316,000; small sized firms have total assets less than £3.26 million; medium sized firms have total assets less than £12.9 million. The percentage of firms with bank credit outstanding are reported in the parenthesis.

Figure 5.1 compares the percentage of trade creditors to total liabilities between micro, small, and medium sized firms. Trade creditors of micro-sized firms in the sample is around 30% of their total liabilities in 1991 and the trade creditors are gradually increasing over years to as much as 80% of their total liabilities in 2010. Similarly, for small-sized firms, their trade creditors are also around 30% of their total liabilities in 1991 and it is gradually increasing over years to around 70% of their total liabilities in 2010. In contrast, trade creditors of the medium sized firms are around 20-30% of their total liabilities and remain stable in proportion to their total liabilities, which is much lower than micro and small sized firms.

Figure 5.1 Trade Creditors to Total Liabilities (%), by Size

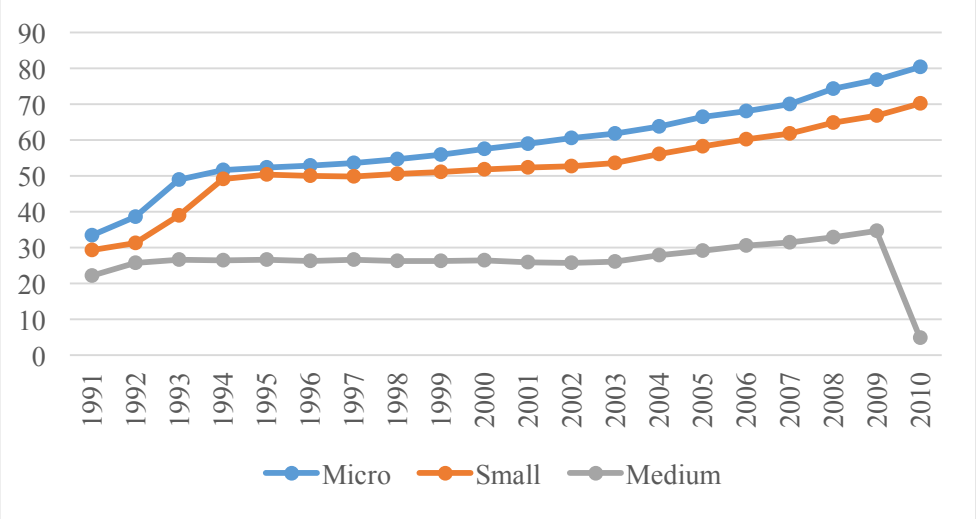


Figure 5.2 compares the percentage of trade debtors to total assets are compared between micro, small, and medium sized firms. Micro firms in the sample extended more inter-firm credit in proportion of their total assets than small and medium sized firms. This is compared to medium firms, which has generally extended credit around 20% of their total assets to their business customers and the proportion is gradually decrease since the financial crisis in 2008.

Figure 5.2 Trade Debtors to Total Assets (%), by Size

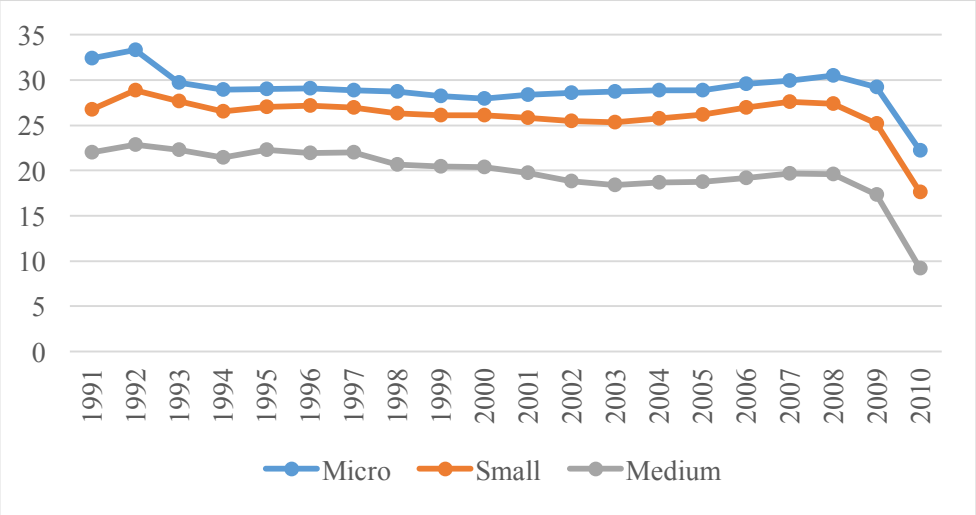
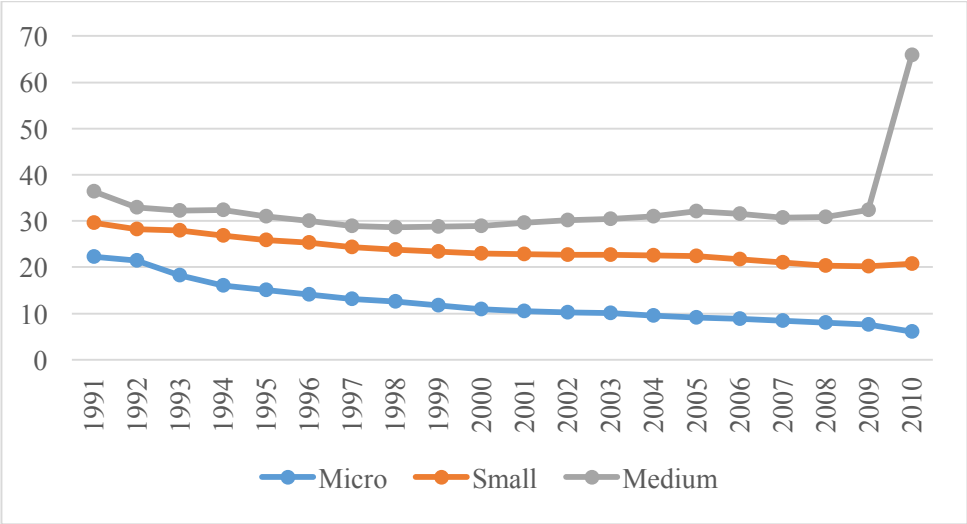


Figure 5.3 summarises the proportion of bank credit in micro, small, and medium firms to their total liabilities. Micro firms have an average bank credit around 20% in proportion to their total liabilities and the figure is gradually falling over years to only around 5% in 2010. Small sized firms have an average bank credit around 30% to their total liabilities and also decreasing over years. Medium sized firms have much lower amount of bank credit in proportion to their total liabilities and the amount seems stable over years. Note that dramatic increase of bank credit in 2010 is merely extreme value due to a tiny sample of medium firms in 2010.

Figure 5.3 Bank Credit to Total Liability (%), by Size



5.7 Estimated Results of the Disequilibrium Model

After an analysis of the corporate financing structure of the firms in the sample, it is now to estimate the demand equation (equation 5.4) and supply equation (equation 5.5) using the 3SLS. After that, the fitted values of both the equations are estimated to find the quantity of loan demand and the quantity of loan supply. The quantity of loan demand and supply are then used to estimate which firms in the sample face borrowing constraint. Borrowing constrained firms are those with excess demand that their quantity of loan demand is greater than the quantity of loan supply.

This section presents the results of the disequilibrium model of credit rationing. Remind that the MCI that estimated in chapter 4 is included in the supply equation and therefore is able to estimate its effect on corporate borrowing. This section first considers the results of the demand equation (in section 5.6.1) before looking at the result of the supply equation (in section 5.6.2). After that, this section reports the number and proportion of firms in the sample face credit rationing. Credit rationing and borrowing constraint are used interchangeably in this thesis, they both refer to the condition of excess demand for bank loans. The results of the disequilibrium model are discussed in section 5.7.

5.7.1 Results of the Demand Equation

This subsection reports the estimated coefficients of the demand equation (equation 5.4). Table 5.8 (in the next page) summaries the estimated coefficients of the demand equation.

a. Firm size

We start by looking at the coefficient of the firm size. The results show that regardless of whether it is micro, small, or medium sized firms in the sample, the coefficients of firm size have a significant positive effect on desired demand for bank loans, which indicates that larger firms have stronger desired demand for bank loans. This is therefore able to confirm the hypothesis 1, that the demand for bank credit for the UK's SMEs increases if the size of the firm is larger.

Table 5.8 Estimated Coefficients of the Demand Equation

Variables	Micro firm	Small firm	Medium firm
Constant	0.08145 (2.62)*	-0.01016 (-0.09)	0.18642 (0.05)*
Internal cash flow/assets	0.00006 (5.35)*	-0.00035 (-10.98)*	-0.10558 (-66.84)*
Net trade credit/assets	0.00924 (32.87)*	-0.00693 (-32.69)*	-0.01706 (-17.96)*
Working capital needs/assets	-0.00006 (-7.46)*	0.00315 (34.37)*	0.09394 (105.01)*
Investment/assets	0.02642 (20.67)*	0.30961 (301.80)*	0.37929 (287.87)*
Firm size	2780.232 (62.92)*	162960.8 (300.50)*	732019.1 (163.07)*
DYEAR			
1991	0.01001 (0.26)	-0.01032 (-0.08)	-0.04711 (-0.01)
1992	0.00889 (0.28)	-0.01275 (-0.11)	-0.06268 (-0.02)
1993	0.01076 (0.36)	0.00453 (0.04)	-0.07478 (-0.02)
1994	0.00980 (0.33)	0.00943 (0.08)	-0.06104 (-0.02)
1995	0.01119 (0.36)	0.01031 (0.09)	-0.09816 (-0.03)
1996	0.00994 (0.33)	0.00406 (0.03)	-0.07186 (-0.02)
1997	0.00557 (0.19)	-0.01414 (-0.12)	-0.08433 (-0.02)
1998	0.00323 (0.11)	-0.02266 (-0.19)	-0.09497 (-0.03)
1999	-0.00248 (-0.08)	-0.03664 (-0.32)	-0.14117 (-0.04)
2000	0.00367 (0.11)	-0.02428 (-0.21)	-0.05993 (-0.02)
2001	0.00507 (0.14)	-0.02135 (-0.18)	0.01542 (0.00)
2002	0.00097 (0.03)	-0.03281 (-0.28)	-0.07034 (-0.02)
2003	0.00158 (0.05)	-0.03658 (-0.26)	-0.08074 (-0.02)
2004	0.00033 (0.01)	-0.03712 (-0.32)	-0.05805 (-0.02)
2005	0.00019 (0.01)	-0.03764 (-0.32)	-0.06183 (-0.02)
2006	2.75e-06 (0.00)	-0.04209 (-0.36)	-0.11194 (-0.03)
2007	-0.00901 (-0.03)	-0.04753 (-0.41)	-0.08890 (-0.02)
2008	0.00258 (0.09)	-0.03430 (-0.30)	-0.07585 (-0.02)
2009	0.00213 (0.08)	-0.02502 (-0.22)	-0.13323 (-0.04)
DINDUSTRY			
Agriculture, Hunting, Forestry	-0.00417 (-0.60)	-0.06069 (-3.08)*	-0.02472 (-0.12)
Mining and Quarrying	0.11243 (6.27)*	-0.04299 (-2.46)*	-0.07018 (-0.65)
Manufacturing	-0.00318 (-1.00)	-0.10684 (-17.39)*	-0.12665 (-1.30)
Construction	-0.00431 (-1.36)	-0.10577 (-18.05)*	-0.13667 (-1.52)
Wholesale and Retail Trade	0.00044 (0.12)	0.03992 (5.18)*	0.10787 (0.96)
Hotels and Restaurant	-0.00110 (-0.31)	-0.06803 (-9.62)*	-0.05870 (-0.56)
Transport, Storage and Comm.	-0.00336 (-1.09)	-0.04178 (-7.36)*	-0.00557 (-0.06)
Real Estate, Renting	-0.00386 (-0.87)	-0.02095 (-1.97)*	0.01062 (0.08)
Education	-0.00410 (-1.06)	-0.01519 (-1.92)	0.00726 (0.06)
Health and Social Work	-0.00447 (-1.42)	-0.04418 (-6.90)*	-0.03935 (-0.39)
R-Square	0.0017	0.1513	0.5199

This table shows the estimated coefficients of the demand equation of the disequilibrium model (equation 5.4). The t-ratios are reported in parenthesis. * denotes the coefficient is significant at 5%. The firms in the sample are classified into micro, small, and medium sized. Micro sized firms have total assets less than £316,000; small sized firms have total assets less than £3.26 million; medium sized firms have total assets less than £12.9 million.

b. Working Capital and Investment Needs

The coefficient of the working capital needs and investment. For small sized and medium sized firms in the sample, both the coefficients of working capital requirement and investment have significant positive effect on the desired loan demand. This confirms that small sized and medium sized firms' desired demand for bank borrowing should increase along with the requirement of working capital and investment. For small firms, the coefficients of working capital requirement is around 0.0032 and for investment is 0.31, which indicates a much stronger effect of investment on desired demand for bank loans than working capital needs. This suggests that £1 increase in investment needs will result in £0.31 increase of desired loan demand for small sized firms, while £1 increase in working capital requirement will increase desired demand for bank borrowing by only £0.0032. For medium firms, the coefficient of working capital requirement is 0.094 and for investment needs is 0.38. This suggests that £1 increase in working capital needs will increase desired loan demand by £0.094, whereas £1 increase in investment will lead to £0.38 increase of desired demand for bank loans.

Therefore, it is able to confirm that the hypothesis 2 and hypothesis 3 for small and medium sized firms that the demand for bank credit for the small and medium sized firms in the UK increases if it has a higher need for working capital and investment.

However, for micro sized firms, the estimated coefficient of working capital requirement has significant negative effect on desired demand for bank borrowing, indicating that they have stronger desired loan demand when they have lower requirement for working capital.

Therefore, for the micro sized firms, it does not have enough evidence to confirm the hypothesis 2. Nonetheless, it is able to confirm that the demand for bank loans for micro sized firms in the UK increases if it has stronger financial need for investment.

c. Internal generated cash flow and Net trade credit

For small sized and medium sized firms, internal generated cash flow and net trade credit have significant negative effect on desired loan demand, indicating that they are important substitutes for bank loans. This suggests that small sized and medium sized firms have stronger desired demand for bank loans when they have less internal funds available to them and received more trade credit from their suppliers. For small sized firms, the extent to which the internal funds substitute for bank loans is about 0.0035 whereas for net trade credit obtained is 0.007. This suggests that £1 increase in internal funds will result in £0.0035 decrease of desired loan demand, and £1 increase in net trade credit received will reduce desired for loan demand by £0.007. Compared to medium sized firms, the coefficient of internal generated cash flow is around 0.1 and net trade credit acquired is 0.017. This suggests that £1 increase in internal funds will reduce desired demand for bank loans by £0.1, whereas £1 increase in net trade credit received will result in decrease £0.017 desired loan demand.

Therefore, it is able to confirm the hypothesis 4 and hypothesis 5 for small and medium sized firms in the sample, that the demand for bank credit for the small and medium sized firms in the UK increases if it has less internal resources available and net trade credit outstanding.

However, for micro sized firms, it is surprising to see that the coefficient of internal generated cash flow and net trade credit have a significant positive effect on desired

for loan demand. This indicates that the micro sized firms' desired demand for bank loans will increase along with the increase in their internal funds and net trade credit.

Therefore, it does not have enough evidence to confirm the hypothesis 4 and 5 for micro sized firms in the sample.

d. Time dummy

For micro sized firms, the coefficients of time dummy variables are positive from 1991 to 1998 and in 2008 and 2009, and negative and generally declining until 2000. This indicates that micro firms have stronger demand for bank loans between 1991 and 1998 but declining from 1999 to 2007, and then increase in 2008 and 2009. This suggests micro firms increase bank credit as source of funds during economic recession in 2008 and 2009. For small firms, the coefficients of time dummy are negative and declining from 1996 to 2009, which suggests that their desired demand for bank loans are declining since 1996, even during economic recession. For medium firms, the coefficients of time dummy are negative throughout the sample period and is deepest in 2009, indicating that the demand for bank loans are decreasing during the sample period and is significant decreased in 2009.

5.7.2 Results of the Supply Equation

After reporting the estimated results of the demand of bank credit, it is now necessary to report the estimated coefficients of the credit supply equation (equation 5.5). Table 5.9. summaries the estimated coefficients of the supply equation.

Table 5.9 Estimated Coefficients of the Supply Equation

Variables	Micro firm	Small firm	Medium firm
Constant	0.10679 (1.55)	-0.07697 (-0.92)	-0.10408 (-0.25)
Current ratio	0.00008 (2.00)*	0.00022 (6.96)*	0.00017 (1.30)
Firm size	2777.205 (62.72)*	165746.8 (300.62)*	888925.4 (171.26)*
Firm age < 5 years	-0.00017 (-0.23)	0.01520 (5.28)*	0.02198 (0.44)
Collateral/assets	0.02429 (19.54)*	0.30648 (296.24)*	0.33742 (234.02)*
Manufacturing industry	0.11504 (6.50)*	0.04149 (2.46)*	0.02121 (0.28)
Trade creditors/assets	0.00907 (32.61)*	-0.00990 (-48.38)*	-0.04153 (-39.94)*
MCI	-0.00031 (-0.51)	-0.00125 (-1.70)	0.00002 (0.00)
QE	-0.07370 (-0.33)	-0.17552 (-0.65)	-1.58077 (-1.18)
R-square	0.0016	0.1507	0.4873

This table shows the estimated coefficients of the supply equation of the disequilibrium model (equation 5.5). The t-ratios are reported in parenthesis. * denotes the coefficient is significant at 5%. The firms in the sample are classified into micro, small, and medium sized. Micro sized firms have total assets less than £316,000; small sized firms have total assets less than £3.26 million; medium sized firms have total assets less than £12.9 million.

a. Firm risk: current ratio

The coefficients of current ratio of both micro and small sized firms have significant positive effect on the desired demand for bank loans, but the effect is not significant for medium sized firms. Current ratio reflects the firm's ability to pay short-term debts and the higher the ratio, the more capability the firm is of paying its debt and therefore a lower default risk. The positive coefficient in the estimation suggests that credit availability increases when the firm is more capable of paying its debt. The coefficient of current ratio for micro sized firms in the sample is around 0.00008, and it is 0.00002

for small sized firms, and 0.00017 for medium sized firms. This suggests that 1% increase in the current ratio of micro sized firms will increase 0.00008% of its credit availability, 0.00002% for small sized firms, and 0.00017% for medium firms.

The coefficients of firm size have a significant positive effect on the availability of bank loans for all sized of firms in the sample. This suggests that larger firms have supplied more credit than smaller firms.

The firm age is an indicator variable equal to one if the firm is less than 5 years old, and is zero if it is or over 5 years old. The coefficient of firm age of micro sized firms has a negative effect on the desired loan demand. The negative coefficient of firm age indicates that they have more credit availability when they are more than 5 years old. This is compared to small sized and medium sized firms, which have positive coefficients of firm age and this suggests that they have more credit availability if they have been established for less than 5 years old.

