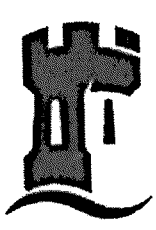

The University of Nottingham

EXTERNAL FINANCE, AND THE CREDIT CHANNEL OF TRANSMISSION OF MONETARY POLICY IN THE UK MANUFACTURING INDUSTRY

by

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(BSc., MSc.)

Thesis submitted to The University of Nottingham for the degree of Doctor of Philosophy

August 2004

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Acknowledgements

First and foremost, I would like to express my profound gratitude and sincere thanks to my joint supervisors, Dr. Paul Mizen and Dr. Spiros Bougheas for their encouragement, support and guidance throughout the preparation of this thesis.

I want to thank several academics who have provided insightful advice in their area of expertise. Prof. Dr. Alan Duncan provided valuable advices on the data and selectivity problem in the data. Dr. Alessandra Guariglia offered crucial feedback on the econometric techniques used in the thesis. I also want to thank my external examiner, Dr. Philip Vermeulen, for his comments. I want to thank to Dr. Simona Mateut for her help in the stage of data collection. Thanks also to staff members and Ph.D. students, especially Dr. Miyuki Shibata, Dr. David Lawson, Mauro Pisu, Vishal Ragoobur and other people in the School of Economics for their help, support, and friendship.

I am grateful to my employer, the Central Bank of the Republic of Turkey, for both financial and non-financial support. I would also like to acknowledge the School of Economics and Experian Centre for Economic Modelling (ExCEM) for providing me with the tuition fee in my third year and for supporting me to join two conferences.

Finally, I want to thank my wife, Nigar and my son, Emre, who endured my stressful moments patiently while I was doing my degree.

Abstract

Understanding the mechanism through which monetary policy affects real economic activity is a very important issue for attaining macroeconomic stability. Financial innovations during the last two decades and imperfections in the financial markets make this mechanism more complicated. The link between policy and real activity can be better understood by taking into consideration the variety of financial assets, agency costs, micro level information involved in financial transactions and identification of supply and demand effects.

We provide a theoretical review where monetary policy affects the real activity not only through the traditional 'interest rate channel' but also by changing the financial positions of firms. In this framework, we identify the responses of firms with various characteristics to monetary policy shocks through the financial accelerator where credit market conditions amplify and propagate the impact of monetary shocks on real activity of financially weak and small firms. Agency costs and other informational problems are more influential on the availability and cost of financial sources and financial choices for these firms, which is very important for the economic performance.

We test these predictions empirically by using a panel of more than fifteen thousands UK manufacturing firm records during the period of 1990-1999. We show that the financial choices of small, young, risky and highly indebted firms are more sensitive to tight monetary conditions than those of large, old, secure and low indebted firms. The evidence is consistent with the credit channel where monetary policy has distributional implications for the bank dependent firms that face difficulties in getting external finance during tight periods.

We also test the impact of policy on firms' inventory investment and employment growth by taking into account base rate to capture the user cost of capital, the ratio of the short term debt to current liabilities, and cash flow in addition to other control variables across firm characteristics by using dynamic panel estimation procedures. This framework enables us to avoid some empirical issues, e.g. identification concerning cash flow, *ad hoc* sample splitting criteria (classifying firms as financially constrained or unconstrained) and endogeneity problem between firm specific variables and inventory investment and employment. Financial variables consistently explain both inventory investment and employment growth across firm groups but the former is more sensitive to the financial variables and the monetary policy stance. Our results imply that the financial structure of firms makes a difference for their real activity, therefore verifying the credit channel for the UK economy.

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CHAPTER ONE

Introduction and Motivation

1.1. Theoretical Framework of the Thesis

Monetary policy, as an instrument for managing aggregate demand and for stabilising prices has become more prevalent relative to fiscal policy during the last decade. The central banks of many countries have increasingly focused on achieving price stability. The instability of money demand in the mid-1980s that took place parallel to innovations in financial markets and liberalization of balance of payments regimes reduced the reliability of money-based intermediate target rules in most countries. Many central banks, for example, adopted various forms of monetary policy rules that consider the bank rates instead of monetary aggregates as instruments or intermediary targets for attaining their inflation targets. In this context, understanding the mechanisms through which monetary policy affects real activity and inflationary pressures in the economy, namely the *monetary transmission mechanism,* becomes a crucial issue for the policy makers.

The traditional money view of transmission mechanism that works through the user cost of capital is no longer capable of explaining the complicated nature of monetary transmission. This view is formulated in a framework of static *IS-LM* models where money and bonds are the only and imperfectly substitutable financial assets, but it falls short in being able to capture market imperfections and financial innovations in the financial markets that are central to the modern view of monetary mechanism. Information related to credit aggregates, financial markets and the financial positions of firms, households and banks, has become the focus of the research in this area. In this context, the developments on the policy side have been accompanied by a number of theoretical and empirical studies that allow for imperfections in financial markets in the

form of adverse selection, moral hazard and agency costs problems. The theoretical approach allows for heterogeneous agents, informational imperfections in the financial markets, and various means of finance. This approach complements the traditional money view and is generally called the credit channel of monetary transmission, and is often divided into two sub channels. The *narrow credit channel* (also called *the bank lending channel*) deals with the impact of monetary policy on the bank loan supply, while the *broad credit channel* focuses on the reactions of non-financial firms and households to the monetary policy shocks acknowledging that informational problems persist among lenders and borrowers in the financial markets. A general framework for these channels is provided in the following paragraphs.