For the measure of firm risk, the current ratio and firm size have provided sufficient evidence to confirm the hypothesis 6 that the supply of bank loans for the micro and small sized firms in the UK decreases if a firm is characterised by higher level of risk. However, the current ratio is not significant for medium sized firms and therefore is not able to confirm the hypothesis 6 for medium sized firms. Moreover, the firm age also is far too completed to confirm the hypothesis about firm risk in the supply of bank loans.

b. Collateral

The coefficients of collateral have significant positive effect on desired demand for bank loans for all sized of firms in the sample. The coefficients of collateral of micro sized firms is 0.0243, small sized firms is 0.3065, and medium sized firms is 0.3374. This suggests that £1 increase in the collateral of micro sized firms will result in increasing loan availability to them by £0.0243, £1 increase in collateral of small sized firms will increase £0.3065 of loan supply to them, and £1 increase in collateral of medium sized firms will increase £0.3374 of loan availability to them.

Therefore, it is able to confirm the hypothesis 7 for all the firm size in the sample, that : the supply of bank credit for the UK's SMEs increases if it can offer more assets as collateral.

c. Manufacturing Industry

The coefficient of manufacturing industry dummy has significant positive effect on the supply of bank loans to micro and small sized firms, but not significant for medium sized firms. It is an indicator variable equal to 1 if the firm belongs to manufacturing industry. The positive coefficients in the estimation suggest that greater bank loans available to the firm if it belongs to manufacturing industry. Therefore, micro and small sized firms in the sample that are belong to the manufacturing industry have significant more bank loans available to them, while but not significant for medium sized firms. If the micro sized firm is a manufacturing firm, then it has 11.5% more bank credit available compared to firms in non-manufacturing sector; if the small sized firm is a manufacturing firm, then it has 4.15% more bank credit available to them compared to firms in non-manufacturing sector; if the medium firm is a manufacturing

firm, then it has 2.12% more bank credit compared to firms in non-manufacturing sector.

d. Trade creditors

The coefficient of trade creditors of micro sized firms has significant positive effect on loan availability, while the coefficients of trade creditors of small and medium sized firms in the sample have significant negative effect on loan supply. This indicates that more loans are available to micro sized firms that obtained more trade credit from their suppliers. However, this contrasted to small and medium sized firms that have lower loan availability as they obtained more trade credit from their suppliers.

Therefore, it is able to confirm the hypothesis 8 for micro sized firms in the sample, that the supply of bank credit for the micro sized firms in the UK increases if it uses more trade credit. However, for small and medium sized firms in the sample, it does not have enough evidence to confirm the hypothesis 8.

e. Monetary Condition

The coefficients of monetary condition index (MCI) have negative effect on loan availability to micro sized and small sized firms, although the effect is not significant. However, the coefficient of the MCI has positive effect on loan availability for medium sized firms. The negative coefficient suggests that firms have more bank credit availability when the monetary condition is loosening but have less credit availability when the monetary condition is tightening. This finding is consistent with the theoretical prediction of credit channel view of monetary policy transmission mechanism. However, this is not the case for medium sized firms. The result shows

that loosen (tighten) monetary policy would reduce (increase) the availability of bank credit to medium sized firms.

Therefore, it is able to confirm the hypothesis 9 for micro sized and small sized firms in the UK, in that the supply of bank credit for the micro sized and small sized firms in the UK increases if the monetary condition in the UK is easing. However, it does not have enough evidence to confirm the hypothesis 9 for medium sized firms in the UK.

f. Quantitative easing

The estimated coefficient of quantitative easing has negative effect on the supply of bank credit but the effect is not significant. This suggests that more credit is available to firms when less money is created on the balance sheet of banks. Therefore, it does not have enough evidence to confirm the hypothesis 10, in that the supply of bank credit for the UK's SMEs increases if there is quantitative easing.

5.7.3 The Proportion of Borrowing Constrained Firms

After reporting the estimated coefficients of both the equation of credit demand and credit supply, it is now to report how many of them face borrowing constraint. Credit rationing and borrowing constraint are used interchangeably in this thesis. Both terminologies are used to describe the situation in which the borrowers have higher demand for bank credit than the supply.

Table 5.10 (in the next page) shows the number of borrowing constrained firms in the period between 1991 and 2010. The proportion (%) are reported in the parenthesis. According to the table 5.10, over the sample period between 1991 and 2010, the average proportion of borrowing constrained firms of the micro sized firms is 58.3%, small sized firms is 56.2%, and medium sized firms is 51.6%. The results show that the proportion of micro sized firms in the sample that are borrowing constraint is significant higher in the recession year of 1991 and generally declines after that until 1995. The proportion slightly increased to 57% and remains stable at around 57% until 2000. The proportion of borrowing constrained micro sized firms started to increase in 2001 and reached its peak in 2008 to 60.3%. The proportion of borrowing constrained micro firms declines in 2009 and 2010.

Table 5.10 Number of Borrowing Constrained Firms (1991-2010)

Year	Micro	Small	Medium
1991	519 (71.7%)	656 (56.5%)	152 (55.5%)
1992	1,881 (60.6%)	4,831 (56.5%)	1,219 (52.5%)
1993	14,453 (58.4%)	9,798 (56.9%)	1,694 (50.4%)
1994	61,741 (55.5%)	22,903 (54.7%)	2,370 (51.9%)
1995	72,168 (55.3%)	26,972 (54.4%)	2,144 (39.2%)
1996	81,831 (56.1%)	30,471 (54.6%)	3,147 (50.8%)
1997	101,289 (57.1%)	39,317 (54.9%)	4,319 (47.9%)
1998	130,238 (56.6%)	53,039 (54.6%)	5,788 (46.1%)
1999	142,318 (57.0%)	56,705 (54.8%)	8,552 (61.7%)
2000	152,370 (57.1%)	60,744 (54.9%)	6,856 (44.6%)
2001	163,608 (57.9%)	65,687 (55.3%)	9,720 (56.9%)
2002	177,449 (58.8%)	70,207 (55.7%)	9,512 (51.6%)
2003	188,882 (59.0%)	75,016 (56.2%)	9,653 (49.7%)
2004	211,480 (59.1%)	81,129 (56.6%)	11,434 (54.3%)
2005	228,266 (58.8%)	86,768 (57.4%)	12,284 (56.7%)
2006	215,647 (59.3%)	86,405 (57.3%)	9,823 (43.2%)
2007	201,874 (59.8%)	85,516 (57.6%)	12,047 (51.7%)
2008	185,831 (60.3%)	81,328 (57.6%)	12,807 (56.9%)
2009	110,283 (58.5%)	44,201 (56.5%)	5,302 (52.6%)
2010	293 (52.5%)	60 (53.1%)	3 (100.0%)
Total	2,442,421 (58.3%)	981,753 (56.2%)	128,826 (51.6%)

This table reports how many and the proportion of firms in the sample face borrowing constraint between 1991 and 2010. The sample firms are classified into micro, small, and medium size. Micro sized firms have total assets less than £316,000; small sized firms have total assets less than £3.26 million; medium sized firms have total assets less than £12.9 million.

For small sized firms, the proportion of borrowing constrained is around 57% in between 1991 and 1993 and then slightly decrease to around 55% in 1994 and the proportion remain stable between 1994 and 2000. The proportion of borrowing constrained small firms then gradually increase in 2001 until its peak at 57.6% in 2008. For medium sized firms, the proportion of borrowing constrained firms is significantly decreasing from 55.5% in 1991 to the lowest at 39% in 1995. The proportion of

medium firms that are borrowing constrained increase in 1996 to 61.7% in 1999 and the proportion is decreasing after that. The proportion is increasing to 57% in 2008.

The descriptive statistics between constrained and unconstrained firms for micro, small, and medium sized in the sample are compared in Table 11, 12, and 13, respectively, in the next page. T-tests are also performed to test the significance of mean difference between constrained and unconstrained firms, whereas Mann-Witney tests are estimated to test the significance of differences in median between constrained and unconstrained firms. In overall, the results of t-tests show that there are significant differences in the mean of total assets between those constrained and unconstrained among micro and small sized firms, but not among medium sized firms in the sample. Among micro and small sized firms, those borrowing unconstraint generally have higher level of assets compared to those of constrained firms. However, among medium sized firms, those unconstraint have slightly lower total assets than those of constrained.

It is now to compare differences between constrained and unconstrained of the micro firms in the sample. According to Table 5.11 (in the next page), the results of t-test also show significant difference in the mean of internal generated cash flow, trade creditors, net trade credit, short-term and long-term financing needs, current ratio, and collateral between those micro firms that are constraint and unconstraint.

Table 5.11 Descriptive Statistics of Constrained, Unconstrained Micro Firms

	Borrowing Constrained		Unconstrained	
	Mean	Median	Mean	Median
Assets (£)	75287 (78177)	44000	100877 (86978)	73000
Bank credit/assets	0.2368 (8.812)	0	0.2725 (12.617)	0
Cash flow/assets	-0.0252 (62.666)	0	0.0774 (25.825)	0.0189
Trade creditors/assets	0.7150 (7.695)	0.32	0.8027 (2.725)	0.4504
Net trade credit/assets	0.4959 (7.684)	0.0909	0.2197 (2.192)	0.0454
Working capital need	-0.4060 (86.628)	0.1676	-0.167 (3.370)	0
Investment need	0.0523 (1.185)	0.1676	-0.001 (0.487)	-0.0088
Current ratio	2.7630 (5.744)	1.2857	2.4934 (10.703)	1
Collateral/assets	0.1296 (1.190)	0.0455	0.4254 (0.547)	0.3548

	t-Value[a]	z-Value[b]
Bank credit/assets	3.403 (0.0007)	465.755 (0.000)
Cash flow/assets	2.044 (0.0410)	169.530 (0.000)
Trade creditors/assets	14.424 (0.0000)	237.391 (0.000)
Net trade credit/assets	-46.183 (0.0000)	237.391 (0.000)
Working capital need	3.632 (0.0003)	-418.225(0.000)
Investment need	-56.172 (0.0000)	-389.365(0.000)
Current ratio	-33.237 (0.0000)	-426.667(0.000)
Collateral/assets	306.177 (0.0000)	1151.444(0.000)

This table reports the differences in the mean and medium of the variables between constrained and unconstrained micro firms. Standard deviation of the mean are reported in the parenthesis. Micro sized firms have total assets less than £316,000. [a] T-tests for differences in means between unconstrained and constrained firms; p-values are reported in parenthesis. [b] Mann–Witney tests for differences in medians between unconstrained and constrained firms; p-values are reported in parenthesis.

The working capital need and current ratio of micro firms, those borrowing constraint generally have deeper negative working capital need but a higher positive current ratio than that unconstraint. A negative working capital need might indicate that they generally have more current liabilities than current assets and it is worse for micro firms that are borrowing constraint than unconstraint. However, the mean values of current ratio show that current assets of unconstrained firms are 2.5 times more than their current liabilities, whereas constrained firms have current assets 2.7 times more than their current liabilities. The negative value in the working capital need might be

the effect of one-year lag of total assets in the denominator. Among micro firms, those constraints generally have a negative internal generated cash flow while unconstrained firms have a positive internal generated cash flow, indicating that micro firms that are borrowing constrained in general are making losses and unconstrained firms are making profit. Although unconstrained micro firms have higher trade creditors than those constrained, they have lower net trade credit than constrained micro firms. This indicates that unconstrained firms received more trade credit from their suppliers than those constrained but at the same time also extended more credit than constrained firms of micro sized. Furthermore, unconstrained firms have around 3.5 times more collateral assets than constrained firms.

The result of the Mann-Witney tests confirms that there are significant differences in medians between unconstrained and constrained firms for all stated variables. The median firms that are unconstrained have more assets than those of constrained firms and it shows that at least 50% of the unconstrained micro firms have £73,000 total assets and it is compared to only £44,000 for those are borrowing constraint. The median of bank credit for both constrained and unconstrained firms are 0, indicating that at least 50% of the micro firms in the sample do not have bank credit, regardless of whether they are borrowing constraint or unconstraint. The median value of cash flow for constrained firms is 0, indicating that at least 50% of them do not make profit and it is compared to unconstrained firms around 0.019 to their total assets. The median value of collateral is 0.35 for unconstrained firms and 0.045 for constrained firms, indicating that at least 50% of micro firms that are unconstraint have 0.35 collateral assets to their total assets, and this is compared to only 0.045 for constrained firms which is around 8 times less than unconstrained firms.

It is now to compare the variables between constrained and unconstrained firms among the small sized firms in the sample. Table 5.12 (in the next page) summaries the descriptive statistics between constrained and unconstrained for small sized firms in the sample. The results show there are significant differences in the mean of bank credit, trade creditors, net trade credit, short-term financing needs, current ratio, and collateral but found no significant differences in the mean of internal generated cash flow and long-term financing needs. Small firms that are unconstraint receive have received more bank credit, generated greater internal cash flows, more collateral assets, and used less trade credit than those are borrowing constraint. Unconstrained firms use bank credit of around 0.13 to total assets more than constrained firms. In terms of the median values, it shows that at least 50% of unconstrained small firms have total assets of £787,000, which is £87,000 more than those are borrowing constraint. At least 50% of the unconstrained firms have 0.15 bank credit and 0.71 collateral to their total assets and this is compared to only 0.0086 and 0.09 for those constraint. The median value of trade credit is 0.167 for unconstrained firms and 0.354 for constrained firms, indicating that at least 50% of the small firms in the sample that are borrowing constraint have used trade credit 2 times more than those unconstrained.

Table 5.12 Descriptive Statistics of Constrained, Unconstrained Small Firms

	Borrowing Constrained		Unconstrained firms	
	Mean	Median	Mean	Median
Assets	957272.2 (675134)	701000	1041871 (710767.6)	787000
Bank credit/assets	0.2209 (7.889)	0.0086207	0.3523 (9.999)	0.151
Cash flow/assets	0.0058 (37.909)	0.0307263	0.0321 (13.205)	0.019
Trade creditors/assets	0.5968 (7.454)	0.3543506	0.3728 (30.798)	0.167
Net trade credit/assets	0.0914 (5.725)	0.000677	0.1889 (30.786)	0.027
Working capital need	0.3138 (5.377)	0.3013393	-0.1195 (33.477)	0
Investment need	0.1207 (7.278)	0	0.1240 (4.526)	0
Current ratio	4.4465 (19.177)	1.485714	3.9973 (38.196)	1
Collateral/assets	0.2402 (7.279)	0.0916808	0.8015 (4.525)	0.709

	t-Value[a]	z-Value[b]
Bank credit/assets	9.7180 (0.000)	391.186 (0.000)
Cash flow/assets	0.5816 (0.560)	-101.049 (0.000)
Trade creditors/assets	-6.9483 (0.000)	-330.840 (0.000)
Net trade credit/assets	3.0702 (0.002)	145.270 (0.000)
Working capital need	-12.6184 (0.000)	-589.133 (0.000)
Investment need	0.3455 (0.730)	-39.483 (0.000)
Current ratio	-10.1318 (0.000)	-397.265 (0.000)
Collateral/assets	59.1781 (0.000)	1000.77 (0.000)

This table reports the differences in the mean and medium of the variables between constrained and unconstrained small firms. Standard deviation of the mean are reported in the parenthesis. Small sized firms have total assets less than £3.26 million. [a] T-tests for differences in means between unconstrained and constrained firms; p-values are reported in parenthesis. [b] Mann–Witney tests for differences in medians between unconstrained and constrained firms; p-values are reported in parenthesis.

Table 5.13 (in the next page) compare the descriptive statistics between constrained and unconstrained medium sized firms. The results of t-test show significant differences in the mean of cash flow, net trade credit, short-term financing needs, current ratio, and collateral between constrained and unconstrained firms, but not for bank credit, trade creditors, and long-term financing needs. Unconstrained firms have slightly more bank credit and internal cash flow, lower short-term financing needs but more long-term needs than constrained firms. Moreover, unconstrained firms also have higher current ratio and collateral than constrained firms, indicating that those medium sized firms that are unconstraint have greater ability to pay short-term debts and have more collateral assets to meet their bank credit. The result of the Mann-Witney tests confirms that there are significant differences in medians between unconstrained and constrained firms for all stated variables. The median value of total assets of unconstrained firms is lower than those constrained and at least 50% of medium firms that are unconstraint have more bank credit, i.e., around 5 times more than those constraints and they have 0.774 collateral to total assets compared to 0.125 for those unconstraint. Similar to small sized firms, at least 50% of medium firms that are borrowing constraint use more trade credit than those unconstrained.

Table 5.13 Descriptive Statistics of Constrained, Unconstrained Medium Firms

	Borrowing Constrained		Unconstrained	
	Mean	Median	Mean	Median
Assets	6019213 (2357143)	5334000	5840703 (2301820)	5115000
Bank credit/assets	0.4327 (24.653)	0.0443	0.4736 (16.829)	0.212
Cash flow/assets	-0.0064 (7.060)	0.0231	0.1211 (11.835)	0.017
Trade creditors/assets	0.3643 (17.104)	0.1356	0.3648 (21.5499)	0.073
Net trade credit/assets	-0.0909 (8.827)	-0.0558	0.0456 (21.3755)	0
Working capital need	0.4492 (18.500)	0.2677	-0.1806 (16.5167)	-0.009
Investment need	0.2586 (27.559)	0	0.4036 (27.4452)	0.005
Current ratio	5.7668 (48.632)	1.4419	7.6774 (140.4018)	0.963
Collateral/assets	0.4252 (27.559)	0.1252	1.0946 (27.4394)	0.774

	t-Value[a]	z-Value[b]
Bank credit/assets	0.4809 (0.631)	125.705 (0.000)
Cash flow/assets	3.2912 (0.001)	-20.602 (0.000)
Trade creditors/assets	0.0064 (0.995)	-93.056 (0.000)
Net trade credit/assets	2.1073 (0.035)	107.391 (0.000)
Working capital need	-8.9539 (0.000)	-253.317 (0.000)
Investment need	1.3171 (0.188)	35.261 (0.000)
Current ratio	4.5990 (0.000)	-181.205 (0.000)
Collateral/assets	6.0797 (0.000)	358.481 (0.000)

This table reports the differences in the mean and medium of the variables between constrained and unconstrained small firms. Standard deviation of the mean are reported in the parenthesis. Medium sized firms have total assets less than £12.9 million. [a] T-tests for differences in means between unconstrained and constrained firms; p-values are reported in parenthesis. [b] Mann–Witney tests for differences in medians between unconstrained and constrained firms; p-values are reported in parenthesis.

5.8 Discussion of the Findings

After reporting the estimated results of both the demand and supply equation of the bank credit, as well as the proportion of borrowing constrained firms in the UK, it is now necessary to discuss the estimated result. i.e., whether these estimated results are consistent with the related theories and the findings of prior literature. This section first discusses the estimated results of the demand equation and then followed by the supply equation in the disequilibrium model. After that, this section discusses the impact of monetary policy on the corporate borrowing, as well as the proportion of borrowing constrained firms.

5.8.1 Determinants of the Demand for Bank Credit

First, we discuss the estimated results of the demand equation in the disequilibrium model. The results of the disequilibrium model of this thesis provides substantial evidence suggesting that internal generated cash flow and trade credit are two important sources of funds that UK's SMEs use to substitute for bank credit. The result of internal generated cash flow is consistent with the prediction of pecking order theory which suggests that companies prefer using internal funds as it is risk free and costless before seeking external finance, i.e., bank loans (Cotei and Farhat, 2009). This is also consistent with the results of empirical study conducted by Atanasova and Wilson (2004), Carbo-Valverde et al. (2008), and Ogawa and Suzuki (2000), Soana et al (2015), which found that internal funds is important substitute for bank loans and firms have greater demand for bank loans if they have lower level of internal funds.