Traditional economic theory states that retained earnings, debt, bonds, and equity as sources of finance are equivalent means of financing investment projects. This proposition is a direct implication of the perfect information assumption of neo-classical economics where economic agents have perfect information on the activities of their counterparts in all economic and financial transactions. The transactions between borrowers and lenders take place in the market, do not incur a cost, and are risk-free. In addition, money is assumed to be neutral: a change in the money supply affects only a proportional change in the price level. Under these circumstances, although monetary policy may affect firms' choice of finance, it does not have any impact on real variables in the economy (Modigliani and Miller, 1958).

This theory is an oversimplification of the real world. Financial transactions may take place through intermediary institutions (banks and other financial intermediaries) in order to minimise transaction costs in the financial markets. The existence of such institutions can be considered as a diversion from the theory outlined above. Therefore, modern economic theories introduce imperfections in financial transactions in the form of transaction costs, asymmetric information and agency costs. The new framework justifies the role of intermediary institutions. These institutions ameliorate market imperfections witnessed by lenders and borrowers and thus improve market efficiency. Contrary to traditional economic theory, policy shocks may transmit to real activity by changing the financial positions of intermediaries (banks and other financial institution) through credit availability and capital structure. However, the existence of intermediary institutions may

not prevent market failures when imperfections are severe (Stiglitz and Weiss, 1981; Myers and Majluf, 1984).

This framework suggests that a contractionary monetary policy will reduce the supply of bank credits (through reducing reserves and thus increasing the cost of funds) if insured deposits and large certificates of deposits on the liabilities side of the banks balance sheet, and loans and securities on the assets side, are not perfect substitutes. In this framework, the extent of the reduction in the loan supply as a result of a contractionary monetary policy depends on the degree of informational asymmetry that exists among banks and depositors, which, in turn, affects the cost of raising new uninsured deposits. The reduction in the loan supply will directly reduce the real activities of those firms that predominantly depend on bank loans. This effect is known as the *bank lending channel.*

Fluctuations in the activity of firms become more significant with a rise in the degree of informational problems (moral hazard, adverse selection, and other incentive problems). These imperfections affect the overall efficiency of economic transactions by altering the choice of finance, investment, and employment decisions. In general, lenders are reluctant to extend funds to financially weak borrowers at the same rates that they offer to financially strong borrowers. Firms with less collateral and a bad reputation (poor track records) would find it more difficult to borrow from banks or from other financial sources at the safe rates as their probability of default would be very high. Therefore, the managers of these firms may adopt risky projects that have high rates of return to compensate for high borrowing costs and to maximize their private benefit. This leads to a wedge between the cost of externally borrowed funds and of risk free borrowing, which is called the *external finance premium.* The premium on external funds greatly influences the financial positions of lenders and borrowers as well as their relation and activities. This framework is studied by the *financial accelerator* literature in which small shocks may lead to large cycles by a pro-cyclical variation of sales, fixed investment, inventory, and the short-term debt of financially weak firms, which have lower net worth and thus have limited access to funds (Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997; Bernanke, Gertler and Gilchrist, 1996 and 1998).

This line of research suggests that a contractionary monetary shock weakens the financial position of firms and it may undermine the ability of the borrowers to finance their investment through external funds as well as that of lenders to extend loanable funds. It argues that poorly collateralised firms, whose balance sheets are weak in terms of net worth, have to pay a high price for external funds relative to large well-collateralized firms. In other words, an initial decline in economic activity as a result of a tight monetary policy has a larger impact on the borrowing and spending decisions of these agents facing credit market frictions, who are most likely to be small and medium sized firms. These series of causes and effects is known as the *broad credit channel.*

The early 1990s recession in the US, which ended up with a 'credit crunch' and a sharper economic slowdown than expected, has motivated research on the credit channel of monetary policy transmission. Economists have paid more attention to the link between monetary policy and economic recessions and they have tried to separate the supply-side from demand-side effects. On the theoretical side, informational and agency problems have been modelled based on the financial accelerator and micro based moral hazard and adverse selection theories. These models allow for a *heterogeneous agent approach* where the reactions of firms or banks to external shocks are not identical. On the empirical side, this new theoretical approach has been applied by using large firm-level panels in order to identify the channels of monetary transmission mechanism.

1.2. The Motivation

Recent financial crises confirm the importance of the financial accelerator mechanism under conditions of severe informational asymmetries, and high agency costs. The transmission mechanism as well as information about basic tendencies in the financial markets is crucial for macroeconomic policy making and thus economic performance. The characteristics of firms and the structure of financial markets are the key issues that should be discussed in detail in order to understand the nature of monetary transmission.

Obviously, aggregation and simplification are the ways that help us to build models in order to understand the facts and derive theoretical predictions. However, overgeneralizations may lead to a loss of a substantial amount of micro-level information that might be crucial for policy makers. Empirical studies on the credit channel of the

transmission mechanism tend to make use of firm level panel data as they become available over time. Panel data analysis naturally includes more information about the credit channel than time series analysis because individual heterogeneity and asymmetric information problems are well described by panel data. This framework allows us to identify the impact of monetary policy shocks not only on aggregate demand but also on its composition and wealth distribution. A tight monetary policy would be very harmful for the economy if policy makers did not have information, for example, about the fact that small firms are dominant and depend on external finance.

In this thesis we try to discover the nature of link between monetary policy and the financial and economic activities of UK manufacturing firms within the framework of the credit channel by using a large data set (a panel of over fifteen thousand firms for the period of 1990-1999). We classify firms according to criteria that are closely related to the informational problems they encounter. We use widely employed criteria in the literature to group firms according to their size, rating, age, gearing, and dividend. This methodology allows us to measure the financial and economic responses of particular groups of firms to a change in monetary policy, which is consistent with the heterogeneous firm approach. In addition, we split the sample, if applicable, into two periods based on the average value of the base rate. This enables us to identify the behaviour of firm groups in a tight versus a benign monetary policy period. In fact, monetary policy may not be fully exogenous to financial and real activity in the economy; it affects firms' activity levels as they interact with the financial conditions of the firms. We have introduced firm specific financial variables alongside the measure of the monetary policy stance to control this.

Alongside the theoretical discussions and data analysis, the empirical study carried out in this thesis produces a substantial amount of feedback about the nature of monetary transmission in the UK. The empirical framework helps us to answer the following questions: (i) What are the implications of a change in the composition of external funds for real activity? (ii) Why do some firms have difficulties in obtaining external funds? (iii) How are small and financially weak firms affected by a monetary contraction? (iv) Does monetary policy play a role in the redistribution of the wealth through financial markets?

1.3. The Organisation and Structure

The thesis implicitly is made up of two parts. In the first part, we predominately study a theoretical framework of the credit channels of monetary transmission. Our aim in this part is to derive theoretical implications on the role of monetary policy for firms' real activity with a special emphasis on external finance. We extend an existing theoretical model by deriving the impact of monetary policy on firms' choice of finance based on comparative static analysis that considers firms' financial characteristics. The second part implements the model through empirical research. Following Kashyap, Stein, and Wilcox (1993) who use the ratio of short-term bank loans to short term bank loan plus commercial papers issued, 'the mix', as a proxy for the choice of firm finance at the aggregate level, we test econometrically the determinants of the choice of firm finance across firm groups and monetary policy regime periods and find evidence for both the bank lending and the broad credit channels. In addition, we use the mix to explain inventory investment and employment in order to test how important the choice of firm finance is for firms' real activity. We now outline the basic features of the chapters briefly.

In the second chapter, we provide a broad picture of recent theoretical and empirical literature of the credit channel of monetary transmission to clarify the issues and concepts that are crucial for the analyses carried out in the following chapters. Therefore, the literature review in that chapter complements the analyses in the following chapters. The chapter overviews seminal papers on the bank lending channel, the broad credit channel, and the choice of finance. We focus on recent theoretical frameworks that incorporate moral hazard, adverse selection and agency costs problems into the relationship between lenders and borrowers. We also review empirical evidence on the credit channel of monetary transmission, putting special emphasis on the UK evidence. The literature that we reviewed implies that the monetary policy transmission mechanism is a complicated issue and therefore it needs more detailed micro level analyses.

In the third chapter, we derive theoretical predictions on the impact of monetary policy on the choice of finance across heterogeneous firms. We extend the model originally constructed by Hoshi, Kashyap and Scharfstein (1993). This paper studies a moral hazard model in order to examine the choice between bank and market finance. We

incorporate monetary policy into the model and derive some comparative statics allowing us to analyse the factors that determine the choice of external finance. This analysis enables us to derive some predictions on the role of firm size, net worth, distribution of risk, project size, and project payoff on the choice of finance as monetary policy changes. The main messages from this chapter are: (i) a tight monetary policy increases the demand for intermediary finance more for those firms whose net-worth ratios are more sensitive to changes in the interest rate, (ii) firms with high net worth and low risk are more likely to get low cost market funds.

In Chapter Four, we provide a brief discussion on macroeconomic performance and developments in the manufacturing industry in the UK economy during the 1990s. In addition, we give detailed information on the FAME data set that includes balance sheets, profit loss accounts and financial ratios of over fifteen thousand firms. We discuss the methodology by which we create our sample from the data set, and carry out a descriptive analysis on the key variables that are used in the econometric analysis. We witness quite a number of missing observations in the sample especially for small and young firms. Although the nature of missing observations is consistent with the data collecting procedure and reporting rules we make sure that our sample does not include systematic errors and missing observations. Therefore, we compare the figures of some key variables of some quoted firms in our sample with alternative data sets, namely *Datastream* and *One Source*. We confirm that there are minor variations in some figures across data sets because of differences in the definition of variables but we conclude that our sample offers rich and consistent information about firms for our empirical analysis.

Chapter Five is devoted to the econometric analysis. We choose the explanatory variables for the choice of finance regressions to control for cyclical demand effects, and for the financial factors mainly derived from the theoretical model provided in Chapter Three. These are the base rate, interaction terms, the rating score, the real tangible assets, age, the gearing ratio, the ratio of tangible assets to total assets, the GDP growth rate, and year dummies. We employ various panel data techniques including fixed effects, and instrumental variable two-stage least squares (*IV-2SLS*) based on the fixed effects to estimate our model. We could capture firm heterogeneity either by splitting the sample into sub-samples representing firm types and carry out regressions for each sub-sample or by using associated interaction terms directly in the regression without splitting the data.

The former method allows us to observe the impact of monetary policy for particular firm type without imposing restrictions on the coefficients of the explanatory variables while the latter offers a large and unique sample for all firm groups but it requires some restrictive assumptions on the explanatory variables where the explanatory variables other than interaction terms are assumed to be identical across firm types. The advantages of the latter method are a large number of observations and a more parsimonious model. By this framework, we can capture the impact of monetary policy conditional on the particular regime and firm characteristic.

We use three different measures of the liabilities composition of firms (or the choice of finance). The first one is the ratio of short-term debt to current liabilities *(MIX1)* by which we tend to find evidence for the bank lending channel in the line of Kashyap *et al (*1993) as well as for the broad credit channel as Oliner and Rudebush (1996) suggest. We explain two additional variables, namely the ratio of total debt to total liabilities *(MIX2)* that may exhibit a similar pattern with *MIX1* and the ratio of short-term debt to total debt *(MIX3)* to test the impact of monetary policy on firms' debt structure. Contrary to *MIX1* and *MIX2,* testing the impact of monetary policy on *MIX3* may not provide direct evidence for the bank lending channel but it gives an idea as to how debt structure reacts to the policy change; the shift in the composition of short term versus long term debt. The findings are generally supportive for the credit channel in the UK. They show that a tight monetary policy has been more restrictive for financially constrained firms in accessing debt finance (basically short term bank loans).