However, it is surprising to see that the coefficient of internal cash flow is positively significant to bank credit for micro sized firms, which can be interpreted as that micro sized firms have lower demand for bank loans even they generated less internal cash flow. This interpretation can be further confirmed by comparing the descriptive statistics between constrained and unconstrained firms. The result shows that the constrained firms generally have significant lower amount of internal cash flow than unconstrained firms and micro firms that are borrowing constraint on average even have a negative internal cash flow. This finding is also consistent with Carbo-Valverde et al. (2008), which found constrained firms have significant lower internal cash flow than those unconstrained. This may be able to explain that micro sized firms tend not want to borrow more money from banks to invest in its business that does not generate desirable returns.

The result of the disequilibrium model of this thesis shows a significant negative correlation between bank credit and trade credit for small and medium sized firms in the sample, providing a substantial evidence of the UK's SMEs supporting the theory of substitution relationship between bank credit and trade credit. The substitution theory suggests that trade credit is often used by SMEs to alleviate financial problem when they have difficulty raising finance from banks or when they are credit constraint by banks. The evidence supporting the substitution theory of bank credit and trade credit is enhanced by the classification of borrowing constraint estimated by the disequilibrium model of this thesis, which found that small sized firms that are borrowing constraint generally have a higher level of trade credit obtained from suppliers than those unconstraint, although micro firms that are borrowing constraint have a lower level of trade credit than those unconstraint while it is indifferent for

medium sized firms. The result also shows that micro sized firms that are borrowing constraint have a lower level of trade credit than those unconstraint and this is not consistent with the substitution theory of trade credit, but may seems reasonable because their suppliers are not willing to sell them on account as a concern of their creditworthiness to payback within the specified period.

The positive coefficients of working capital and investment needs for small and medium sized firms indicate that they demand for more bank loans when they have greater needs of working capital and investment. This provides evidence suggesting that bank credit is one of the major sources of corporate finance to considered by SMEs in the UK to fund working capital and investment. This also confirms the theory of credit market imperfection that suggest the bank credit is the key external source of finance for SMEs. This is consistent with the empirical studies of Kremp and Sevestre (2011) and Farinha and Felix (2014) examined on French and Portuguese SMEs respectively, which find positive coefficients of working capital needs and investment on bank credit, suggesting that the demand for bank loans is strongly driven by working capital and investment needs. However, the result shows it is not the case for micro sized firms in the sample and their demand for bank loans increase (decrease) when they have lower (higher) needs of working capital but stronger needs (lower) needs for long-term investment, and a higher (lower) level of internal generated cash flow. It might be making sense if micro sized firms with a high level of internal cash flow (i.e., a measure of profitability) might want to expand businesses by obtaining more finance from bank loans, further evidenced by greater needs for long-term investment.

5.8.2 Determinants of the Supply of Bank Credit

On the other hand, the estimated results of the loan supply in the disequilibrium model show that the supply of bank loans can be significantly determined by current ratio as a measure of risk, firm size, collateral assets, the extent of trade creditors, and if the firm belongs to manufacturing industry, but not significantly determined by firm age, monetary condition, and quantitative easing.

The results of the disequilibrium model provide substantial evidence confirming that the more bank credit are available for larger firms with more collateral assets. This also confirms the role of collateral assets play in mitigating the adverse selection and moral hazard problem stemming from informational asymmetry between borrowers and banks. This finding is consistent with Atanasova and Wilson (2004), Berger et al. 2011; Steijvers and Voordeckers, 2009; Berger and Udell, 1995; Bandt et al., 2008.

The result of the disequilibrium model suggests that more bank credit is available for micro firms when they used more trade credit offered by their supplier. This appears to confirm the complementary role of trade credit, which suggests that trade credit behaviour can provide a signal to the banks about the credit quality of a firm (Alphonse et al., 2006; Huang et al., 2010; Cole, 2010; Ellingsen and Vlachos, 2009; Gama et al., 2009). However, this is not the case for small and medium sized firms in the sample. The results show that more bank credit is available for small and medium sized firms if they have lower amount of trade credit outstanding. This may be due to the fact that trade credit represents the existing short-term debt and therefore banks concern their ability to repay the bank credit when they have higher amount of trade credit outstanding.

Next, we discuss the impact of monetary policy on the availability of bank loans to the SMEs in the UK. The bank credit channel emphasises the shocks of monetary policy on banks' balance sheets that affect the availability of loanable supply to borrowers (Bernanke, 2007; Disyatat, 2010). The credit channel of monetary policy transmission is significant to the economy because many SMEs in the UK depend on bank credit to fund their business activities, i.e., working capital and investment activities. However, the results of the disequilibrium model show that the coefficient of monetary condition has a negative effect on the loanable supply to micro and small sized firms in the sample. This is therefore not consistent with the theoretical prediction that a small change in the monetary policy shock has a large impact on the economic activity through corporate borrowing. This does not provide substantial evidence to confirm the prediction of the credit channel of monetary policy transmission. Despite the effect is not significant, it provides, to certain extent, evidence to support the credit channel of monetary policy transmission. That is, firms have more bank credit availability when the monetary condition is loosening but have less credit availability when the monetary condition is tightening.

The bank credit channel of quantitative easing suggests that the asset purchases of the quantitative easing has created more reserves at the BoE and a corresponding increase in customer deposits when the asset purchase taken placed through banks, in turn that might increase banks' capacity to extend more loans. However, the result shows that it has a negative effect on the supply of bank credit. This suggests that more credit is available to firms when less money is created on the balance sheet of banks. This is not consistent with the bank credit channel of quantitative easing. Nonetheless, the BoE has expected a very limited effect of quantitative easing on the bank credit

because it is not targeting at increasing the availability of bank credit to the corporate sector.

5.8.3 Borrowing Constrained Vs. Unconstrained SMEs

During financial crisis 2007-2010

There is considerable amount of literature recognised the credit crunch emerged in the financial crisis and that restricted the SMEs in the access of bank credit. During credit crunch period, there is a sudden reduction in the general availability of bank loans or sudden tightening of the conditions required for borrowers to acquire loan from banks (Korab and Pomenkova, 2017). During the credit crunch period, a large number of borrowers may not able to obtain the desired quantity of bank credit independently of the interest rates due to the tighten credit policy. Previous studies also found survey evidence of more SMEs in the UK faced loan rejection during the financial crisis compared to the prior period. The result of the disequilibrium model finds that the proportion of medium firms in the sample are borrowing constraint is significantly higher in 2008 than previous years. This provides evidence confirming that corporate borrowing of medium firms was affected by the credit crunch emerged in the recent financial crisis. However, the result of the disequilibrium model finds no substantial evidence of higher proportion of micro and small firms faced borrowing constraint during the financial crisis. In addition, the result of the disequilibrium model confirms that lower proportion of medium firms in general are borrowing constraint than the micro and small firms.

There is no significant increase in the proportion of borrowing constraint for micro and small sized firms in during the period of financial crisis. A possible explanation is

that the quantity of credit demand in the disequilibrium model is based on the financial ratio of the SMEs. Due to the limited information on the SMEs, there may not able to fully, correctly assess the credit demand of these firms. Previous evidence is the UK are based on the questionnaire data from both the banks and companies themselves. There may have some differences due to the data collection method.

Compare their financial ratios

The differences between borrowing constrained and unconstrained firms are also compared. It finds a substantial evidence confirming that borrowing unconstrained firms have relatively higher level of collateral assets compared to those of borrowing constrained. This is quite making sense because banks also assess the borrower's credit risk based on the level of assets that can be offered as collateral. This confirms the role of collateral to mitigate the effect of credit market imperfection. For SMEs that are informational opaque, borrowers are able to use collateral to secure their loans and to provide guarantee to mitigate the adverse selection problem arise from the information asymmetry.

We also find that on average that micro firms that are constrained are characterised by higher working capital and investment needs but lower amount of assets and internal cash flow, lower amount of collateral, and lower trade credit outstanding than those unconstrained. This appears to consistent with the prediction that borrowing constrained firms of micro sized have higher capital needs but unable to obtain from banks because they have lower amount of collateral and lower ability to repay short-term debt. This further provide evidence to confirm the importance of collateral in mitigating the micro sized firms, that are particularly informational opaque due to a

lack of business and credit history, and they are more subject to credit rationing than other sized of firms in the UK.

For small sized firms, those borrowing constrained also have a higher working capital need but slightly lower investment need, lower amount of assets and internal cash flow, lower collateral, but received higher trade credit outstanding than those unconstrained. This provides evidence suggesting that small firms that are borrowing constrained use more inter-firm credit offered by their suppliers to alleviate financial problem. It also appears to consistent with the prediction that small firms that are constrained have higher needs for financing to maintain their working capital. However, they are borrowing constrained likely due to their lower ability to generate internal cash flow and lower collateral, and higher credit risk measured by a lower ability to pay short-term debt.

For medium sized firms, those face borrowing constraint also have significant higher financial needs to support their working capital, but have a lower amount of assets and collateral, and higher credit risk measured by lower ability to pay short-term debts. This is making sense in that borrowing constrained firms have more demand for bank credit to support their working capital, and they are more likely to face credit rationing due to a lower collateral to support their loans and higher credit risk. Comparing the credit risk of the borrowing constrained and unconstrained firms of medium sized, the current ratio of the borrowing constrained firms is much lower than those unconstraint.

5.9 Summary

The estimated results of demand equation in the disequilibrium model show that the demand for bank loans of firms are significantly determined by its working capital and investment needs, internal generated cash flow, trade credit, and firm size. For small and medium sized firms, their demand for bank loans increase when they have stronger needs of working capital and investment, lower level of internal cash flow and trade credit obtained from suppliers, and higher level of assets as a measure of firm size. This is compared to the micro sized firms in the sample which their demand for bank loans increase when they have greater internal generated cash flow and trade credit, lower needs of working capital but stronger needs of long-term investment, and higher level of assets as a measure of firm size. On the other hand, the estimated results of the loan supply in the disequilibrium model show that the supply of bank loans can be significantly determined by current ratio as a measure of risk, firm size, collateral assets, the extent of trade creditors, and if the firm belongs to manufacturing industry, but not significantly determined by firm age, monetary condition, and quantitative easing. We also find that the proportion of medium firms in the sample are borrowing constrained is significantly higher in 2008 than previous years. This provides evidence confirming that corporate borrowing of the medium firms in the UK were more affected by the credit crunch emerged in the financial crisis. However, the result of the disequilibrium model finds no evidence of higher credit rationing in the micro firms and small sized firms during the financial crisis. In addition, the result of the disequilibrium model confirms that lower proportion of medium firms are borrowing constraint than the micro and small firms.

6. Borrowing Constraints and the Trade Credit in the UK

6.1 Introduction

In chapter 5, this thesis already examined the extent of credit rationing of the small and medium enterprises (SMEs) in the UK and the impact of monetary policy on the corporate borrowing. A question arise from the analysis is that how those borrowing constrained firms raise finance to fund their working capital and business operation. In recognition that trade credit is one of the major sources of financing in the UK, this chapter examines whether the borrowing constrained firms have used trade credit to support their working capital and business operations. In other words, this chapter provides an examination of the substitution relationship between trade credit and bank credit for the SMEs in the UK. This chapter investigates the trade credit channel of monetary policy transmission, which is to examine the impact of monetary policy on the trade credit behaviour in the UK. Moreover, this chapter also attempt to examine the redistribution theory of trade credit, which posits that borrowing unconstrained firms use their credit obtained from banks will distribute to constrained firms via inter-firm credit.

This chapter starts with a review of the prior literature to provide an understanding into the underlying theories of trade credit and the trade credit channel of monetary policy, which explains how monetary policy affect the trade credit usage. This chapter also review the empirical methodologies to examine the trade credit channel of monetary policy transmission. This chapter also estimate the substitution relationship

between bank credit and trade credit, and compare the differences in the substitution relationship between those borrowing constrained and unconstrained using the same dataset in Chapter 5.

6.2 Literature Review

This section reviews the relevant literature of trade credit and discusses the underlying theories and existing evidence behind the substitution between bank credit and trade credit in the corporate financing structure, as well as the existence of both bank credit and trade credit channel of monetary policy transmission. It starts with defining trade credit and explaining the theories about motives for using trade credit. Some contextual analyses of the determination of trade credit usage beyond the theories are also discussed in order to provide understanding about the intentions for using trade credit. Then, it discusses some theoretical explanations of the credit crunch problems and its implications on financing structure of corporate sector, in attempt to provide reasoning that trade credit might be a source of financing substitute for bank credit.

6.2.1 What is Trade Credit

Trade credit is a source of short-term fund, which is used to fund part of a firm's investments in inventory and account receivable (Danielson and Scott, 2004). More specifically, the idea of trade credit is that suppliers sell goods or services to their business customers, but do not require immediate payment. Instead, the suppliers only require them to pay at a specific time in the future, normally within 30 days after the date stated on the invoice. This deferred payment is termed as trade credit and is only occurred between business firms rather than public consumers. Fundamentally, there

are two major types of trade credit based on the credit terms: net term and two-part term. The net terms refer to the credit term with a specific period when the business customers must make the payment. For example, net 30 means that the buyer has to make the payment within 30 days. The two-part term adds a discount term for business customers who make early payment for their purchases on credit. A typical example of two-part term is 2/10 net 30, which means that the buyer has to make the payment within 30 days and will receive a discount of 2% if make the full payment within 10 days after the invoice date. From this perspective, the discount rate for early payment can be perceived as an implicit interest rate for trade credit, which is the cost of trade credit. Using example of two-part credit term of 2/10 net 30, the firm will have to pay 2% for using trade credit over 10 days, which is equivalent to an annual interest rate of 43.8%. The formula for implicit interest rate of trade credit is as below:

$$IR = \left[\frac{100}{100 - DR}\right]^{\frac{360}{NP-DP}} - 1$$

where IR = Implicit interest rate of the trade credit, DR = Discount rate for early payment, NP = Net period or the period the customer must make their payment, DP = Discount period or the period of early payment to receive discount.

As shown, the interest cost of trade credit is much higher than other source of finance and thus in order to avoid this expensive cost, business firms must make their payment to suppliers within the discount period (if the impose the discount term for sales on credit) or the net period. Next, we are going to explain why firms use trade credit.

6.2.2 Motives for Using Trade Credit

In recognition of the fact that trade credit in general is a much costly alternative to bank loans, this raise questions about why trade credit remains a pervasive source of financing for SMEs. The proponents of trade credit channel claim that suppliers may be in a better position than the traditional banks or financial intermediaries in supplying finance to their business customers. This can be explained by the conventional theories of trade credit, which are transaction cost, financing advantage, and price discrimination.

Transaction cost theory

The transaction costs theory highlights the vital role of trade credit in the business management of cash or working capital for the cost saving motives. The basic idea is that trade credit enables corporate firms to pay for their purchases at a later date and more importantly, by separating the delivery of goods and payment and deferring the payment for their supplies, the trade credit enables firms to make certain the cash they need to hold for payment and have sufficient time to plan for the conversion of liquid assets into cash in the most cost effective way. This perspective implies that firms could reduce their cash in hands to a minimum level. Moreover, using trade credit also allows a firm to reduce the transaction cost incurred by cumulating the payment obligation and pays them on a specific date (e.g., at the end of each month or quarter), which is known as transaction volume motive. It also allows a firm to reduce the effect of growth on working capital needs. In the absence of the credit granted from suppliers, firms would need to pay for their purchases on delivery, and more significantly, implies an uncertain of the volume and timing of cash flow and therefore would always

need to maintain a higher level of precautionary cash in hands to payoff the purchases of goods (Garcia-Teruel and Matinez-Solano, 2010a; Cole, 2010). Therefore, trade credit is suggested contribute to a greater effectiveness and efficiency in the management of working capital and cash (Paul and Wilson, 2007).

Financing advantage theory

The financing advantage theory of trade credit claims that suppliers have informational advantage over bank lenders in assessing and monitoring the creditworthiness of its customers (Cole 2010; Garcia-Teruel and Matinez-Solano, 2010a). There are three rationales to explain this claim. First, the frequent interactions between suppliers and customers, the concurrent transactions with the customers, and the knowledge of industry specificities allow suppliers to routinely gather information about creditworthiness of their customers, and thus better able to overcome the problems of adverse selection and moral hazard stemming from information asymmetries (Fabbri and Menichini, 2009; Gama et al., 2009; Halsey, 2010; Love and Zaidi, 2010). Second, suppliers appear to have greater control of the customers because they can threaten to cut off the supply if customers do not make the payment within the specified time period, especially when there are only a few suppliers in the industry and if the customers are greatly relying on their suppliers in the business operations (Garcia-Teruel and Matinez-Solano, 2010a). Third, suppliers may be in better position to finance SMEs and permit trade credit defaults because suppliers have cost advantage in repossessing and reselling the assets of its customers in the event of non-payment (Guariglia and Mateut, 2006; Cole 2010). This is contrast to banks in which the collateral assets incur higher cost to resell in case for default payment.

Besides that, given the information about creditworthiness of the business customers, suppliers are also willing to provide trade credit to their customers because of the cost saving in inventory by delivering the goods to their customers earlier than it suppose to, i.e., the payment date.

Cole (2010) uses the US data from the Surveys of Small Business Finances (SSBFs) that contains 6 million firms, confirms the financing advantage theory. The study finds that firms that rely on credit from suppliers tend to be larger (note: among the small businesses), more liquid, worse credit quality, and tend not to be a service provider. This appears to be true because although smaller firms may have greater demand in trade credit due to difficulty in assessing to bank credit, the extent to which their suppliers allow them to purchase on credit is based on the assessment of their creditworthiness. It is rationale for suppliers to believe that smaller firms have lower liquidity and ability to repay and therefore only allow a lower limit for purchases on credit. Instead, larger among small firms with greater liquid assets and growth prospects are likely to be more creditworthy, suppliers find it beneficial to supply credit to them, and therefore greater amount of trade credit provided to those firms.

Price Discrimination Theory

A question rise earlier that why suppliers have incentive to permit or extend credit to firms. Price discrimination theory of trade credit attempts to provide answer to this query. Specifically, suppliers offer credit to discriminate among its customers, through offering different credit terms. As discussed by the financing advantage theory, suppliers have better informational advantage over banks and other institutions in collecting information about creditworthiness of non-financial firms. As a result,

suppliers are able to discriminate between good and bad firms and provide short-term credit to firms which face liquidity problem. Creditworthy firms who repay the trade credit earlier before the date as stated in the two-part credit terms would obtain discounts on their purchases, whereas firms who pay late find the price of trade credit to be favourable than other alternative (Cole, 2010). This short-term credit from suppliers appears to be significant for small firms, which often bear the brunt of credit rationing because they tend to have less liquidity, greater profitability, and cash flow volatility than large firms. In fact, it has been identified that lack of funds and heavy reliance on short-term finance are the main causes of corporate failure in the UK.

Besides that, suppliers may have interest in supplying goods to their customers on credit to keep them in operation (Love and Zaidi, 2010). One good reason is that suppliers often rely on the customers' business to market their products, and therefore may allow more credit to be granted to financial constrained firms than banks. Huang et al. (2010) provide an alternative interpretation, argued that it is the competitive forces that drives larger firms with excessive cash flow to extend longer credit terms to downstream firms which are suffering from bank credit rationing. In contrast, smaller and illiquid firms, which are more likely to be credit constrained, extend less credit to their customers and purchase more on credit from their suppliers (Love and Zaidi, 2010). On the other hand, bank lenders tend to require collateral assets to secure the loans and therefore unlikely a favourable source of finance during monetary tightening when the rising interest rate would deteriorate the firms' balance sheets through the implied reduction in the value of collateral assets and lower present value of business investment. From this perspective, trade credit is argued a substitute to bank credit during the period of credit crunch or monetary tightening.

Petersen and Rajan (1997) present an important empirical paper to provide evidence of these theories explaining the motives for using trade credit by examining the determinants of a firm's usage of trade credit. Based on one-year US survey data in 1988-1989, they test the price discrimination and financing advantage theory using net profits and net sales growth in both model of account payable and receivable. Consistent with the price discrimination theory, the study finds that firms with higher net profit, negative sales growth, and loss making firms with negative sales growth extend more credit to customers. The former firms can drive sales by transferring their liquidation advantage to their business customers, while loss-making firms have incentive to drive sales. For financing advantage theory, which describes that suppliers can foresee the future profitable firms but negative profit currently, the study finds that profit making firms and loss making firms but positive sales growth receive more credit, while loss making firms with negative sales growth receive fewer trade credit from their suppliers.

Fabbri and Menichini (2010) presents an important conceptual paper with supporting survey evidence. First, they identified that the use of trade credit greatly depends on the characteristics of the input such as the level of standardisation and collateral value. Specifically, firms which purchase goods use more credit than those buy services, and suppliers of services offer less credit than suppliers of standardised goods. Moreover, they also highlight an interesting insight that firms use trade credit not necessarily face credit constraint, but credit unconstrained firms exploit the liquidation advantage of their suppliers to finance their business activities. This is consistent with the financing advantage theory that describes suppliers have incentive to offer credit to their business customers to save storage costs of tangible goods and to drive sales turnover

for profitability, and this is disregard of whether they are credit rationed or unrationed. Fabbri and Menichini (2010) provides an alternative interpretation is that the reliance on trade credit does not depend on credit rationing if inputs purchased on credit are sufficiently liquid.

6.2.3 Credit Cycle Theory and Trade Credit

Asymmetries information has been one of the major problems in the credit market because borrowers may have ex-ante private information about the expected return of their investment projects and lenders face difficulties in justifying whether the investment project will generate the expected amount of return. Moreover, corporate borrowers might take on riskier investment projects than the originally proposed and so might have an ex-post private information over bank lenders. As a result, lenders face risks of adverse selection concerning the quality of prospective borrowers. The agency cost incurred in overcoming the information asymmetries problem will be translated into external financing premium, which varies with different borrowers. A major implication of credit market imperfection is that bank loans are preferable source of external finance because of the banks' ability to better identification of borrowers' quality and achieving cost advantage in monitoring the ability of borrowers to repay loans and therefore lower agency cost incurred in overcoming the problems of information asymmetries. The external financing premium varies with the perceived risk of borrowers. The higher the risk of default, the higher premium changed on the borrowers. However, when risk of the particular borrower is too high that the premium charged is unable to compensate the losses of the adverse selection and therefore explaining why some borrowers are credit rationed by bank lenders.

The recent financial distress in banking sector has brought a severe implication on the credit conditions in the sense that it deteriorates the balance sheets of both banks and business firms and that diminish their ability to lend. As a result, banks have generally tightened their lending policy in order to minimise the risk of default involved in the period of financial crisis. This credit condition is known as the credit crunch. This credit crunch problem can be explained by the credit cycle theory, which posits that banks and financial institutions tend to excessively increase their lending to corporate borrowers during economy boom and sharply slash down the lending to corporate borrowers during recession, partly due to the risk involved in the associate economy cycle (Duca et al., 2009; Rotheli, 2010). This appears to be true because most business companies are likely to make more profit during economy boom due to increased purchasing power and demand for products and services in the market, and money loan out are more likely to be repaid and thus less risk involved. However, during economy recession, more business organisations are likely to make losses due to inappropriate investment (especially in the asset and financial market) and reduction in the market demand for their products or services offered, driven by rising unemployment and inflation rate. As a consequence, in order to ensure business continuity, these companies are likely to downsizing the number of employees to reduce operating costs, which in turn could lower the consumers' purchasing power, and further deepen the economy recession. In such a period of economic downturn, banks are most likely to tighten their lending policy due to higher risk of default during the period. In fact, in the period of recent financial crisis in 2007, bank credit granted to SMEs has been decelerated significantly in several regions, including UK (Aisen and Franken 2010, BOE 2010).

There are several empirical surveys have provided some figures and evidence in the UK showing that the SMEs, which are vulnerable to macroeconomic shocks, were suffered from the credit crunch problem in the period of the recent financial crisis. BoE (2010), in the 'Credit Conditions Surveys', reported that the availability of bank credit to corporate has been drastically shrunk during the recent financial crisis started since the mid-2007. Another survey conducted by Fraser (2010) for the ESRC, which analyses the changes in SMEs finances from 2004 to 2008 (i.e., from the height of credit boom to the depths of credit crisis), reveals that the SMEs overdraft rejection rate has been increased 3.5 times (from 4.2% to 15.3%) and term loan rejection increased 2.5 times (from 6.1% to 16.3%) over the period. The survey also reported that overdraft loan size for SMEs has been decreased by 75% among high-risk firms (i.e., from £58,000 to £14,500), and even loans by low risk firms have been increased 78% in collateral posted. These figures may provide a simple illustration of rationing in credit market is obvious to SMEs in the recent period of economy recession. This ongoing credit crunch problem is particularly significant because many firms greatly dependent on short-term borrowing to fund inventories and other working capital, and can significantly affect the business operations and investment activities.

6.2.4 Monetary Policy Innovations and Trade Credit Channel

In addition to the natural economic cycle, monetary policy innovation would also have an impact on the credit condition through the monetary policy transmission mechanism. Traditional interest rate channel of monetary policy transmission suggests that monetary policy innovations have an impact on economic activities through its influence on cost of capital that would affect profitability of the firms' prearranged

investment activities. Specifically, during the monetary policy tightening, the rising interest rate increases the cost of capital for investment activities and result in a reduction in profitability. In response, rational investors may reduce interest-sensitive investment activities and consumptions including reducing number of employees in order to minimise the operating cost. This is, in turn, likely to deteriorates the domestic demand as a result of a reduction in the purchasing power of consumers in general, which would worsen the sales revenue of firms in general.

The credit view enhances the explanation of transmission mechanism of monetary policy by introducing the role of banks and financial institutions in amplifying and propagating the impact of initial interest rate shock on economic activities. The ways that the effect of monetary policy can be transmitted to corporate sector under the credit view can be divided into the balance sheet channel and bank credit channel. Balance sheet channel describes that in the event of monetary tightening, the rising interest rate influences the firms' balance sheets through extra burden in firms' debt and impairment in the value of assets, which in turn affect their creditworthy and decreasing their ability to raise finance from banks, at least not without higher interest rate. Bank lending channel affects the corporate borrowing through the influence of monetary policy innovations in the supply side of bank credit (i.e., banks' balance sheet) through the open market operations by the central bank, either gives banks more reserves or takes reserves away from banks by buying or selling government securities in the open market, as well as through the policy of binding reserve requirement. These credit views of monetary policy transmission attempts to explain the amplification and propagation of the initial influence of monetary contraction to the availability of bank credit to corporate sector.

6.2.5 Substitution of Trade Credit for Bank Credit

Both the credit crunch and the monetary policy tightening have negative implications on business firms, in that the bank lenders generally tighten their lending policies and that result in increasing number of firms face borrowing constraint, especially for small, young and opaque firms which are likely to be credit rationed by banks due to the greater concern of adverse selection and moral hazard problems stemming from information asymmetries. The rising interest rate during monetary policy tightening increase the burden of corporate debt and might cause some firms not afford the expensive finance cost. Trade credit, in this deteriorating credit condition, may become a useful alternative source of external financing for business firms. As explained in the discussion of transaction cost, financing advantage, and price discrimination theory, suppliers may be in better position than banks in providing short-term credit to firms. Using trade credit allows a firm to reduce the transaction cost by cumulating the payment obligation and pays them on a specific date. Delaying the payment to suppliers enables firms to exploit the liquidation advantage of the suppliers in order to relaxing their working capital management. For suppliers, they are willing to provide business customers to purchase on credit for the purpose of driving sales to compete in the market and saving inventory costs. Trade credit also allows suppliers to price discriminate among business customers by offering discount for early payers. The forgone discount for firms who pay later than the discount period is perceived as interest cost for using the trade credit.

Petersen and Rajan (1994) provided a useful explanation of the substitution of trade credit for bank loans. Consistent with the pecking order of corporate finance theory,

they suggest that a firm will use the cheapest source of funds, i.e., internal cash, before borrowing from banks and financial institutions. If the bank and institutional lenders do not ration credit, then the firm will use only the combination of cash in hands and bank loans to finance their prearranged investment opportunities. However, if the firm is credit rationed by bank lenders, then it will turn to use trade credit as a substitute fund. The main reason is that trade credit is a much expensive source of finance than bank loans (as calculated earlier in section 2.1: the forgone even only 2% discount for early payment imply an interest rate of 43.8%) and so argue that should only be used as the last resort.

During the credit crunch period where banks and financial institutional lenders have generally tightened their lending policies, SMEs are more likely to face restriction in accessing to bank loans and therefore might turn to use more on credit provided by their suppliers, through deferring the payment of their supplies, in order to alleviate financing problem. A similar condition appears to happen during monetary policy tightening where the rising interest rate affects not only the lending ability of banks, but more importantly affecting the creditworthy of firms to obtain bank loans, through the implying extra discount in future cash flows from investment activities and the value of collateral assets.

After a discussion of the theory about the substitution relationship between trade credit and bank credit, it is now to discuss the empirical evidence in the prior literature. In US, Petersen and Rajan (1994) provide important evidence of substitution relationship between trade and bank credit using the Survey of Small Business Finances (SSBF) conducted by the Federal Reserve Board. They use the percentage of trade credit paid

late and the amount of trade credit discount foregone as proxies for trade credit demand. They found evidence that firms depend greatly on credit provided by suppliers if they have shorter relationships with banks, by delaying the payments or foregoing the discount for early payment. Moreover, they also find evidence suggesting that firms which depend more on trade credit tend to located in less concentrated market and have relationship with more financial institutions. Their later paper published in 1997 uses a method of simultaneous equation, discovered a significant negative relationship between length of banking relationship and trade credit demand and a positive but not significant relationship between trade credit demand and borrowing constraints. In other words, this means that firms with shorter or weaker relationship with banks use more trade credit while borrowing constrained firms do not seems to use more trade credit as substitution for bank credit.

Danielson and Scott (2004) extend the research of Petersen and Rajan (1997) to examine the relationship between trade credit demand and availability of bank loan, and incorporate trade credit price and firm or industry characteristics as control variables, using survey data of the National Federation of Independent Business (NFIB) 1995. They model the availability of bank loan as a function of firm risk, strength of banking relationship, and market structure. Using bivariate probit method of estimation, they found evidence suggesting that small US firms use trade credit when they were denied and did not applying bank loans to finance their businesses.

Using a panel of around 47 thousands of SMEs in the Europe over period 1996-2002, Garcia-Teruel and Matinez-Solano (2010a) discovered that usage of trade credit is greater for larger firms with higher growth of sales, but short of cash flows and less

access to other source of short-term financing. The study also finds firms that granted more trade credit to their customers tend to be larger but have lower sales growth, and have greater access to short-term finance at lower costs. This is consistent with the incentive theory that sellers extend trade credit to customers in order to drive sales.

In the UK, Atanasova and Wilson (2004) examines on the trade credit usage between borrowing constrained and unconstrained firms, and their empirical research on 639 UK SMEs over the period from 1990 to 1999 finds that the reduction of bank loans during tightening monetary policy causes bank dependent firms to cut their operating expenses, and increase their use of trade credit as alternative to bank credit. The study also discovers that borrowing constrained firms have used more trade credit to support their financing needs for business growth when compared to borrowing unconstrained firms. Mateut et al. (2006) obtain a similar result with an empirical investigation of 16,000 UK manufacturing firms. Guariglia and Mateut (2006) examine around 600 firms in the UK during 1980-2000 find supporting evidence suggesting the trade credit can be used to offset the liquidity problems, especially for credit constrained firms, and able to make the economy recession less severe.

Using the data from emerging countries in the Southeast Asia, Love et al. (2007) studies on the public listed firms, find that more liquid firms after a crisis event extend more credit to their customers and accept less credit from their suppliers. Their later paper, Love and Zaidi (2010), which examines the 3000 firms that are mostly SMEs between November 1998 and February 1999, finds that credit constrained firms do not increase their purchases on credit after the crisis and have a shorter length of time to

pay back to their suppliers. The study also finds that those credit-constrained firms extend less credit to their customers and set a shorter length of repayment time.

6.3 Estimation Methodology

To examine the substitution relationship between trade credit and bank credit, this thesis uses the model of trade credit determinants. By incorporating the bank credit received and other firm-specific variables that determining the trade credit usage in the models, it is able to see how usage of trade credit changes with variations in bank credit and through business and economic cycles. Regarding the estimation method, panel data estimation method is used to test the regression, which follows the form as:

$$Y_{i,t} = \beta_k X_{k,i,t} + \gamma_0 MCI_t + \mu_i + v_{i,t} \quad (6.1)$$

where the subscript *i* indicates different firms, *t* as time (year), $X_{k,i}$ are *k* firm-specific variables that determine the usage of trade credit, M is the measure of monetary policy, $v_{i,t}$ as the error terms, μ_i are the unobserved time invariant firm-effects arising from the characteristics of different firms. Fixed effect model is chosen because the assumptions of random effects model (i.e., μ_i is independent and normally distributed, and μ_i and $v_{i,t}$ are independent of each other) are hardly satisfied in practice. Hausman tests are carried out to confirm the choice of fixed effect model.

In order to examine the trade credit and bank credit channel of monetary policy transmission, monetary condition index (MCI) is also included in the models so to be able to see the variation in the use of trade credit and bank credit by the SMEs when

monetary policy is tightened or contraction. The MCI has already been estimated in chapter 4.

One of the major limitations in previous empirical studies is that they consider only the credit received from suppliers (i.e., account payable) but ignore the credit granted to business customers (i.e., account receivable) in examining the trade credit channel of monetary policy transmission (e.g., Atanasova and Wilson, 2003; Guariglia and Mateut, 2006). This thesis considers both credit received from the suppliers (account payable) and supply to business customers (account receivable) in explaining the impact of monetary policy innovations on the firms' bank and trade financing.

6.4 Model Specification of Substitution Hypothesis

After describing the empirical methodology used to estimate the substitution relationship between trade credit and bank credit, it is now necessary to establish the hypotheses and measuring the variables. This hypotheses and variables explain both the trade credit demand and the willingness to offer trade credit to other firms.

6.4.1 Dependent Variable

First, the dependent variable for the model trade credit demand or trade credit received from suppliers is justified to be the ratio of accounts payable (*AP*) to one year lagged total assets. Accounts payable is the amount of trade credit the firms received from their suppliers. Second, the dependent variable for the trade receivable model or trade credit extended to customers is the ratio of accounts receivable (*AR*) to total assets. Accounts receivable is the amount of trade credit the firms extended to their customers.

The use of ratio to one year lagged total assets is to control the operational scale or firm size and to capture the significance of trade credit in financing the firm's assets.

6.4.2 Establishes the Hypotheses and the Explanatory Factors

The hypotheses are established by discussing the determinants of both the demand of the trade credit and willingness of offer trade credit to other firms.

1. Firm risk

Higher firm risk should indicate the lower ability of the firms to obtain formal bank credit. Higher firm risk should then obtain external finance by delaying the payment of goods purchase from their suppliers. As discussed earlier in this chapter, suppliers may be better than banks in assessing the risk of the firms. However, suppliers also assess the risk of the firms when deciding to extend the credit period to their customers. Therefore, suppliers should extend more credit to firms with lower level of risk. *Current ratio* has been identified as an important risk measure about the ability of a firm to repay short-term debts and therefore it is included in the trade creditors model. It is expected that higher current ratio means a lower risk of the firms and therefore should be a negative effect of firm risk on accounts payable.

Hypothesis 1: The demand of the UK's SMEs for trade credit increases when the firm risk is lower.

Hypothesis 2: The willingness of the UK's SMEs to extend trade credit to business customers increases when it has a lower risk.

2. Working capital needs

The SMEs with higher financial need for working capital should require more finance, including the trade credit. Indeed, working capital need include to finance the goods purchased from suppliers. On the other hand, suppliers should not be able to extend more trade credit to business customers when they have less working capital need.

Hypothesis 3: The demand of the UK's SMEs for trade credit increases when the firm has greater need for working capital.

Hypothesis 4: The willingness of the UK's SMEs to extend trade credit to business customers increases when the firm has less need for working capital.

3. Maturity of firm's assets

Maturity of the firm's assets can be another determinant of demand for credit from suppliers and explanation for extending credit to customers. Firms hold more short-term assets are expected to have greater demand for short-term credit, including trade credit. The rationale is that firms need to match the maturity of the liabilities with the liquidity of their assets in order to make sure the cash flows produced by assets are enough to pay the periodic liabilities (Garcia-Teruel and Matinez-Solano, 2010b). Therefore, it should predict that firms with bigger investment in current assets require more trade credit in order to smooth the management of working capital. The empirical study of Garcia-Teruel and Matinez-Solano (2010a) on large sample of European SMEs confirms this prediction. For the credit extend to customers, firms with high maturity of firm's assets should extend less credit to customers because high investment in current assets have lower their capability to extend credit to customers.

For accounts payable model, the maturity of firm's assets is proxied by accounts receivable and inventory. For accounts receivable model, the maturity of firm's assets is proxied by accounts payable and inventory. Account receivable is considered as one of the determinants of the demand for trade credit because greater amount of credit the firms extend to their customers. One should predict that the firms would seek more funds to relax the amount of credit they extend to their customers. However, firms with higher amount of credit received from suppliers (i.e., accounts payable) should have higher capacity to provide credit to customers and therefore a positive correlation. Higher level of inventory implies a greater investment in the business and should have higher need for financing, including credit from suppliers (i.e., accounts payable). However, for accounts receivable or credit extend to customers, firms with higher level of inventory implies higher investment in assets and therefore may have less capacity to extend credit to customers. However, some may argue that firms with higher level of inventory may have incentive to extend credit to customers in order to promote sales.

Hypothesis 5: The demand of the UK's SMEs for trade credit increases when it has more outstanding in the account receivable and inventory level.

Hypothesis 6: The willingness of the UK's SMEs to extend trade credit to business customers increases when the it has less outstanding in the account payable and a higher inventory level.

4. Internally generated cash flows

Demand for trade credit can be determined by the cost and availability of the substitutes including internally generated cash flows. Indeed, pecking order theory of

finance suggests that internal generated cash flow is a costless and risk-free source of finance and should be used in the first priority before seeking costly external finance. Therefore, one can predict that if a firm is able to generate high level of internal cash flow to support the business operation, then its demand for trade credit should be decreased. Firms that unable to generate sufficient internal cash flow to finance investment activities increase demand for trade credit. In respect to the accounts receivable model, similarly, firms with higher internal generated cash flows are able to offer more credit to customers but firms with less internal generated cash flow have less capability to provide credit to their customers. Driving sales is one of the major incentives for firms to extend credit to customers.

Hypothesis 7: The demand of the UK's SMEs for trade credit increases when it has lower level of internal generated cash flow.