In Chapter Six, following Kashyap *et al.* (1993), we use *MIX1* and cash flow as financial variables in addition to other variables to explain inventory and employment growths using a framework of the financial constraint literature developed by Fazzari, Hubbard and Petersen (1988) and Kaplan and Zingales (1997). We suppose that inventory investment is highly responsive to the financial positions of firms and monetary policy shocks because they involve a lower adjustment cost compared to employment. We use the lags of dependent variables and of other explanatory variables in our regressions to capture the dynamics. The *Arellano-Bond GMM procedure* provides consistent and efficient estimates for this type of model. The estimation results confirm the broad credit channel where inventory investment and employment across firm groups react heterogeneously to changes in cash flows and monetary policy stance. *MIX1* also appears

to be an important explanatory variable in the sense that it has generally a significant and positive coefficient. This result confirms the fact that choices of firm finance matter for the firms' real activity. In addition, inventory growth is more sensitive to financial variables and the monetary policy stance than employment growth.

As we discuss in Chapter Three, our sample includes some missing observations. If missing observations were not randomly distributed, our estimations could potentially lead to selectivity bias. In Chapter Seven, we discuss the theory of selectivity bias and we carry out some tests to determine whether the selectivity bias related to our sample can be ignored or not. We estimate the models in Chapters Five and Six with variable addition techniques proposed by the sample selection literature. We have mixed evidence. Some of the results do not reject the hypothesis that sample selection problems can not be ignored while some of them reject the same hypothesis. However, the main implications of the empirical results do not generally change across estimation techniques. That is, the results are robust even though the coefficients change significantly. Put another way, the signs of coefficients barely change across estimation techniques and samples.

Finally in Chapter Eight, we overview the basic findings and provide a discussion on the contributions and limitations of the thesis to the literature. We also suggest further research topics in this area.

CHAPTER TWO

The Credit Channel of Monetary Transmission: A Literature Review

2.1. Introduction

During the second half of the twentieth century the main schools of economic thought have extensively debated the role of money in the real economy. The classical quantity theory of money implies that a change in exogenously controlled money supply does not impact on the real variables such as real interest rates, relative prices, real wages, consumption, investment and income but that it does result in a proportional change in the aggregate price level. This proposition, also known as the 'neutrality of money', has been a source of extensive debate in the macroeconomic literature. Contrary to the classical model in which money serves as a 'veil' over real activity, monetarist and Keynesian models attributed an important role to money in terms of its interaction with aggregate demand.

According to monetarists, a change in the money supply has a short-run impact on real economic activity because of mistaken expectations and nominal rigidities but in the long run this impact disappears as agents perfectly foresee the change in money supply. In contrast, under the traditional Keynesian model, for example, according to the theory of liquidity preference, the real interest rate in the money market is determined exogenously by the monetary authority through changes in reserves.[1] Therefore, monetary policy in the short run has the ability of changing real interest rates, and thus investment, consumption, wealth, income, and relative prices.

There is an ongoing debate on the link between monetary policy and economic activity, which is known as the monetary transmission mechanism. Early Keynesian

[1] Central banks of many countries tend to change reserves through open market operations rather than through the required reserve ratio.

researchers have used structural *IS-LM* models where monetary policy generally affects economic activity (mainly investment and consumption) through an *interest rate channel* which is known also as the *money view*. Monetarists, however, have tended to understand this mechanism by employing reduced-form evidence that implies a variety of monetary transmission channels. Nevertheless, both Keynesian and monetarist views imply that money has some real effects in the short term even thought their answers to the question of how monetary shocks affect the economy are different. In contrast, real business cycle theory does not accept the view that money is important for understanding business cycle fluctuations. According to this theory, real economic equilibrium is affected by real shocks in the form of productivity shocks, not by nominal shocks as shifts in monetary policy (Prescott, 1986).

The empirical evidence suggests that the effects of monetary policy on real activity are systematic, significant, and sizeable even though there is still a substantial amount of debate on this issue. There is still, for example, a gap between the perspectives of academic researchers and policy makers about the mechanisms of monetary transmission. Theoretical models derive systematic and simplified links between monetary policy and real activity but policy makers still need to know more about the prices and the quantities conceptualised in these models because they are rarely identifiable or observable in real life. For example, theoretical models suggest that changes in real interest rates affect real variables but policy makers cannot observe real interest rates and therefore their subjective expectations influence the process of policy making. The aggregation is another issue that creates some drawbacks for policy makers when they attempt to foresee the impact of policies efficiently.

Research in this area still needs to discover more coherent answers to the following questions: How does monetary policy transmit into real activity? Does it alter the composition of economic activity in addition to its effect at the aggregate level? Does the choice of finance matter for the impact of monetary policy on real activity, and if it does, is it possible to identify supply and demand shocks separately? Can central banks really control broad money after a financial innovation that leads to the appearance of a number of new money substitutes? It is also a crucial issue to identify whether central banks

perform monetary policy independently or if they only react to what is happening in the economy.

In this chapter, we discuss the basic channels through which monetary policy transmits. We are going to concentrate more on the theoretical and empirical literature on the credit channels of monetary transmission where the financial and real activities are predominantly considered in a disaggregated framework rather than an aggregated one. We aim at giving a broad picture of this literature to make sure that the reader can follow the further discussions made in the following chapters. In these chapters we predominantly adopt micro analyses based on models with heterogeneous firms and on the empirical side we employ panel data techniques.