Hypothesis 8: The willingness of the UK's SMEs to extend trade credit to business customers increases when it has a higher level of internal generated cash flow.

5. Bank credit

Credit market imperfection is highlighted that caused by problems of adverse selection and moral hazard arising from asymmetric information between bank lenders and corporate borrowers. Banks approve loans to corporate borrowers on the ground of their assessment about creditworthiness of the corporate borrowers. Risk involved with the borrower is positively correlated with the level of interest rate charged. Bank lenders are not willing to provide credit to over risky firms at too high interest rate because those firms have a very high probability of default. From this perspective, there may be a substitution relationship between bank credit and trade credit in the

sense that when firms are credit rationed by banks, then they might turn to obtain funds from suppliers by delaying payment on purchases. For accounts receivable, firms that are able to obtain more bank loans not only to support their working capital needs but also able to offer more credit to their customers. The redistribute theory describes this perspective states that firms which are not credit-constrained by banks can obtain sufficient and may even more amount of bank loans they need and that allows them to distribute the bank credit to corporate customers for alleviating the financial problems of their customers. Therefore, bank loans should be positively correlated with accounts receivable.

Hypothesis 9: The demand of the UK's SMEs for trade credit increases when it has lower level of bank credit outstanding.

Hypothesis 10: The willingness of the UK's SMEs to extend trade credit to business customers increases when it has a higher level of bank credit outstanding.

6. Monetary conditions

Bank credit channel of monetary policy transmission suggests that tighten monetary policy will lead to not only increasing the cost of capital for business firms (i.e., interest rate channel), but also deterioration in balance sheets for both banks and firms. As a result, during monetary policy tightening, banks tend to tighten lending policy and causing more firms face greater difficulty in raising finance from banks. These credit-rationed firms might turn to obtain credit from suppliers in order to alleviate financing problem. Therefore, the monetary condition of a country should have a positive impact on the demand for trade credit. Similarly, during monetary policy tightening, firms increase difficulty in raising funds from banks and in turn have less

capacity to extend more credit to customers. Therefore, monetary condition is believed to have a positive correlation with the trade credit extended to customers. The MCI has been estimated in chapter 4.

Hypothesis 11: The demand of the UK's SMEs for trade credit increases during monetary condition is tightening.

Hypothesis 12: The willingness of the UK's SMEs to extend trade credit to business customers increases when the monetary condition is loosening.

7. Quantitative Easing

The bank lending channel of the transmission of quantitative easing (as discussed in chapter 2) might lead to an improvement in the bank credit. As a result, it should be able to predict a negative relationship between quantitative easing and trade credit demand and a positive relationship between quantitative easing and trade debtors. Quantitative easing lead to a fall in the demand for trade credit and therefore increase the willingness of firms to offer inter-firm credit. A measure of quantitative easing is included in both the trade creditors and trade debtors equation in order to examine the impact of asset purchases under the quantitative easing programme on the corporate borrowing, i.e., the bank lending channel. This thesis follows Morais et al. (2015) to use the change in the balance sheet of the Bank of England as ratio to nominal GDP as a measure of quantitative easing.

Hypothesis 13: The demand of the UK's SMEs for trade credit increases when the quantitative easing is introduced.

Hypothesis 14: The willingness of the UK's SMEs to extend trade credit to business customers increases when the quantitative easing is introduced.

The final form of the trade payable and trade receivable model are:

$$\frac{ap_{it}}{a_{i,t-1}} = \beta_0 + \beta_1 cr_{it} + \beta_2 \frac{wc}{a_{i,t-1}} + \beta_3 \frac{ar_{it}}{a_{i,t-1}} + \beta_4 \frac{stocks_{it}}{a_{i,t-1}} + \beta_5 \frac{cf_{it}}{a_{i,t-1}} + \beta_6 \frac{loan_{it}}{a_{i,t-1}} + \beta_7 MCI_t + \beta_8 QE_t + \nu_{it} \quad (6.1)$$

$$\frac{ar_{it}}{a_{i,t-1}} = \gamma_0 + \gamma_1 cr_{it} + \gamma_2 \frac{wc}{a_{i,t-1}} + \gamma_3 \frac{ap_{it}}{a_{i,t-1}} + \gamma_4 \frac{stocks_{it}}{a_{i,t-1}} + \gamma_5 \frac{cf_{it}}{a_{i,t-1}} + \gamma_6 \frac{loan_{it}}{a_{i,t-1}} + \gamma_7 MCI_t + \gamma_8 QE_t + \nu_{it} \quad (6.2)$$

6.5 Estimation Result

After constructing the model of accounts payable and accounts receivable, it is now necessary to estimate the model using the fixed effect model of the panel data approach. We use the results of disequilibrium model that classify the sample firms into borrowing constrained and unconstrained, and compare the differences of these model between the borrowing constrained and unconstrained firms. This section first reports the account payable model, which explains the demand of trade credit. This section then reports the accounts receivable model, which explains the willingness of firms to extend credit.

6.5.1 Trade Creditors – Who Demand Credit

Table 6.1 in the next page summarises the comparison of estimated parameters of the trade creditors model between borrowing constrained and unconstrained firms. The results are interpreted in the page after next.

Table 6.1 Estimated Coefficients of the Trade Creditors Model

Variables	Micro firm	Small firm	Medium firm
Borrowing constrained			
Constant	-0.2170 (-3.84)*	0.0977 (1.85)	-0.7436 (-2.19)*
Trade debtors/assets	2.1199 (100.20)*	0.7977 (886.03)*	0.7571 (599.75)*
Stocks/assets	0.8099 (208.86)*	0.8052 (1021.68)*	0.6279 (162.98)*
Cash flow/assets	0.0236 (157.42)*	-0.0141 (-133.63)*	-0.9444 (-49.72)*
Bank credit/assets	0.0364 (66.96)*	-0.1672 (-175.52)*	-0.3644 (-100.30)*
Working capital need/assets	-0.0205 (-187.22)*	-0.3272 (-255.44)*	-0.3366 (-81.97)*
Current ratio	-0.0091 (-9.65)*	-0.0003 (-1.32)	0.0051 (9.40)*
MCI	0.0031 (6.25)*	0.00018 (0.38)	0.0074 (2.49)*
QE	1.0042 (6.31)*	-0.1527 (-1.04)	-0.2541 (-0.31)
Borrowing unconstrained			
Constant	0.0643 (4.00)*	0.0248 (0.29)	-0.0017 (-0.02)
Trade debtors/assets	0.9401 (1017.09)*	0.4875 (40.05)*	0.8008 (51.93*)
Stocks/assets	0.6192 (261.70)*	0.3376 (103.77)*	0.1203 (7.94)*
Cash flow/assets	0.00002 (0.46)	0.8494 (1815.54)*	-0.00004 (-0.02)
Bank credit/assets	-0.0001707 (-1.12)	-0.11346 (-51.89)*	0.1549 (96.18)*
Working capital needs/assets	-0.3118 (-614.49)*	-0.8344 (-4568.03)*	0.0083 (9.11)*
Current ratio	-0.0015 (-8.30)*	0.0014 (4.96)*	-5.76e-06 (-0.08)
MCI	0.0008 (5.44)*	0.0010 (1.28)	0.0002 (0.18)
QE	0.3598 (7.94)*	0.0255 (0.11)	-1.0020 (-3.23)*

This table shows the differences in the demand for trade credit between borrowing constrained and unconstrained firms. The dependent variable is the trade creditors, i.e., accounts payable. * denotes the coefficients are significant at 1% level. t-value are reported in parenthesis. The firms in the sample are classified into micro, small, and medium sized. Micro sized firms have total assets less than £316,000; small sized firms have total assets less than £3.26 million; medium sized firms have total assets less than £12.9 million.

a. Firm risk

According to Table 6.1, the coefficients of current ratio have significant negative effect on trade credit demand for micro firms, regardless of whether they are constraint or unconstraint. This indicates that they have more demand for trade credit when they have lower ability to repay short-term debts. In contrast, small unconstrained firms and medium constrained firms have stronger demand for trade credit when they have greater ability to repay short-term debts.

Therefore, it is able to confirm the hypothesis 1 for small and medium sized firms, in that their demand for trade credit increases when the firm risk is lower. However, it should not have enough evidence to confirm the hypothesis 1 for micro sized firms.

b. Working capital needs

The coefficients of working capital needs are significant negative to trade credit demand for micro and small sized firms, indicating that they have higher demand for trade credit when they have lower working capital needs and the effect is stronger for unconstrained firms than constrained firms. However, for unconstrained medium firms, it is a positive coefficient, indicating that they have higher demand for trade credit when they have higher needs for working capital.

Therefore, it does not have enough evidence to confirm the hypothesis 3 that the demand of the UK's SMEs for trade credit increases when the firm has greater need for working capital, except for the unconstrained medium firms. There is evidence to show the demand for trade credit increases when the unconstrained medium firms have greater need for working capital.

c. Maturity of the firm's assets

For micro, small, and medium sized firms in the sample, the coefficients of the trade debtors have significant positive effect on the trade payable, for both the borrowing constrained and unconstrained firms. This suggests that whether the firm is micro, small, or medium sized, or whether it is borrowing constrained or unconstrained, the amount of credit from suppliers of a firm in the sample increase along with the amount of trade credit given to customers. Firms in the sample should obtain more amount of credit from suppliers when they have given more amount of credit to customers. The coefficients of trade debtors are 2.12, 0.7977, and 0.7571 for borrowing constrained micro-sized, small-sized, and medium-sized firms, respective. This is compared to 0.94, 0.4875, and 0.80 for unconstrained micro-sized, small-sized, and medium-sized firms. For micro-sized firms that are borrowing constrained, £1 increase in trade credit given to customers will result in £2.12 increase in trade credit obtained from suppliers, and this is compared to unconstrained micro-sized firms, £1 increase in trade credit given to customers will increase trade credit obtained from suppliers by £0.94. For small-sized firms that are borrowing constrained, £1 increase in trade credit given to customers will increase £0.7977 in the credit obtained from suppliers. This is compared to those unconstrained, which £1 increase in trade credit given to customers will result in £0.4875 increase in credit obtained from suppliers. For medium-sized firms that are borrowing constrained, £1 increase in trade credit given to customers will increase the credit obtained from suppliers by £0.757. This is compared to those unconstrained, which £1 increase in trade credit given to customers will increase £0.80 in credit obtained from suppliers.

The coefficients of stocks have significant positive effect on the trade creditors for both constrained and unconstrained micro, small, and medium-sized firms. Constrained firms in general have a higher demand for trade credit than unconstrained firms. £1 increase in stock of micro firms that is constraint increase £0.81 in trade credit demand and it is compared to £0.62 for those unconstraint. For small sized firms, £1 increase in stock can increase £0.805 in trade credit demand of constrained firms and it is compared to only £0.338 for unconstrained firms. Medium sized constrained firms have £0.63 increase in demand for trade credit for every £1 increase in stocks, whereas unconstrained firms have £0.12 increase in trade credit demand for every £1 increase in stock.

Both the results on the trade credit and inventory have confirmed that the hypothesis 5, that the demand of the UK's SMEs for trade credit increases when it has more outstanding in the account receivable and inventory level.

d. Internal generated cash flow

The coefficients of internal generated cash flow have negative significant effect on trade credit demand of small sized firms that are borrowing constraint but positive significant for those unconstraint. This indicates that small sized firms that are borrowing constraint have a lower demand for trade credit when they have more internal generated cash flow, whereas those unconstraint have lower demand for trade credit even when they have lower level of internal cash flow. This suggests that trade credit is an important source of external fund for constrained firms. Small firms that are borrowing constraint reduce trade credit demand by £0.014 for every £1 increase in internal generated cash flow, while those unconstraint reduce trade credit demand

by £0.85 for every £1 decrease in internal generated cash flow. A positive effect of internal generated cash flow on trade credit demand is also found on both borrowing constraint and unconstraint of micro sized firms. Medium sized firms have more demand for trade credit when they have lower internal generated cash flow and the effect is much stronger for constrained firms than those unconstrained. Medium firms that are borrowing constrained reduce £0.94 demand for bank credit for every £1 increase in internal generated cash flow, and this is compared to only £0.00004 for those unconstrained.

Therefore, it should have enough evidence to confirm the hypothesis 7 for medium firms regardless of whether it is constraint or unconstraint, and confirm for small firms borrowing constraint, that their demand for trade credit increases when it has lower level of internal generated cash flow.

e. Bank credit

The coefficients of bank credit are negative significant for small firms both constraint and unconstraint but the effect is higher for those borrowing constraint than unconstraint, indicating that bank credit is a significant source of fund substitute for trade credit for small sized firms both constraint or unconstraint. The result also show that bank credit is also an important source of funds substitute for trade credit for medium firms that are constraint and micro firms that are unconstraint. However, it shows a positive coefficient of bank credit for micro constrained firms and medium unconstrained firms, indicating a higher demand for trade credit when they have more bank credit obtained.

Therefore, it should have enough evidence to confirm the hypothesis 9 for small firms, and medium firms that are constraints and micro firms that are unconstraint, that the demand for trade credit increases when it has lower level of bank credit outstanding.

f. MCI

The coefficients of MCI have positive effect on trade credit demand for micro, small, and medium firms regardless of whether they are constraint or unconstraint, indicating that firms use more trade credit as a source of funds during a tighten monetary condition. The impact of monetary condition on trade credit demand is significant for micro sized firms than small and medium sized firms.

There should have enough evidence to confirm the hypothesis 11 for micro sized firms that the demand for trade credit increases during monetary condition is tightening. However, it should not have enough evidence to confirm the hypothesis 11 for small and medium sized firms.

g. Quantitative easing

A positive coefficient of quantitative easing indicates firms have stronger demand for trade credit when there is a positive intervention by the central bank to inject more money into the market, whereas a negative coefficient indicates firms have stronger demand for trade credit when the central bank reduces such intervention. Medium sized firms have stronger demand for trade credit when the central bank reduce the intervention to purchase gilts from non-bank sector and the effect is stronger if it is borrowing unconstraint.

Therefore, it should have enough evidence to confirm the hypothesis 13 for micro sized firms that the demand for trade credit increases when the quantitative easing is introduced.

6.5.2 Trade Debtors: Who Offers Credit

Table 6.2 in the next page shows the estimated parameters of the trade debtors model.

a. Firm risk

The coefficients of current ratio have a positive effect on trade credit offered to business customers for unconstraint firms in the sample, indicating that firms that are unconstraint tend to offer more inter-firm credit when they have stronger ability to pay back short-term debt. In contrast, micro and medium firms that are borrowing constraints tend to offer more (less) inter-firm credit even they have weaker (stronger) ability to pay short-term debt. However, this is contrasted to small sized firms which tend to offer more inter-firm credit if they have higher ability to payback short-term debt, regardless of whether they are borrowing constraint or unconstraint.

Therefore, it should have enough evidence to confirm the hypothesis 2 for micro sized and medium sized firms that are borrowing constraints that the willingness to extend trade credit to business customers increases when it has a lower risk.

Table 6.2 Estimated Coefficients of the Trade Debtors Model

Variables	Micro firm	Small firm	Medium firm
Borrowing constrained			
Constant	0.3042 (161.10)*	0.3168 (6.77)*	1.2095 (3.05)*
Trade creditors/assets	0.0024 (100.20)*	0.6254 (886.03)*	1.0397 (599.75)*
Stocks/assets	0.0015 (11.61)*	-0.4421 (-470.39)*	-0.8742 (-205.54)*
Cash flow/assets	-1.01e-06 (-0.20)	0.0081 (86.10)*	1.2299 (55.43)*
Bank credit/assets	0.0001 (6.35)*	0.1391 (164.63)*	0.5495 (133.71)*
Working capital need/assets	5.32e-06 (1.43)	0.1610 (138.08)*	0.4311 (90.20)*
Current ratio	-0.0019 (-59.23)*	0.0008 (3.67)*	-0.0071 (-11.04)*
MCI	-0.0007 (-43.13)*	-0.0013 (-3.17)*	-0.0110 (-3.14)*
QE	-0.1223 (-22.82)*	-0.3722 (-2.86)*	0.1758 (0.19)
Borrowing unconstrained			
Constant	0.3273 (28.97)*	0.2084 (23.63)*	0.3077 (13.21)*
Trade creditors/assets	0.4654 (1017.09)*	0.0052 (40.05)*	0.0350 (51.93)*
Stocks/assets	-0.0762 (-44.66)*	0.0127 (37.56)*	-0.0099 (-3.15)*
Cash flow/assets	0.0005 (14.29)*	-0.0040 (-32.96)*	0.0110 (24.00)*
Bank credit/assets	0.0043 (40.33)*	0.0217 (96.52)*	0.0652 (232.16)*
Working capital needs/assets	0.1441 (374.66)*	0.0041 (37.61)*	-0.0111 (-59.57)*
Current ratio	0.0004 (3.31)*	0.0002 (6.84)*	0.00002 (1.25)
MCI	-0.0008 (-7.74)*	-0.0003 (-4.08)*	-0.0003 (-1.44)
QE	-0.3905 (-12.25)*	-0.0802 (-3.24)*	-0.0361 (-0.56)

This table shows the differences in the behaviour of trade debtors (i.e., the willingness to offer inter-firm credit) between borrowing constrained and unconstrained firms. The dependent variable is the trade debtors, i.e., accounts receivable. * denotes the coefficients are significant at 1% level. t-value are reported in parenthesis. The firms in the sample are classified into micro, small, and medium sized. Micro sized firms have total assets less than £316,000; small sized firms have total assets less than £3.26 million; medium sized firms have total assets less than £12.9 million.

The coefficients of working capital needs have positive significant effect on micro and small firms both borrowing constraint and unconstraint, but not significant for micro firms that are borrowing constraints. This indicates that they tend to offer more inter-firm credit when they have higher need for working capital, i.e., current assets. For medium sized firms, those borrowing constraints tend to offer more inter-firm credit but those borrowing unconstraint tend to offer less when they have higher need for working capital.

Therefore, it has not enough evidence to confirm the hypothesis 4 that the willingness of the UK's SMEs to extend trade credit to business customers increases when the firm has less need for working capital.

b. Maturity of the firm's assets

For micro sized firms that are borrowing constraint, the coefficient of stocks has a positive significant effect on trade credit extended to customers, but the coefficient is negative significant for those unconstraint. This indicates micro sized firms that are borrowing constraint increase their trade credit extended to customers when they have higher stocks level as a measure of short-term assets but those unconstraint tend to extend more inter-firm credit when they have lower level of stocks. This is contrasted to small firms that are borrowing constraint have a negative effect while those borrowing unconstraint have a positive effect. Medium firms have negative effect of stocks on trade credit extend to customers but stronger effect for borrowing constraint than unconstraint.

The coefficients of trade creditors have significant positive effect on the trade debtors for all micro, small, and medium firms, and the effect is stronger for micro that are

unconstraint than those constraints; small firms that are constraint than unconstraint; and medium firms that are constraint than unconstraint. This indicates that micro sized firms that are unconstraint willing to provide credit to business customers than those constraint. Micro sized firms that are unconstraint increase the amount of trade credit extended by £0.4654 for every £1 increase in trade credit demand, but compared to only £0.0024 for micro firms that are constraint. For small sized firms, £1 increase in trade credit demand increase £0.625 trade credit extended to customers if they are borrowing constraint but only increase by £0.005 if they are unconstraint. For medium sized firms, £1 increase in the trade credit received by those borrowing constraint increase £1.04 trade credit extended to their business customers and this is compared to only £0.035 for those unconstraint.

Therefore, it does not have enough evidence to confirm the hypothesis 6 for all the SMEs groups in the sample.

c. Internal generated cash flow

The coefficients of internal generated cash flow have a negative effect on trade debtors for micro firms that are borrowing constraint but a positive effect for those unconstraint, indicating that micro firms that are borrowing constraint offer more inter-firm credit even when they have less internal funds generated but those unconstraint tend to offer more inter-firm credit when they are able to generate more internal funds. This is contrasted to small firms that are borrowing constraint tend to offer more inter-firm credit when they generate more internal funds and those unconstraint tend to offer more inter-firm credit even when they have lower internal

funds. Medium firms that are borrowing constraint tend to offer more inter-firm credit than those unconstraint when they have more internal funds.

Therefore, it should have enough evidence to confirm the hypothesis 8 for medium sized firms that the willingness to extend trade credit to business customers increases when it has a higher level of internal generated cash flow. However, it should not have enough evidence to confirm the hypothesis for micro firms that are constraints and small firms that are unconstraint.

d. Bank credit

The coefficients of bank credit have significant positive effect on trade debtors regardless of their size and borrowing constraint or unconstraint, indicating that all firms tend to offer more inter-firm credit when they access to more bank credit and the extent varies with whether they are borrowing constraint or unconstraint. For micro sized firms, £1 increase in bank credit of those borrowing unconstraint increases £0.004 inter-credit offer to customers and compared to only £0.0001 for those constraint. For small firms, £1 increase in bank credit of those are borrowing constraint tend to offer £0.14 more inter-firm credit and those unconstraint increase £0.02 more inter-firm credit. The effect of bank credit is greater for medium firms that are borrowing constraint, which offer £0.55 more inter-firm credit for every £1 increase in bank credit while those unconstraint only offer £0.065 more inter-firm credit.

Therefore, it should have enough evidence to confirm the hypothesis 10 that the willingness of the UK's SMEs to extend trade credit to business customers increases when it has a higher level of bank credit outstanding.

e. MCI

The coefficients of MCI have negative significant effect on trade credit offered to business customers but the effect is not significant for medium firms that are borrowing unconstraint, indicating that firms tend to extend less credit to business customers during a tighten monetary condition and extend more during loosen monetary condition.

Therefore, it should have enough evidence to confirm the hypothesis 12 that the willingness of the UK's SMEs to extend trade credit to business customers increases when the monetary condition is loosening.

f. Quantitative easing

The coefficients of quantitative easing have significant negative effect on trade debtors but a positive effect for medium firms that are borrowing constraint. This indicates that firms in general regardless of constraint or unconstraint tend to reduce inter-firm credit to business customers when the central bank injects more money into the market by purchasing gilts from non-bank sector. However, medium sized firms that are borrowing constraint tend to offer more inter-firm credit when the central bank purchased more gilts from the non-bank sector. The coefficients of quantitative easing are -0.39, -0.08, and -0.036 for micro, small, and medium sized firms that are borrowing unconstraint, respectively, which suggest that every 1-unit increase in the central bank's balance sheet to GDP will reduce £0.39 trade credit extended to customers for micro firms that are borrowing unconstraint, £0.08 and £0.036 for small and medium firms that are borrowing unconstraint, respectively. This is contrasted to micro and small sized firms that are borrowing constraint every 1-unit increase in the

central bank's balance sheet to GDP increase inter-firm credit offered to customers by £0.12 and £0.37, respectively, but medium firms that are borrowing constraint tend to reduce offering inter-firm credit by £0.176.

Therefore, it should not have enough evidence to confirm the hypothesis 14 that the willingness of the UK's SMEs to extend trade credit to business customers increases when the quantitative easing is introduced.

6.5.3 Hausman Test to Confirm the Fixed Effect Model

This subsection reports the Hausman test to confirm the use of fixed effect model for the trade creditors and trade debtors equations. Table 6.3 to 6.10 shows the results of relevant Hausman test. All the p-values = 0.0000, confirming that fixed effect should be used to estimate the trade creditors and trade debtors equation.

Table 6.3 Hausman Test for Trade Creditors Model of Micro Constrained

	Coefficients			
	(b)	(B)	(b-B)	
	Fixed	Random	Difference	S.E.
Trade debtors/assets	2.1199	2.0519	0.0680	0.0099
Stocks/assets	0.8099	0.8112	-0.0013	0.0011
Internal cashflow/assets	0.0236	0.0236	-0.00004	0.00007
Bank credit/assets	0.0364	0.0398	-0.0034	0.0002
Working capital need/assets	-0.0205	-0.0203	-0.0002	0.00005
Current ratio	0.0091	-0.0144	0.0052	0.0004
MCI	0.0031	0.0044	-0.0013	0.0001
QE	1.0042	1.0536	-0.0494	0.0258
chi2(8) = 552.18, Prob>chi2 = 0.0000				

This table shows the result of Hausman test for the trade creditor model of borrowing constrained firms of micro size. The Hausman test is used to test if the fixed effect model is appropriate for the model. The p-value = 0.0000, confirming that fixed effect model should be used.

Table 6.4 Hausman Test for Trade Creditors Model of Micro Unconstrained

	Coefficients			
	(b)	(B)	(b-B)	
	Fixed	Random	Difference	S.E.
Trade debtors/assets	0.9401	0.9298	0.0102	0.0004
Stocks/assets	0.6192	0.6933	-0.0741	0.0013
Internal cashflow/assets	0.00002	-0.00007	0.00009	0.00002
Bank credit/assets	-0.0002	-0.0006	0.0004	0.00009
Working capital need/assets	-0.3118	-0.3044	-0.0074	0.0003
Current ratio	0.0015	-0.0019	0.0005	0.00008
MCI	0.0008	0.0011	-0.0003	0.00004
QE	0.3598	0.3873	-0.0274	0.0094
chi2(8) = 4646.93, Prob>chi2 = 0.0000				

This table shows the result of Hausman test for the trade creditor model of unconstrained firms of micro size. The Hausman test is used to test if the fixed effect model is appropriate for the model. The p-value = 0.0000, confirming that fixed effect model should be used.

Table 6.5 Hausman Test for Trade Debtors Model of Micro Constrained

	Coefficients			
	(b)	(B)	(b-B)	
	Fixed	Random	Difference	S.E.
Trade creditors/assets	0.0024	0.0024	-0.00001	9.99e-06
Stocks/assets	0.0015	0.0004	0.0011	0.00004
Internal cashflow/assets	-1.01e-06	-0.00001	0.00001	2.34e-06
Bank credit/assets	0.0001	-0.0001	0.00002	7.48e-06
Working capital need/assets	5.32e-06	0.00002	-0.00001	1.70e-06
Current ratio	-0.0019	-0.0027	0.0008	0.00001
MCI	-0.0007	-0.0008	0.00008	4.99e-06
QE	-0.1223	-0.1335	0.0112	0.0011
chi2(8) = 5479.29, Prob>chi2 = 0.0000				

This table shows the result of Hausman test for the trade debtor model of constrained firms of micro size. The Hausman test is used to test if the fixed effect model is appropriate for the model. The p-value = 0.0000, confirming that fixed effect model should be used.

Table 6.6 Hausman Test for Trade Creditors Model of Small Constrained

	Coefficients			
	(b)	(B)	(b-B)	
	Fixed	Random	Difference	S.E.
Trade debtors/assets	0.7977	0.8209	-0.0233	0.0004
Stocks/assets	0.8052	0.7973	0.0079	0.0002
Internal cashflow/assets	-0.0141	-0.0131	-0.0010	0.00003
Bank credit/assets	-0.1672	-0.0656	-0.1016	0.0007
Working capital need/assets	-0.3272	-0.4892	0.1620	0.0009
Current ratio	-0.0003	0.0003	-0.0006	0.00009
MCI	0.0002	0.0010	-0.0008	0.0001
QE	-0.1527	-0.0605	-0.0922	0.0200
chi2(8) = 41779.74, Prob>chi2 = 0.0000				

This table shows the result of Hausman test for the trade creditor model of borrowing constrained firms of small size. The Hausman test is used to test if the fixed effect model is appropriate for the model. The p-value = 0.0000, confirming that fixed effect model should be used.

Table 6.7 Hausman Test for Trade Debtors Model of Small Constrained

	Coefficients			
	(b)	(B)	(b-B)	
	Fixed	Random	Difference	S.E.
Trade creditors/assets	0.6254	0.6341	-0.0087	0.0003
Stocks/assets	-0.4421	-0.4466	0.0045	0.0004
Internal cashflow/assets	0.0081	0.0077	0.0004	0.00003
Bank credit/assets	0.1391	0.0628	0.0764	0.0006
Working capital need/assets	0.1610	0.2867	-0.1257	0.0008
Current ratio	0.0008	0.0002	0.0007	0.00008
MCI	-0.0013	-0.0017	0.0004	0.0001
QE	-0.3722	-0.4173	0.0451	0.0231
chi2(8) = 28737.87, Prob>chi2 = 0.0000				

This table shows the result of Hausman test for the trade debtor model of constrained firms of small size. The Hausman test is used to test if the fixed effect model is appropriate for the model. The p-value = 0.0000, confirming that fixed effect model should be used.

Table 6.8 Hausman Test for Trade Creditors Model of Medium Constrained

	Coefficients			
	(b)	(B)	(b-B)	
	Fixed	Random	Difference	S.E.
Trade debtors/assets	0.7571	0.7978	0.0406	0.0007
Stocks/assets	0.6279	0.1384	0.4895	0.0030
Internal cashflow/assets	-0.9444	-0.0215	-0.9229	0.0187
Bank credit/assets	-0.3644	-0.0334	-0.3310	0.0035
Working capital need/assets	-0.3366	-0.1581	-0.1784	0.0037
Current ratio	-0.0051	0.0014	0.0037	0.0003
MCI	0.0074	0.0044	0.0030	0.0015
QE	-0.2541	-0.2964	0.0423	.
chi2(8) = 117515.01, Prob>chi2 = 0.0000				

This table shows the result of Hausman test for the trade creditor model of borrowing constrained firms of medium size. The Hausman test is used to test if the fixed effect model is appropriate for the model. The p-value = 0.0000, confirming that fixed effect model should be used.

Table 6.9 Hausman Test for Trade Creditors Model of Medium Unconstrained

	Coefficients			
	(b)	(B)	(b-B)	
	Fixed	Random	Difference	S.E.
Trade debtors/assets	0.8008	0.5259	0.2749	0.0149
Stocks/assets	0.1203	0.8888	-0.7686	0.0135
Internal cashflow/assets	-0.00004	-0.0102	0.0102	.
Bank credit/assets	0.1549	0.1629	-0.0080	0.0011
Working capital need/assets	0.0083	-0.0009	0.0084	0.0001
Current ratio	-5.76e-06	-1.21e-06	-4.55e-06	.
MCI	0.0002	0.0005	-0.0003	.
QE	-1.0019	-0.9420	-0.0599	.
			chi2(8) = 21961.23, Prob>chi2 = 0.0000	

This table shows the result of Hausman test for the trade creditor model of unconstrained firms of medium size. The Hausman test is used to test if the fixed effect model is appropriate for the model. The p-value = 0.0000, confirming that fixed effect model should be used.

Table 6.10 Hausman Test for Trade Debtors Model of Medium Constrained

	Coefficients			
	(b) Fixed	(B) Random	(b-B) Difference	S.E.
Trade creditors/assets	1.0397	1.0187	0.0209	0.0011
Stocks/assets	-0.8742	-0.1938	-0.6804	0.0033
Internal cashflow/assets	1.2299	0.0127	1.2172	0.0219
Bank credit/assets	0.5496	0.0690	0.4806	0.0039
Working capital need/assets	0.4311	0.1997	0.2313	0.0043
Current ratio	-0.0071	-0.0021	-0.0049	0.0004
MCI	-0.0110	-0.0092	-0.0018	0.0019
QE	0.1758	-0.0869	0.2628	.
chi2(8) = 56657.63, Prob>chi2 = 0.0000				

This table shows the result of Hausman test for the trade debtor model of constrained firms of medium size. The Hausman test is used to test if the fixed effect model is appropriate for the model. The p-value = 0.0000, confirming that fixed effect model should be used.

6.6 Discussion of the Estimated Results

After reporting the results of the estimated coefficients of both the trade credit demand and trade debtors equations, it is now necessary to provide a discussion of the results. This is to discuss whether the findings of the empirical study are consistent with the theories and findings of the prior literature.

We first discuss the trade credit demand between borrowing constrained and unconstrained. The amount of credit from suppliers of a firm in the sample increase along with the amount of trade credit given to customers, regardless of whether they are borrowing constrained and unconstrained. The higher the level of their stocks outstanding, the higher the both constrained and unconstrained firms of micro, small, and medium sized of their trade credit outstanding, suggesting that they are depending on trade credit on their stocks. Moreover, the result also shows that the internal generated cash flows and bank credit are important substitute for constrained firms than those unconstrained. This is quite consistent with both the theories and empirical studies in the prior literature, including Atanasova and Wilson (2004). Indeed, the substitution theory suggests that bank credit is an important substitutable funds for trade credit. When firms have restricted access to the bank credit, firms are likely to use more trade credit as an external funds substitute for bank credit. However, the trade credit demand model found that this is not the case for medium unconstrained firms which they have higher demand for trade credit even when they have accessed to more bank credit.

The results of the trade credit demand model also found that micro and small sized firms have higher demand for trade credit when they have lower working capital needs

and the effect is stronger for unconstrained firms than constrained firms. This suggests that working capital needs may unable to explain the trade credit behaviour for micro and small sized firms.

The trade credit demand model also found that small unconstrained firms and medium constrained firms have stronger demand for trade credit when they have greater ability to repay short-term debts. This finding is consistent with the theoretical prediction of the credit risk. Higher credit risk should have less access to trade credit.

A more important finding of this trade credit demand is that the monetary condition has a positive impact on the trade credit demand, regardless of whether the firms are constrained or unconstrained. This is consistent with the theoretical prediction, to certain extent, that firms use more trade credit during a tighten monetary condition, when the bank credit availability are affected by the higher interest rate. However, this is indifferent for borrowing constrained and unconstrained firms. In addition, the impact of monetary condition on trade credit demand is stronger for micro firms than small firms.

On the quantitative easing, the trade credit demand model found that medium sized firms have stronger demand for trade credit when the central bank reduce the intervention to purchase gilts from non-bank sector and the effect is stronger if it is borrowing unconstraint. In other words, medium sized firms should have lower demand for trade credit when the quantitative easing increase the reserves and deposit on the bank side. This is quite consistent with the theoretical prediction because when there are intervention on the banks' balance sheet, bank credit should be more

available to the firms and that reduce their demand and dependence on the trade credit to support their working capital needs.

After that, we consider the willingness of firms to extend credit. First, the result shows that unconstrained firms of small and medium sized are willing to extend more trade credit to other firms when they have more internal generated cash flow and they have access to more bank credit. This is quite consistent with the redistribution theory of trade credit, which suggests that firms that have access to more bank loans will distribute their bank credit obtained to others through inter-firm credit. However, the result shows that small and medium sized firms that are borrowing constrained are more willing to extend more trade credit to other firms than those unconstrained. In addition, micro firms that are borrowing constraint offer more inter-firm credit even when they have less internal funds generated but those unconstraint tend to offer more inter-firm credit when they are able to generate more internal funds. Although this is not consistent with the theoretical prediction, but it may making sense that borrowing constrained firms are looking to generate more revenue and therefore willing to extend more credit by offering sales at later payment. This is further confirmed by the finding that micro and small sized firms tend to offer more inter-firm credit when they have higher need for working capital. However, this is not the case for medium firms that are borrowing unconstrained. Medium firms that are borrowing unconstrained tend to offer less credit when they have higher needs for working capital.

This thesis also found that small firms that are unconstraint tend to offer more inter-firm credit when they have stronger ability to pay back short-term debt. This is quite making sense since firms with higher ability to pay back short-term debt are able offer

more trade credit. Otherwise, by delaying the payment received on the sales, they might have liquidity problem unable to meet the maturity of short-term liabilities. However, the results show that this is not the case for micro and medium firms.

In respect to the impact of monetary condition, the result show that firms tend to extend less trade credit during a tighten monetary condition and extend more credit during loosen monetary condition. This is quite making sense as firms should have restricted in the access to bank credit during tighten monetary condition due to a higher interest rate and therefore unwilling to offer more trade credit to their business customers. Instead, during a loosen monetary condition, bank credit are cheaper and therefore easier access to bank credit and therefore firms are more willing to offer more credit. In respect to the quantitative easing, it is quite surprising to see the result that finds that firms tend to unwilling to offer inter-firm credit when there is invention by the central banks to increase the reserves and deposit on the banks' balance sheet.

6.7 Summary

This chapter aims to estimate if borrowing constrained firms use bank credit as a source of funds substitute for bank credit by comparing the trade credit demand between constrained and unconstrained firms. The results generally confirm that borrowing constrained firms use more bank credit than unconstrained firms for small and medium size. Moreover, this chapter also estimate the willingness of firms to offer trade credit to other firms. The results generally show that borrowing unconstrained firms extend more credit to other firms when they have access to bank credit. This is quite consistent with the redistribution theory of trade credit, which suggests that

unconstrained firms will redistribute their credit obtained from bank loans to other firms through offering inter-firm credit. However, the effect is not as much as those of borrowing constrained. In other words, this appear to indicate that borrowing constrained firms are more willing to redistribute the amount of bank loans they have received, to the extent that they are not fully constrained, to other firms than those unconstrained. This might be driven by the idea that borrowing constrained firms strive for obtaining more revenue by allowing more sales on account.

7. Conclusion

7.1 Summary

The huge losses in the financial sector has raised the issues of credit crunch in the UK. The credit crunch has implications on the ability of SMEs in the UK in access to the bank credit, which is an important source of finance to them. In response to the intensified financial crisis, the Bank of England's (BoE) Monetary Policy Committee (MPC) has implemented loosening monetary policy, including interest rate cut close to zero bound and large scale asset purchases known as quantitative easing to inject money directly into the economy in order to boost spending and investment activities. This raise questions about the effectiveness of these measures of monetary policy to steer the economy. Inspired by these issues in the UK economy, this thesis aims to examine the extent to which the SMEs in the UK face credit rationing and to examine the impact of monetary policy and quantitative easing on the corporate borrowing. Moreover, this thesis also attempts to examine how the credit rationed firms raise funds in order to support the working capital and business operations, whether they have used trade credit as a source of funds substitute for bank credit. In addition, this thesis also examines the willingness of firms to extend trade credit. The scope of this thesis is not limited to the recent financial crisis, but the overall borrowing conditions of the SMEs in the UK between 1991 and 2010, and to review the role of banks play in the monetary policy transmission.

The credit rationing refers to a situation in which a borrower desires to obtain a specific amount of bank loan but the bank reject to supply, at least not the full amount, despite or because the borrower offer to pay higher interest rate, even if the bank has excessive loanable supply. The existence of credit rationing can be explained by the credit market imperfection theory, which suggests that every corporate borrower is different in terms of their creditworthiness and financial positions. Bank lenders concern about the risk and return and they are generally unable to predict the creditworthiness of corporate borrowers due to the asymmetric information between them. The problems of adverse selection and moral hazard have prevented bank lenders from fulfilling the loan requirement of corporate borrowers when the interest charged is unable to cover the risks involved in loan contract, and therefore credit rationing.