In section two, we briefly discuss basic concepts and channels associated with the monetary transmission. Section three is devoted to the discussion of the basic theoretical framework for the credit channel. That is, we focus on the bank lending channel and the broad credit channel with a special emphasis on the financial accelerator theory. Moreover, in this section we review some studies on the choice of firm finance. This literature introduces informational problems into the relationship between lenders and borrowers or between managers or shareholders, and has a very close connection with the credit channel. We provide a review of some empirical studies related to the credit channel in section four. The last section is devoted to some concluding remarks.

2.2. A Brief Introduction to Monetary Policy Channels

2.2.1. Traditional Money View

Conventional views often oversimplify the interaction between money and real activity. As explained above, this created a gap between policy and theory. However, some recent studies, both theoretical and empirical, seem to narrow this gap. In this section, we will briefly discuss the traditional channel of monetary transmission as stated in the textbooks, and provide recent evidence on the drawbacks of this channel to provide a picture of the modern monetary transmission. This discussion will lead us to focus on alternative channels of monetary transmission especially the credit channel.

The traditional monetary transmission mechanism, the interest rate channel, which was extensively studied within the standard *IS-LM* model, can be defined in the following way: an expansionary monetary policy leads to an increase in the money supply and a fall in the real interest rate, which in turn lowers the cost of investment funds, thereby increasing investment spending, and output. According to this view, the monetary authority can control money supply and prices are assumed to be sticky in the short run. Therefore a decline in real money balances leads to an increase in short term real interest rates in the money market. In addition, asset holders are assumed to choose between only two alternative instruments namely money and bonds. Bank loans, equity and other forms of credit are viewed as perfect substitutes for the bonds (auction market credit).

This view is consistent with the Modigliani-Miller irrelevance theorem where the performance of firms is independent of the firms' financial structure and financial markets operate without frictions. That is, retained earnings, debts, and equity are equivalent and perfect substitutes on the liability side of non-financial firms as implicitly assumed also by Arrow-Debreu type models. Firms can costlessly substitute between bank and non-bank finance and thus investment or other real activities should be independent of the sources of finance (Modiglian and Miller, 1958).

The earlier literature beginning with Keynes emphasises that the interest rate channel is operating through firm' decisions about investment while recent research recognised that this channel is effective also through consumers' decisions about housing and consumer durable expenditure. Monetary authorities use interest rates in the money market to change expectations about the future course of real activity in the economy. Expectations about inflation, profitability, unemployment, sales, and wages reflect the confidence of agents about their consumption and investment decisions. Monetary authorities try to affect expectations and confidence levels in order to attain their short term and long term targets. The reaction of agents to an increase in interest rates in terms of expectations formation may differ from time to time depending on targets, the stage of business cycles, and the credibility of the central bank.[2]

[2] We will discuss the issues related with measuring monetary policy stance in section four where we review empirical studies.

Obviously, this view fails to explain some important aspects. We will summarise some of them. Firstly, this channel explains the mechanisms through which monetary policy affects aggregate demand, investment, future and current consumption, economic competitiveness and even labour supply but it does not have much to say about the impact of policy on wealth distribution. It is assumed that every household, firm, or bank has the same financial position and therefore they react uniformly to a change in the real interest rate. In reality, however, financially weak agents are more sensitive in terms of adjusting their activities to a rise in the real interest rate.

Secondly, it underestimates the magnitude of policy effects on the real economy without considering an external finance premium that results form market imperfections and leads to additional increases in the cost of capital. This fact becomes more obvious as economic recessions result in deeper contractions than economists anticipate. That is, the business cycle is more volatile under market imperfections.

Thirdly, monetary policy affects real activity in the short-run only through short-term interest rates because of slow adjustments in prices. Therefore this view has some weaknesses in explaining the impact of policy on long lived assets such as housing or production equipment, which should be primarily sensitive to real long-term interest rates. The responses of residential and business fixed investments to monetary shocks are realised at a different time with substantial lags. Although monetary policy has limited control over the real long-term interest rates the residential investments are very sensitive to changes in monetary policy because of a change in the premium on external finance (Bernanke and Gertler, 1995).

Fourthly, it is difficult to explain the late response of the investments (generally between 6-24 months in the US) to monetary shocks. In fact, inventories or other forms of investment may continue to decline due to the external finance premium as the recession sets in even if interest rates decline. Therefore, the traditional view is not able to explain the duration of the recessions.

2.2.2. More on the Monetary Transmission

The monetary transmission is a complex topic because there are many channels through which monetary policy operates. New Keynesians and monetarists developed some macro and micro basis models and incorporated market imperfections and price rigidities into the existing framework in the 1990s.[3] In addition to money and bonds, this literature focuses on various forms of financial assets that are subject to various degrees of informational problems.[4] This literature tries to answer the question of how monetary policy has real effects rather than the question of whether monetary policy has real effects. This new line of research is an enhancement, and complements the money view; it is not necessarily an independent view of the monetary transmission mechanism. Three main channels with a number of sub-channels of monetary transmission have been mainly discussed in the recent literature alongside the traditional view as shown in Figure 2.1; namely the exchange rate channel, other assets price channel and the credit channel (See also Mishkin, 1995; Bank of England, 1999).

First, as countries tend to become more open in terms of commodity trade and financial transactions, more attention has been paid to the exchange rate channel. This channel is very much connected with the other transmission channels. A rise in the interest rates results in an increase in demand for domestic currency. This leads to an appreciation of domestic currency, in turn domestic commodities in terms of foreign currency become expensive and thus the export of goods and services as a component of total income decline. In short, a contractionary policy reduces real activity through changing international trade composition (Obsfelt and Rogoff, 1995).

Second, the traditional money view focuses only on bond prices and interest rates but monetary policy may also transmit through other assets prices such as equity prices, foreign exchange or, as in the credit channel, lending rates. Tobin's q theory explains how monetary policy can affect the economy through its impact on the valuation of stocks. An

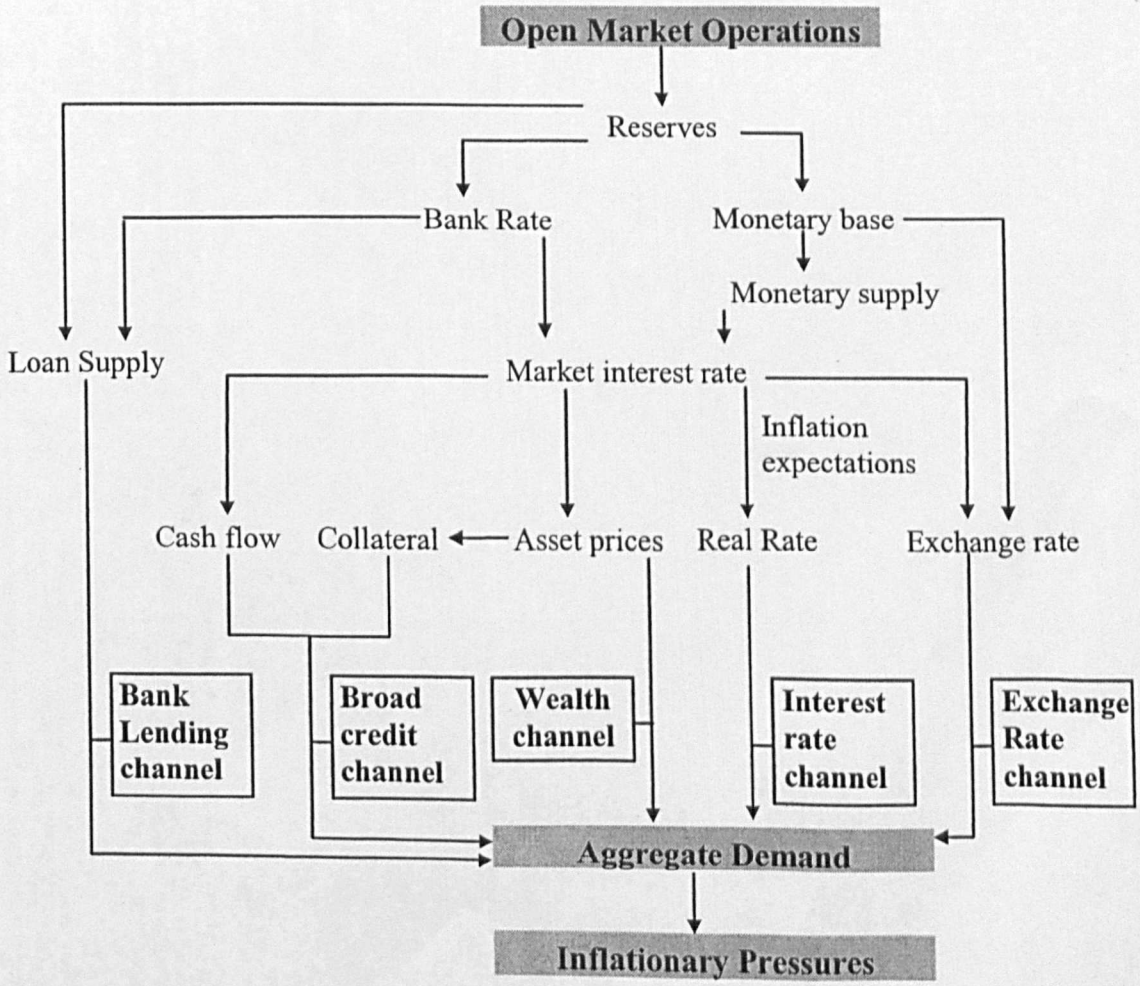
[3] According to the rational expectation approach, monetary policy can be effective only if the monetary authority misinforms the agents, thus creating price surprises that lead to a change in real behaviour (Lucas, 1972).

[4] Bernanke calls the number of imperfectly substitutable financial assets as the Brainard number of the theory in comment for Friedman and Kuttner (1993).

increase in money supply leads to an increase in the demand for stocks thus stock prices and firms' market values increase, and eventually firms invest more. On the other hand, an increase in stock prices makes households feel wealthier and consequently they tend to consume more.

Third, the credit channel becomes operative when the assumptions of perfect substitutability among different forms of finance (external and internal funds for non-financial firms, and loans and securities for banks) and of adjustable prices are relaxed. This means that credit on the asset side of banks' balance sheet may be treated as a source of shocks at least as important as money. This channel provides a theoretical and empirical framework for examining some the crucial questions that have been posed above.

Figure 2.1: Monetary Transmission Channels[5]



[5] The figure is adopted from Kuttner and Mosser (2002)

During the last decade, research on the credit channel has become increasingly very popular among theoretical and empirical researchers. Three main reasons may be seen behind this development. Firstly, an upsurge of the literature on asymmetric information led to the marriage of models of informational imperfections in corporate finance with traditional macroeconomic models. Secondly, the financial crisis in the US in the early 1990s had an unexpectedly deep impact on real activity caused by the credit crunch. This encouraged economists to concentrate more on channels of monetary transmission that take into consideration financial imperfections and banks. Lastly, although the underlying theory remained valid, developments like financial innovation and deregulation changed the role of money. A stable relationship between observed money and real activity is no longer manifested in empirical evidence (Friedman, 1995). We are going to discuss this channel in detail from both the theoretical and empirical points of view in the rest of this chapter.