In respect to transmission mechanism of conventional monetary policy, the credit view enhances the money view in explaining the impact of interest rate on corporate borrowing through bank credit. There are two channels of monetary policy transmission from the credit view: the balance sheet channel and the bank lending channel. The balance sheet channel works in a way that rising interest rates following a tightening monetary policy reduces firms' net worth and cash flows, thus a negative impact on firms' financial health. This increases loan premium that banks have to charge. The bank lending channel emphasises the amplification and propagation effects that generated by the banking sector, mainly through the impact of monetary policy on banks' balance sheet that influence the availability of loanable supply to their borrowers. From the view of the credit channel of monetary policy transmission, in addition to the financial characteristics of corporate borrowers, any macroeconomic

shock to the supply of bank loans would also suggested that may affect the cost and availability of bank loans to the corporate sector.

In respect to the quantitative easing, its bank lending channel of transmission mechanism works in a way that banking sector would generate additional reserves at BoE and a corresponding increase in customer deposits when assets are purchased from non-banks through intermediate transaction. The additional reserves mean that banks' holdings of liquid assets will have increased, which might make banks more willing to extend illiquid loans. However, it is expected that the quantitative easaing only a limited effect on corporate borrowing as it is designed to target at the asset purchases from non-bank companies.

In order to estimate the extent of credit rationing and to examine the impact of monetary policy and quantitative easing on the corporate borrowing, this thesis uses the disequilibrium model. The disequilibrium model, which comprises of a demand and a supply equation, each containing the determinants of demand and supply of bank credit, respectively. The demand equation and the supply equation are used to estimate the firms' quantity of loan demand and loan supply. The credit rationed firms are those with the quantity of loan demand exceeds the quantity of loan supply. By using the disequilibrium model to estimate credit rationing, it is able to capture and to detangle the factors affecting the demand and supply of bank loans.

The estimated results of demand equation in the disequilibrium model show that the demand for bank loans of firms are significantly determined by its working capital and investment needs, internal generated cash flow, trade credit, and firm size. For small and medium sized firms, their demand for bank loans increase when they have stronger

needs of working capital and investment, lower level of internal generated cash flow and trade credit obtained from suppliers, and higher level of assets as a measure of firm size. This is compared to micro sized firms in the sample which their demand for bank loans increase when they have greater internal generated cash flow and trade credit, lower needs of working capital but stronger needs of long-term investment, and higher level of assets as a measure of firm size.

The results of the disequilibrium model of this thesis provides substantial evidence suggesting that internal generated cash flow and trade credit are two important sources of funds that UK's SMEs use to substitute for bank credit. The result of internal generated cash flow is consistent with the prediction of pecking order theory which suggests that companies prefer using internal funds as it is risk free and costless before seeking external finance, i.e., bank loans (Cotei and Farhat, 2009). This is also consistent with the results of empirical study conducted by Atanasova and Wilson (2004), Carbo-Valverde et al. (2008), and Ogawa and Suzuki (2000), Soana et al (2015), which found that internal funds is important substitute for bank loans and firms have greater demand for bank loans if they have lower level of internal funds.

However, it is surprising to see that the coefficient of internal cash flow is positively significant to bank credit for micro sized firms, which can be interpreted as that micro sized firms have lower demand for bank loans even they generated less internal cash flow. This interpretation can be further confirmed by comparing the descriptive statistics between constrained and unconstrained firms. The result shows that the constrained firms generally have significant lower amount of internal cash flow than unconstrained firms and micro firms that are borrowing constraint on average even

have a negative internal cash flow. This may be able to explain that micro sized firms tend not want to borrow more money from banks to invest in its business that does not generate desirable returns.

This thesis also find evidence suggesting that bank credit is one of the major sources of corporate finance to considered by SMEs in the UK to fund working capital and investment. This also confirms the theory of credit market imperfection that suggest the bank credit is the key external source of finance for SMEs. However, the result shows it is not the case for micro sized firms in the sample and their demand for bank loans increase (decrease) when they have lower (higher) needs of working capital but stronger needs (lower) needs for long-term investment, and a higher (lower) level of internal generated cash flow. It might be making sense if micro sized firms with a high level of internal cash flow (i.e., a measure of profitability) might want to expand businesses by obtaining more finance from bank loans, further evidenced by greater needs for long-term investment.

On the other hand, the estimated results of the loan supply in the disequilibrium model show that the supply of bank loans can be significantly determined by current ratio as a measure of risk, firm size, collateral assets, the extent of trade creditors, and if the firm belongs to manufacturing industry, but not significantly determined by firm age, monetary condition, and quantitative easing. The results of the disequilibrium model provide substantial evidence confirming that the more bank credit are available for larger firms with more collateral assets. This also confirms the role of collateral assets play in mitigating the adverse selection and moral hazard problem stemming from informational asymmetry between borrowers and banks. This finding is consistent

with Atanasova and Wilson (2004), Berger et al. 2011; Steijvers and Voordeckers, 2009; Berger and Udell, 1995; Bandt et al., 2008.

It has recognised the credit crunch emerged in the financial crisis and that restricted the SMEs in the access of bank credit. During credit crunch period, there is a sudden reduction in the general availability of bank loans or sudden tightening of the conditions required for borrowers to acquire loan from banks. During the credit crunch period, a large number of borrowers may not able to obtain the desired quantity of bank credit independently of the interest rates due to the tighten credit policy. Previous studies also found survey evidence of more SMEs in the UK faced loan rejection during the financial crisis compared to the prior period. The result of the disequilibrium model finds that the proportion of medium firms in the sample are borrowing constraint is significantly higher in 2008 than previous years. This provides evidence confirming that corporate borrowing of medium firms was affected by the credit crunch emerged in the recent financial crisis. However, the result of the disequilibrium model finds no substantial evidence of higher proportion of micro and small firms faced borrowing constraint during the financial crisis. In addition, the result of the disequilibrium model confirms that lower proportion of medium firms in general are borrowing constraint than the micro and small firms.

In terms of the impact of monetary policy on the availability of bank loans for the SMEs in the UK, this thesis estimated the monetary condition index (MCI) as an indicator of the monetary condition in the UK. The MCI is included in the supply equation in order to estimate the impact of monetary policy on the corporate borrowing. The results of the disequilibrium model confirm the credit channel of monetary policy

transmission. Firms have more access to bank credit when the monetary condition is loosening and firms have less access to bank credit when the monetary condition is tightening. Similarly, a measure of quantitative easing is included in the supply equation to examine the impact of quantitative easing on the bank credit availability. However, this thesis finds a little effect of quantitative easing on the bank credit. Nonetheless, it meets the prediction that the quantitative easing works through the portfolio rebalancing channel rather than through bank credit channel.

The results of the trade credit model find that borrowing constrained firms use more bank credit than unconstrained firms for small and medium size. Moreover, this thesis also estimates the willingness of firms to offer trade credit to other firms. The results generally show that borrowing unconstrained firms extend more credit to other firms when they have access to bank credit. This is quite consistent with the redistribution theory of trade credit, which suggests that unconstrained firms will redistribute their credit obtained from bank loans to other firms through offering inter-firm credit. However, the effect is not as much as those of borrowing constrained. In other words, this appear to indicate that borrowing constrained firms are more willing to redistribute the amount of bank loans they have received, to the extent that they are not fully constrained, to other firms than those unconstrained. This might be driven by the idea that borrowing constrained firms strive for obtaining more revenue by allowing more sales on account.

7.2 Limitations and Direction for Future Research

There are several limitations that can be identified in this thesis. The first limitation is about the estimation of the monetary condition index (MCI). The key to the estimation of the MCI is the weights of interest rate and exchange rate. There are several studies in the literature have suggested the time varying aspect of the MCI due to the fact that the weights are depending on the average effect of the interest rate and exchange rate on the GDP output over the sample period. In this thesis, it is assumed that the time varying effect has been incorporated into the weights of interest rate and exchange rate by using the VAR model to estimate the weights. The VAR model takes into account the shocks of interest rate and exchange rate on the economic output over two years period. It is therefore argued that the VAR has taken into the overall effect of the interest rate and exchange rate over the 20 years period rather than on each year.

The second limitation is about the estimation of the disequilibrium model. Most previous studies that examined the credit rationing using the disequilibrium model adopted the maximum likelihood estimation method as indicated by Maddala and Nelson (1974). However, due to the problems encountered in the statistical coding, it was not able to estimate the disequilibrium model using the maximum likelihood method. Nonetheless, it is still able to estimate the disequilibrium model using the three stage least square (3SLS).

The third limitation is probably related to my personal health problem. I was diagnosed with nasopharyngeal cancer (NPC) in June 2014 and has received medical treatment in Singapore for half a year. The cancer has probably developed for more than a year because two very large tumours were found in my nose. I suffered very serious

headache and nose bleeding for more than a year. This has affected my research for this thesis. Around one and half year after the medical treatment, I have fully recovered from the cancer and returned to the university for my thesis. However, I still suffered some side effects, such as get tired and cold very easily due to a weak immune system as a result of the chemotherapy. I believed that these side effects have affected the quality of this thesis.

If given opportunity for future research, I would improve the measure of monetary condition to include other financial effects, known as the financial condition index. Indeed, stocks in the stock prices and asset prices may also affect the bank credit market, in that it affect the balance sheet of both the corporate sector and the banking sector, and thus the credit channel.

References

Abdulsaleh, A.M. and Worthington, A.C. 2013. Small and Medium-Sized Enterprises Financing: A Review of Literature. *International Journal of Business and Management*. **8**(14), pp.36-54.

Adair, A., Berry. J., Haran, M., Lloyd, G. and McGreal, S. 2009. The Global Financial Crisis: Impact on Property Markets in the UK and Ireland. University of Ulster Real Estate Initiative.

Adair, P. and Fhima, F. 2014. Small and Medium-sized Enterprises' Credit Rationing on the Tunisian Bank Credit Market. *Journal of Economics and Development Studies*. **2**(1), pp.81-97.

Aisen, A. and Franken, M. 2010. Bank Credit During the 2008 Financial Crisis: A Cross-Country Comparison. *IMF Working Paper*. **10**(47).

Allen, F., Babus, A. and Carletti, E. 2009. Financial Crises: Theory and Evidence. University of Pennsylvania: Finance Department. European Corporate Governance Institute (ECGI).

Alphonse, P., Ducret, J. and Severin, E. 2006. When Trade Credit Facilitates Access to Bank Finance: Evidence from US Small Business Data. EFMA 2004 Basel Meetings Paper.

Astley, M., Giese, J., Hume, M. and Kubelec, C. 2009. Global Imbalances and the Financial Crisis. *Bank of England Quarterly Bulletin*. **49**(3), pp.178-190.

Asteriou, D. and Hall, S. 2007. Applied Econometrics: A Modern Approach Using Eviews and Microfit. New York: Palgrave Macmillan.

Atanasova, C.V. and Wilson, N. 2003. Bank Borrowing Constraints and the Demand for Trade Credit: Evidence from panel Data. *Managerial and Decision Economies*. **24**(6/7), pp.503-514.

Atanasova, C.V. and Wilson, N. 2004. Disequilibrium in the UK Corporate Loan Market. *Journal of Banking & Finance*. **28**(3): pp.595-614.

Atta-Mensah, J. and Dib, A. 2008. Bank Lending, Credit Shocks, and the Transmission of Canadian Monetary Policy. *International Review of Economics and Finance*. **17**(1), pp.159-176.

Auel, M.C. and de Mendonca, H.F. 2010. Macroeconomic Relevance of Credit Channels: Evidence from an Emerging Economy under Inflation Targeting. *Economic Modelling*. **28**(3), pp.965-979.

Baek, E.G. 2005. A Disequilibrium Model of the Korean Credit Crunch. *The Journal of the Korean Economy*. **6**(2), pp.313-336.

Bandt, O., Bruneau, C. and Amri, E. 2008. Stress Testing and Corporate Finance. *Journal of Financial Stability*. **4**(3), pp.258-274.

Bank of England (2010) Credit Conditions Survey 2010 Q4. [Online]. [Accessed 12 July 2012]. Available from: http://www.bankofengland.co.uk/publications/

Bannock, G. 2005. The Economics and Management of Small Business. An International Perspective. New York: Routledge.

Batini, N. and Turnbull, K. 2000. Monetary Conditions Indices for the UK: A Survey. External MPC Unit Discussion Paper No. 1. Bank of England.

Batini, N. and Turnbull, K. 2002. A Dynamic Monetary Condition Index for the UK. *Journal of Policy Modeling*. **24**, pp.257-281.

Baumol, W.J. and Blinder, A. 2009. Macroeconomics: Principles & Policy, 11th edn. USA: South-Western Cengage Learning.

Bellier, A., Sayeh, W. and Serve, S. 2012. What Lies Behind Credit Rationing? A Survey of the Literature. Thema Working Paper 2012-39. Université de Cergy Pontoise, France. [Online]. [Accessed 14 July 2014]. Available from: http://ssrn.com/abstract=2144801

Berger, A.N. and Udell, G.F. 1995. Relationship Lending and Lines of Credit in Small Firm Finance. **Journal of Business**. **68**(3), pp.351-381.

Berger, A.N. and Udell, G.F. 1998. The Economics of Small Business Finance: The Roles of Private Equity and Debt Markets in the Financial Growth Cycle. *Journal of Banking and Finance*. **22**, pp.613-673.

Berger, A.N., Espinosa-Vega, M.A., Frame, W.S. and Miller, N.H. 2011. Why Do Borrowers Pledge Collateral? New Empirical Evidence on the Role of Asymmetric Information. *Journal of Financial Intermediation*. **20**(1), pp.55-70.

Bernardo, G., Ryan-Collins, J. and Werner, R.A. 2013. UK QE Reconsidered: the Real Economy Effects of Monetary Policy in the UK, 1990-2012 – An Empirical

Analysis. Centre for Banking, Finance and Sustainable Development. University of Southampton.

Bernanke, B.S. (2007) The Financial Accelerator and the Credit Channel. Speech at the Credit Channel of Monetary Policy in the Twenty-first Century Conference, Federal Reserve Bank of Atlanta, Georgia, June 15, 2007. [Online] [Accessed 16 March 2011]. Available from: http://www.federalreserve.gov/newsevents/speech/

Bernanke, B.S. and A.S. Blinder, A.S. 1988. Credit, Money, and Aggregate Demand. *American Economic Review*. **78**(2), pp.435-439.

Bernanke, B.S. and Blinder, A.S. 1992. The Federal Funds Rate and the Channels of Monetary Transmission. *The American Economic Review***. 82**(4), pp.901-921.

Bernanke, B.S. and Gertler, M. 1995. Inside the Black Box: The Credit Channel of Monetary Policy Transmission. *The Journal of Economic Perspectives*. **9**(4), pp.27-48.

Bernanke, B.S., Gertler, M. and Gilchrist, S. 1996. The Financial Accelerator and the Flight to Quality. *The Review of Economics and Statistics*. **78**(1), pp.1-15.

Bernanke, B.S., Gertler, M. and Gilchrist, S. 1999. The Financial Accelerator in a Quantitative Business Cycle Framework. Economic Research Reports. New York University, Faculty of Arts and Science.Bolton and Freixas, 2006;

Bernanke, B.S. and Lown, C.S. 1991. The Credit Crunch. *Brookings Paper on Economic Activity*. No.2, pp.205-247.

BIS. 2010. SMEs Access to External Finance. Department for Business Innovation and Skills. BIS Economics Paper No.16.

Boissay, F. and Gropp, R. 2007. Trade Credit Defaults and Liquidity Provision by Firms. European Central Bank Working Paper Series No.753. [Online]. [Accessed 14 July 2010]. Available from: http://www.ecb.int/

Bolton, P. and Freixas, X. 2006. Corporate Finance and Monetary Transmission Mechanism. *The Review of Financial Studies*. **19**(3), pp.829-870.

Bougheas, S., Mizen, P. and Yalcin, C. 2006. Access to External Finance: Theory and Evidence on the Impact of Monetary Policy and Firm-specific Characteristics. *Journal of Banking & Finance*. **30**(1), pp.199-227.

Brissimis, S.N. and Delis, M.D. 2009. Identification of a Loan Supply Function: A Cross-Country Test for the Existence of a Bank Lending Channel. *International Financial Markets, Institutions and Money*. **19**(2), pp.321-335.

Brissimis, S.N. and Magginas, N.S. 2005. Changes in Financial Structure and Asset Price Substitutability: A Test of the Bank Lending Channel. *Economic Modelling*. **22**(5), pp.879-904.

Brown, B.C. 2011. Credit Rationing and Sticky Interest Rate. Presentation at 86th Annual WEAI Conference, July 1, 2011. [Online]. [Accessed 14 July 2014]. Available from: https://www.cpp.edu/~bbrown/

Butt, N. Churm, R., McMahon, M. Morotz, A. and Schanz, J. 2014. QE and the Bank Lending Channel in the United Kingdom. Working Paper No. 511. Bank of England.

Carbo-Valverde, S., Rodriguez-Fernandez, F. and Udell, G.F. 2012. Trade Credit, the Financial Crisis, and Firm Access to Finance. [Online]. [Accessed 15 July 2014]. Available from: https://www.centralbank.ie/

Calzolari, G. 2015. Small and Medium-Sized Enterprises Financing: A Review of Literature. *International Journal of Business and Management*. **8**(14), pp.36-54.

Cavalcanti, M. 2010. Credit Market Imperfections and the Power of the Financial Accelerator: A Theoretical and Empirical Investigation. *Journal of Macroeconomics*. **32**(1), pp.118-144.

Cavusoglu, T. (2002) Credit Transmission Mechanism in Turkey: An Empirical Investigation. ERC Working Papers in Economic 02/03. Ankara: Middle East Technical University.

Christiano, L., R. Motto and M. Rostagno (2007) Shocks, Structures or Monetary Policies. The Euro Area and US After 2001. NBER Working Paper No. 13521.

Churm, R., Joyce, M., Kapetanios, G. and Theodoridis, K. 2015. Unconventional Monetary Policies and the Macroeconomy: the Impact of the United Kingdom's QE2 and Funding for Lending Scheme. Staff Working Paper

No.542. Bank of England. [Online]. [Accessed 15 March 2016]. Available from: http://www.bankofengland.co.uk/

Costa, S. 2000. Monetary Conditions Index. Banco de Portugal: Economic Bulletin, September 2000. [Online]. [Accessed 8 April 2011]. Available from: https://www.bportugal.pt/

Cole, R. (2010) Bank Credit, Trade Credit or No Credit: Evidence from the Survey of Small Business Finance. *Working Paper Series*.

Cotei, C. and J. Farhat (2009) The Trade-off Theory and the Pecking Order Theory: Are They Mutually Exclusive? *North American Journal of Finance and Banking Research*. **3**(3), pp.1-16.

Cowling, M. 2010. The Role of Loan Guarantee Schemes in Alleviating Credit Rationing in the UK. *Journal of Financial Stability*. **6**(1), pp.36-44.

Crawley-Moore, L. 2011. Mark Hoban MP Highlights Importance of SMEs for UK Economy at 2011 AIM Conference. London Stock Exchange Group Press Release: 24th March 2011. [Online]. [Accessed 8 April 2011]. Available from: http://www.londonstockexchangegroup.com/

Crotty, J.R. 1993. Neoclassical and Keynesian Approaches to the Theory of Investment. [Online]. [Accessed 14 April 2017]. Available from: http://people.umass.edu/crotty/JPKE1993.pdf

Crotty, J.R. 1996. Is New Keynesian Investment Theory Really "Keynesian"? Reflections on Fazzari and Variato. *Journal of Post Keynesian Economics*. **18**(3), pp.333-357.