2.3. The Credit Channel

Contrary to what the traditional money view implies, this channel devotes a significant role to the financial positions of firms, households, and banks because of imperfections in financial interactions.[6] Since there are a number of financial assets that are imperfect substitutes, banks, firms, and households cannot switch across financial assets without incurring a cost. Monetary policy shocks are likely to change the availability, cost and composition of financial assets. The presence of transaction costs and the asymmetric distribution of information in financial markets creates grounds for the existence of government regulations and banks (or other financial intermediaries) that alleviates the extent of informational asymmetries and transaction costs, agency costs, and in turn, improves the efficiency and productive capacity of the economy. In short, monetary policy also transmits into real activity through a mechanism that considers the financial conditions of agents.

[6] The adverse selection and moral hazard problems may appear more often in relatively less developed financial markets characterised by unexpected changes in the interest rates and prices (good, equity or stock) and uncertainty. The extent of these problems is believed to have also affected the depth of recent financial crises in developing countries.

The external funds would be more expensive than internal funds for financially fragile firms in imperfect markets. The expected return received by the lenders exceeds the cost of the corresponding fund, and mainly stems from asymmetric distribution of information among borrowers and lenders. Therefore, monetary shocks affect the financial positions of those firms who need external finance, thus reducing the ability of borrowers to finance their investment projects. An initial decline in economic activity as a result of a tight monetary policy may have a significant impact on the borrowing and spending decisions of the agents facing credit market frictions, most likely households and financially weak firms. Therefore, in this framework, monetary shocks can have an impact on the redistribution of sources from investors or consumers to lenders.

Theoretical and empirical studies on the credit view have concentrated in two main channels as mentioned in previous the chapter, namely the bank lending channel and the broad credit channel through which monetary policy shocks affect real economic activity.[7] The impact of monetary policy on the bank loan supply defines the bank lending channel while its impact on the borrowing capability of firms and households through changes in their collateral net worth or cash flow (the balance sheet channel) defines the broad credit channel. Some other channels can also be classified within the broad credit channel, namely those that consider wealth and household liquidity effects.

Conflicting evidence obtained from aggregate data has played an important role in the development of a micro basis analysis associated with the credit channel of monetary transmission. Contrary to the reduced form models that are extensions of the standard *IS/LM* model and allow for the coexistence of bonds and bank loans under the assumptions of imperfect substitutability[8], the models that have a microeconomic basis allow for firm heterogeneity. These models have been built in order to understand the interaction between the financial structure of lenders and borrowers, and real economic activity within the framework of asymmetric information and agency cost problems. The

[7] See Kashyap and Stein (1993) for a review of literature on the lending channel literature and Hubbard (1994) for a survey on the broad credit channel.

[8] See Bernanke and Blinder (1988), Romer and Romer (1990), Friedman and Kuttner (1993), Kashyap et al. (1993) for extensions of IS-LM models. Among these, Friedman and Kuttner (1993) emphasise also the price of financial instruments (interest rates) as well as their supply to derive implications for the monetary transmission mechanism.

models in this literature tend to identify supply and demand dynamics and therefore they may be classified along two main lines of research.

The first line of research can also be classified into two groups of models. The models in the first group tend to analyse the impact of policy shocks on the supply and cost of funds (the lending channel) and the financial structure of fund suppliers (mainly intermediaries).[9] The second group of models is related to the credit rationing literature. Adverse selection and moral hazard problems in financial markets may lead the financial market to fail.[10] Although banks have the ability to lend and firms have a sufficient demand for these funds, banks may ration credit to certain firms who have a high default probability. Credit rationing is a sufficient condition for the bank lending channel but it is not a necessary condition, that is, this channel may be operative even when markets do not fail.

The second line of research examines the dynamics of the demand for funds within the principal agent framework. The models in this area of research may also be classified into two categories. The first one is related to the financial accelerator theory in which policy shocks lead to cycles through the financial positions of borrowers and intermediaries.[11] This research area studies the impact of policy shocks on the cost, availability, and demand of internal and external funds of non-financial firms under informational asymmetries and incentive problems. The second group of models examines the taxonomy of firms according to their source of external finance such as bank debt, equity, and various forms of market finance. What distinguishes these sources of external finance is the ability of financial institutions to monitor the activities of their clients and thus overcome the problems due to asymmetries of information.[12] This framework allows us to analyse the implications of policy shocks for borrowers' choice of finance and real activity.

[9] Stein (1998), Fisher (1999), Jayaratne and Morgan (2000) and Kishan and Opeiela (2000).
[10] Among others see Stiglitz and Weiss (1981), Eckstein and Sinai (1986)
[11] Bernanke and Gertler (1989), Fuerst (1995), Bernanke, Gertler and Gilchrist (1996), Kiyotaki and Moore (1997), Carlstrom and Fuerst (1997), Bernanke, Gertler and Gilchrist (1998), Gertler, Gichrist and Natalucci (2001)
[12] Diamond (1991), Hoshi et al (1993), Besanko and Kanatas (1993), Holmsrom and Tirole (1997), Repullo and Suarez (2000), Bolton and Freixas (2000).

As discussed above, since the credit quantity observed in the market is jointly determined by loan supply and borrowers' demand it is difficult to distinguish whether the impact of monetary policy originates from the supply side or the demand side of the financial transactions in the credit view. The central bank can influence banks' supply of money and credit by altering reserves but the observed quantity depends on other influences such as the behaviour of banks and borrowers. In the next two sub-sections, we provide a theoretical review that considers the supply or demand dynamics, respectively.