Danielson, M. and Scott, J.A. 2004. Bank Loan Availability and Trade Credit Demand. The Financial Review. 39, pp.579-600.

Dang, V.A. 2005. Testing the Trade-Off and Pecking Order Theories: Some UK Evidence. Money Macro and Finance (MMF) *Research Group Conference 2005*. Money Macro and Finance Research Group.

De la Torre, A., Peria, M.S.M. and Schmukler, S.L. 2010. Bank Involvement with SMEs: Beyond Relationship Lending. *Journal of Banking & Finance*. **34**, pp.2280-2293.

Dell'Ariccia, G., Detragiache, E. and Rajan, R.. 2008. The Real Effect of Banking Crises. *Journal of Financial Intermediation*. **17**, pp.89-112.

Dennis, R. 1997. A Measure of Monetary Conditions. Reserve Bank of New Zealand. [Online]. [Accessed 8 April 2011]. Available from: http://www.rbnz.govt.nz/

Diaz, R.A. and Olivero, M.P. 2010. On the Firm-Level Implications of the Bank Lending Channel of Monetary Policy. *Journal of Economic Dynamics & Control*. **34**(10), pp.2038-2055.

Disyatat, P. 2010. The Bank Lending Channel Revisited. BIS Working Papers, No 297, Bank for International Settlements.

Duca, J.V., J. Muellbauer and A. Murphy, 2009. Housing Markets and the Financial Crisis of 2007-2009: Lessons for the Future. *Journal of Financial Stability*. **6**(4), pp.203-217.

Duchin, R., O. Ozbas and B.A. Sensoy. 2010. Costly External Finance, Corporate Investment, and the Subprime Mortgage Credit Crisis. *Journal of Financial Economics*. **97**(3), pp.418-435.

Engle, R.F. and Granger, W.J. 1987. Co-Integration and Error Correction: Representation, Estimation, and Testing. *Econometrica*. **55**(2), pp.251-276.

Ekpu, V.U. 2016. Determinants of Bank Involvement with SMEs: A Survey of Demand-Side and Supply-Side Factors. SpringerBriefs in Finance.

Elwood, S.K. 2010. Advancing the Credit Channel and Credit Rationing in the Undergraduate Curriculum: A Useful Model. *Journal of Economics and Finance Education*. **9**(1), pp.11-19.

Ericsson, N., Jansen, E., Neva, A. and Nymoen, R. 2000. Interpreting a Monetary Condition Index in Economic Policy. [Online]. [Accessed 8 April 2011]. Available from: http://www.norges-bank.no/

European Commission, 2011. SMEs' Access to Finance: Survey 2011. European Commission Enterprise and Industry.

European Commission, 2015. Small and Medium-Sized Enterprises' Access to Finance. European Commission, European Semester Thematic Fiche. [Online]. [Accessed 20 March 2017]. Available from: http://ec.europa.eu/

Ellingsen, T. and J. Vlachos. 2009. Trade Finance in a Liquidity Crisis. *Policy Research Working Paper No. 5136*, The World Bank.

Fabbrini, D. and Menichini, A.M.C. 2010. Trade Credit, Collateral Liquidation, and Borrowing Constraints. *Journal of Financial Economics*. **96**(3), pp.413-432.

Farinha, L. and Felix, S. 2014. Credit Rationing for Portuguese SMEs. Financial Stability Papers, Banco De Portugal.

Fioretti, G. 2005. Credit Rationing and Internal Ratings in the Face of Innovation and Uncertainty. University of Siena. [Online]. [Accessed 14 April 2017]. Available from: https://ideas.repec.org/

Fountas, S. and Papagapitos, A. 2001. The Money Transmission Mechanism: Evidence and Implications for European Monetary Union. Economics Letters, 70: 397-404.

Ferreira, C. 2007. The Bank Lending Channel Transmission of Monetary Policy in the EMU: A Case Study of Portugal. *The European Journal of Finance*. **13**(2), pp.181-193.

Florio, A. 2006. The Asymmetric Effects of Monetary Policy in a Matching Model with a Balance Sheet Channel. *Journal of Macroeconomic*. **28**(2), pp.375-391.

Frank, M.Z. and Goyal, V.K. 2003. Testing the Pecking Order Theory of Capital Structure. *Journal of Financial Economics*. **67**(2), pp.217-248.

Fraser, S. 2010. Small Firms in the Credit Crisis: Evidence from the UK Survey of SME Finances. *Economic & Social Research Council (ESRC)*. [Online] [Accessed 08 April 2011]. Available from: http://www.esrcsocietytoday.ac.uk/,

Freixas, X. and Rochet, J-C. 2008 Macroeconomics of Banking. 2th edn, Cambridge: *MIT Press*.

Gambacorta, L. 2005. Inside the Bank Lending Channel. *European Economic Review*. **49**(7), pp.1737-1759.

Gambacorta, L. and Marques-Ibanez, D. 2011. The Bank Lending Channel: Lessons from the Crisis. BIS Working Papers No.345. [Online]. [Accessed 08 April 2013]. Available from: http://www.bis.org/

Gama, A.P., C. Mateus and Teixeira, A. 2009. Does Trade Credit Facilitate Access to Bank Finance? Empirical Evidence from Portuguese and Spanish Small Medium Size Enterprises. *Social Science Research Network*.

Gama, A.P.M and Duarte, F.D. 2015. Collateral and Relationship Lending in Loan Pricing: Evidence from UK SMEs. *WSEAS Transactions on Business and Economics*. **12**, pp.21-35.

Garcia-Appendini, E. and Montoriol-Garriga, J. 2013. Firms as Liquidity Providers: Evidence from the 2007-2008 Financial Crisis. [Online]. [Accessed 08 April 2014]. Available from: http://papers.ssrn.com/

Garcia-Teruel, P.J. and Martinez-Solano, P. 2010a. Determinants of Trade Credit: A Comparative Study of European SMEs. *International Small Business Journal*. **28**(3), pp.215-233.

Garcia-Teruel, P.J. and Martinez-Solano, P. 2010b. A Dynamic Perspective on the Determinants of Account Payable. *Review of Quantitative Finance and Accounting*. **34**(4), pp.439-457.

Gerali, A., S. Neri, L. Sessa and Signoretti, F.M. 2009. Credit and Banking in a DSGE Model. Bank of Italy, Macro-Linkages, Oil Prices and Deflation Workshop.

Gerlach, S. and Smets, F. 2000. MCIs and Monetary Policy. *European Economic Review*. **44**, pp.1677-1700.

Goodfriend, M. and B. McCallum, B. 2007. Banking and Interest Rates in Monetary Policy Analysis. *Journal of Monetary Economics*. **54**(5), pp.1480-1507.

Gottschalk, J. 2001. Monetary Conditions in the Euro Area: Useful Indicators of Aggregate Demand Conditions. Kiel Working Paper No. 1037, Kiel Institute of World Economics. [Online]. [4 April 2017]. Available from: https://www.ifw-members.ifw-kiel.de/

Grant, C. 2007. Estimating Credit Constraints Among US Households. *Oxford Economic Papers*. New Series. **59**(4), pp.583-605.

Guariglia, A. and Mateut, S. 2006 Credit Channel, Trade Credit Channel, and Inventory Investment: Evidence from a Panel of UK Firms. *Journal of Banking & Finance*. **30**(10), pp.2835-2856.

Hall, S. 2001. Credit Channel Effects in the Monetary Transmission Mechanism. *Bank of England Quarterly Bulletin*: Winter 2001, pp.442-448.

Halsey, B. 2010. The Future of Trade Credit. *Business Credit*. **112**(6), pp.30-32.

Hayashi, F. 1987. Tests for Liquidity Constraints: A Critical Survey. In Bewley, T. ed. *Advances in Econometrics*. Fifth World Congress, 2: Cambridge University Press.

Helsen, F. and Chmelar, A. 2014. Collateral and Credit Rationing: The Role of Collateral in Explaining and Remediating the Limited Flow of Credit to Households and SMEs. ECRI Policy Brief No. 7. [Online]. [Accessed 20 March 2017]. Available from: http://aei.pitt.edu/

Hodgman, D.R. 1960. Credit Risk and Credit Rationing. *Quarterly Journal of Economics*. **74**(2): pp.258-278.

Huang, Z. 2003. Evidence of a Bank Lending Channel in the UK. *Journal of Banking and Finance*. **27**(3), pp.491-510.

Huang, H., X. Shi and Zhang, S. 2010 Counter-cyclical Substitution between Trade Credit and Bank Credit. *Journal of Banking & Finance*, forthcoming.

Hubbard, R.G. 1995. Is There a Credit Channel for Monetary Policy? *Federal Reserve Bank of Saint Louis Review*. May/June 1995, pp.63-77.

Hulsewig, O., E. Mayer and Wollmershauser, T. 2006. Bank Loan Supply and Monetary Policy Transmission in Germany: An Assessment Based on

Matching Impulse Responses. *Journal of Banking & Finance*. **30**(10), pp.2893-2910.

Hyder, Z. and Khan, M. 2007. Monetary Condition Index for Pakistan. *SBP Research Bulletin*. **3**(2), pp.165-190.

Hyytinen, A. and Vaananen, L. 2006. Where Do Financial Constraints Originate from? An Empirical Analysis of Adverse Selection and Moral Hazard in Capital Markets. *Small Business Economics*. **27**(4/5), pp.323-348.

IMF. 2009. Global Financial Stability Report: Responding to the Financial Crisis and Measuring Systematic Risk. World Economic and Financial Surveys.

Janda, K. 2006. Lender and Borrower as Principal and Agent. *Institute of Economic Studies Working Paper 24/2006*, Faculty of Social Sciences Charles University in Prague.

Jarrow, R.A. 2011. Credit Market Equilibrium Theory and Evidence: Revisiting the Structural versus Reduced Form Credit Risk Model Debate. *Finance Research Letter*. **8**(1): pp.2-7.

Jimborean, R. 2009. The Role of Banks in the Monetary Policy Transmission in the New EU Member States. *Economic Systems*. **33**(4): pp.360-375.

Joyce, M. Lasaosa, A., Stevens, I. and Tong, M. 2011. The Financial Market Impact of Quantitative Easing in the United Kingdom. [Online]. [Accessed 08 April 2014]. Available from: http://www.bankofengland.co.uk/

Joyce, M. and Spaltro, M. 2014. Quantitative Easing and Bank Lending: A Panel Data Approach. Bank of England Working Paper No.504.

Joyce, M., Miles, D., Scott, A. and Vayanos, D. 2012. Quantitative Easing and Unconventional Monetary Policy – An Introduction. The Economic Journal, F271-F288.

Kashyap, A.K., J.C. Stein and Wilcox, D.W. 1993. Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance. *The American Economic Review*. **83**(1), pp.78-98.

Kashyap, A.K. and Stein, K.C. 1995. The Impact of Monetary Policy on Bank Balance Sheets. *Carnegie-Rochester Conference Series on Public Policy*. **42**(1), pp.151-195.

Kashyap, A.K. and Stein, J.C. 2000. What Do a Million Observations on Banks Say About the Transmission of Monetary Policy. *The American Economic Review*. **90**(3), pp.407-428.

Kishan, R.P. and Opiela, T.P. 2000. Bank Size, Bank Capital, and the Bank Lending Channel. *Journal of Money, Credit, and Banking*. **32**(1), pp.121-141.

King, M. 2011. Global Imbalances: The Perspective of the Bank of England. Banque de France. *Financial Stability Review*, No.15.

Kohler, M., J. Hommel and M. Grote, M. 2006. The Role of Banks in the Transmission of Monetary Policy in the Baltics. *Discussion Paper No. 06-005*, ZEW: Centre for European Economic Research.

Korab, P. and Pomenkova, J. 2017. Credit Rationing in Greece During and After the Financial Crisis. *Finance a úvěr-Czech Journal of Economics and Finance*. **67**(2), pp.119-139.

Kremp, E. and Sevestre, P. 2011. Did the Crisis Induce Credit Rationing for French SMEs. Banque de France. [Online]. [Accessed 8 April 2014]. Available from: https://www.banque-france.fr/

Liew, K.S. 2004. Which Lag Length Selection Criteria Should We Employed? Economics Bulletin. [Online]. 3(33), pp.1-9. [Accessed 10 July 2016]. Available from: http://citeseerx.ist.psu.edu/

Love, I. and Zaidi, R. 2010. Trade Credit, Bank Credit and Financial Crisis. *International Review of Finance*. **10**(1): 125-163.

Love, I., L.A. Preve and Sarria-Allende, V. 2007. Trade Credit and Bank Credit: Evidence from Recent Financial Crises. *Journal of Financial Economics*. **83**(2): 453-469.

Luci, E. 2004. Developing a Theory of Financial Intermediation in Transition. Bank of Albania Working Papers. [Online]. [Accessed 10 April 2017]. Available from: https://www.bankofalbania.org/

Maddala, G.S. 2001. Introduction to Econometrics. Wiley.

Maddala, G. and Nelson, F. 1974. Maximum Likelihood Methods for Models of Markets in Disequilibrium. *Econometrica 42*: 1003-1030.

Martin, C. 1990. Corporate Borrowing and Credit Constraints: Structural Disequilibrium Estimates for the U.K. *The Review of Economics and Statistics*. **72**(1), pp.78-86.

Mateut, S., Bougheas, S. and Mizen, P. 2006. Trade Credit, Bank Lending and Monetary Policy Transmission. European Economic Review. 50(3), pp.603-629.

Mateut, S. and Mizen, P. 2003. Trade Credit and Bank Lending: An Investigation into the Determinants of UK Manufacturing Firms Access to Trade Credit. European University Institute Working Paper, No.2003/3.

Mateut. S., Mizen, P. and Ziane, Y. 2010. Trade Credit Extension, Inventories or Credit Sales? [Accessed 10 July 2016]. Available from: http://www.le.ac.uk/

Modigliani, F. and Miller, M.H. 1958. The Cost of Capital, Corporation Finance and the Theory of Investment. The American Economic Review. **48**(3), pp.261-297.

Morais, B., Peydro, J. and Ruiz, C. 2015. The International Bank Lending Channel of Monetary Policy Rates and Quantitative Easing. World Bank Group.

OECD, 2006. Financing SMEs and Entrepreneurs. Organisation for Economic Co-Operation and Development (OECD). Policy Brief. November 2016. Available from: http://www.oecd.org/, accessed on 16th March 2011.

OECD, 2015. New Approaches to SMEs and Entrepreneurship Financing: Broadening the Range of Instruments. [Online]. [Accessed 14 April 2017]. Available from: https://www.oecd.org/

Ogawa, K. and Suzuki, K. 2000. Demand for Bank Loans and Investment Under Borrowing Constraints: A Panel Study of Japanese Firm Data. *Journal of the Japanese and International Economies*. **14**(1): 1-21.

Osborne-Kinch, J. and Holton, S. 2010. A Discussion of the Monetary Condition Index. [Online]. [Accessed 10 July 2014]. Available from: https://core.ac.uk/

Paul, S. and Wilson, N. 2007. The Determinants of Trade Credit Demand: Survey Evidence and Empirical Analysis. *Journal of Accounting – Business & Management*. **14**: 96-116.

Paul, S. and Guermat, C. 2009. Trade Credit as Short-term Finance in the UK. Centre for Global Finance, Working Paper Series, 10/9. University of the West of England.

Peek, J. and Rosengren, E.S. 2010. The Role of Banks in the Transmission of Monetary Policy, in Berger, A.N., P. Molyneux and J. Wilson (2010) The Oxford Handbook of Banking. Oxford: Oxford University Press.

Peeters, M. 1999. Measuring Monetary Conditions in Europe: Use and Limitations of the MCI. MPRA. [Online]. [Accessed 10 July 2014]. Available from: http://papers.ssrn.com/

Petersen, M. and Rajan, R. 1994. The Benefits of Lending Relationship: Evidence from Small Business Data. *The Journal of Finance*. **49**(1), pp.3-37.

Petersen, M. and Rajan, R. 1997. Trade Credit: Theories and Evidence. *The Review of Financial Studies*. **10**(3), pp.661-691.

Rajan, R. and Zingales, L. 1998. Financial Dependence and Growth. *American Economic Association*. **88**(3), pp.559-586.

Ramskogler, P. 2011. Credit Money, Collateral and the Solvency of Banks: A Post Keynesian Analysis of Credit Market Failures. *Review of Political Economy*. **23**(1), pp.69-79.

Rotheim, R.J. 2006. Credit Rationing. In Arestis, P. and Sawyer, M.C. (eds) A Handbook of Alternative Monetary Economics. *Cheltenham*: Edward Elgar.

Rotheli, T.F. 2010. Causes of the Financial Crisis: Risk Misperception, Policy Mistakes, and Banks' Bounded Rationality. *The Journal of Socio-Economics*. **39**(2), pp.119-126.

Shinkai, J-I. and Kohsaka, A. 2010. Financial Linkages and Business Cycles of Japan: An Analysis Using Financial Conditions Index. OSIPP Discussion Paper: DP-2010-E-008. [Online]. [Accessed 10 March 2014]. Available from: http://econpapers.repec.org/

Siklar, I. and Dogan, B. 2015. Monetary Condition Index with Time-Varying Weights: An Application to Turkish Data.

Shaik, S. and Miljkovic, D. 2008. Nature of Dynamic Relationship between Farm Real Estate Values and Federal Farm Program Payments. Agribusiness and Applied Economics Report No.636.

Soana, M., Verga, G. and Regalli, M. 2015. Bank Credit Lending to Small and Medium Enterprises: Was There A Credit Crunch in Italy. Proceedings. [Accessed 10 March 2016]. Available from: http://dspace-unipr.cineca.it/

Steijvers, T. and Voordekers, W. 2009. Collateral and Credit Rationing: A Review of Recent Empirical Studies as a Guide for Future Research. *Journal of Economic Surveys*. **23**(5), pp.924-946.

Stiglitz, J. and Weiss, A. 1981. Credit Rationing in Markets with Imperfect Information. *The American Economic Review*. **71**(3), pp.393-410.

The Authority of the House of Lords, 2013. Roads to Success: SME Exports. [Online]. [Accessed 10 April 2017]. Available from: https://www.publications.parliament.uk/

Toroj, A. 2008. Estimation of Weights for the Monetary Condition Index in Poland. Department of Applied Econometrics Working Papers. [Online]. [Accessed 10 March 2014]. Available from: http://kolegia.sgh.waw.pl/

Vijverberg, C. 2002. An Empirical Financial Accelerator Model: Small Firms' Investment and Credit Rationing. *Journal of Macroeconomics*. 26, pp.101-129.

Vlieghe, G.W. (2010) Imperfect Credit Markets: Implications for Monetary Policy. *Bank of England Working Paper No. 385*.

Voordeckers and Steijvers (2008) Credit Rationing for SMEs in the Corporate Bank Loan Market of a Bank-Based Economy. [Accessed 10 March 2014]. Available from: http://www.efmaefm.org/

Wehinger, G. 2014. SMEs and the Credit Crunch: Current Financing Difficulties, Policy Measures and a Review of Literature. OECD Journal: Financial Market Trends Volume 2013/2.

Wofson, M.H. 1996. A Post Keynesian Theory of Credit Rationing. *Journal of Post Keynesian Economics*. **18**(3), pp.443-470.