2.3.1. The Bank Lending Channel: Supply Side

2.3.1.1. Definitions and Issues

Under the money view of the transmission mechanism, banks can only change deposits on the liability side of their balance sheets. A monetary contraction results in a reduction in reserves and thus the nominal money balances of households and retail deposits (or insured deposits). Banks maintain lending activity by issuing large certificate of deposits (or uninsured deposits) or reducing their security portfolio to offset the reduction in the insured deposits.[13] Retail deposits and the certificate of deposits issued by banks are assumed to be perfect substitutes. Since prices are not fully adjusted, households' real money balances decline as real interest rates increase, and eventually investment and other real economic activity declines. In contrast, overall bank credit supply does not change as a reaction to monetary policy shocks.

However, loans and securities as bank assets and retail and large certificate of deposits (wholesale deposits) as bank liabilities may be imperfect substitutes. In other words, banks would not react to a change in reserves or interest rates by simply altering their holdings of securities and leaving loan supply unchanged or by financing loans by issuing large certificate of deposits. Similarly, firms would not be able to offset without cost a change in the bank loan supply by issuing more equity. Therefore, a contractionary monetary policy will reduce bank loan supply that affects directly economic activity of

[13] Insured and uninsured deposits are perfect substitutes in this view. Insured bank deposits are determined through the reserve requirement ratio while banks issue uninsured certificates of deposits.

particular borrowers who cannot raise funds from alternative sources.[14] In addition, a rise in the interest rate as a result of a decline in the reserves eventually leads bank lending rates to increase faster than bond rates.

As we may implicitly observe from the previous paragraph, there are some important conceptual and identification issues associated with the bank lending channel. First, a contraction in the money supply will lead to a decline in the credit volume in the economy. Bernanke and Blinder (1988) have already modelled this fact using the *IS-LM* framework and we will discuss this benchmark model in detail later. However, the question of whether monetary policy necessarily affects bank lending as a component of total credit still needs to be answered. For example, Romer and Romer (1990) claim that the decline in bank deposits arising from open market sales can be offset by issuing large certificate of deposits therefore there is not an independent bank lending channel.

Second, the evidence shows that bank credit volume declines as a result of monetary contractions. Theoretical models need to identify the supply and demand dynamics separately in order to provide a consistent and efficient framework for policy makers. Romer and Romer (1990) argue that bank credits are determined more likely by demand factors rather than by a contractionary effect of monetary policy while Kashyap *et al.* (1993) claim the opposite. This issue can be resolved through further micro basis empirical and theoretical analyses.

Third, bank loans are crucial for a set of borrowers. Some groups of firms may not have enough internal funds and thus need to finance their projects from external sources. Since banks have monitoring technology, they provide funds efficiently to those firms experiencing difficulties with financing. For example, if firms are small or lack collateral or have short track records, they have to pay a higher cost when they issue bonds or equity. During contractionary periods, although such firms' demand for bank finance increases, banks may be reluctant to provide funds to these firms or may not have enough resources for this type of borrower. The bank lending channel operates when the following

[14] Bean, Larsen and Nikolov (2002) name the normal deposits and certificate of deposits as retail and wholesale deposits, respectively while Stein (1998) classify them as insured deposits that are subject to reserve requirements and uninsured deposits that are not subject to reserve requirements

two conditions hold. There exist some borrowers with high information costs (primarily bank-dependent) and there is a reduction in the loan supply following a tight monetary policy.

Fourth, there is also a set of borrowers who have close relations with banks, other financial institutions, or other non-financial firms. Negative shocks may not affect the financial and real activity of such borrowers significantly because they get the necessary finance at reasonable rates by exploiting this relationship. We come to this issue later in Chapter Five.

Fifth, the framework given above implies that banks are subject to informational problems as a result of issuing large certificates of deposits in order to compensate for the decline in the retail deposits. That is, banks that do not own large capital cannot costlessly issue certificate of deposits without cost. Financially strong banks may raise funds from the market to continue their lending activities but small and financially weak banks may have to reduce their lending activities as reserves shrink. Stein (1998) develops a model where depositors charge a premium on uninsured bank debt because they can not differentiate between good and bad bank (adverse selection). Due to a government guarantee, there is no premium on insured deposits. Lending of poorly capitalised banks will be more sensitive to deposit shocks because the wedge between the returns on loans and securities is larger for these banks. Jayaratne and Morgan (2000) and Kishan and Opeiela (2000) find evidence for these theoretical predictions.

2.3.1.2. Basic Theoretical Models

In this section we are going to go over two basic models developed by Bernanke and Blinder (1988) and Kashyap, Stein and Wilcox (1993). The first model derives a general framework for the credit channel while the second one emphasises the uniqueness of bank loans in the sense that having a relation with banks and getting loans from them produces a benefit for borrowers who are bank dependent. In fact, the second model is going to be a reference point of the empirical research in this thesis.

Bernanke and Blinder's Model of the Credit Channel

Bernanke and Blinder (1988) have formulated a theoretical model of the credit channel by modifying the standard *IS-LM* model by introducing bank loans as an imperfect substitute for bonds. The model can be formulated as follows:[15]

$$S(y, r_B) = D^h(y, r_B) + B^h(y, r_B) \qquad (2.1)$$

where real saving, S, is the sum of household money, D^h and bond holdings, B^h and all components depend on real income, y, and the interest rate in the bond market, r_B. Investment demand of firms, I, is financed through bonds according to the money view while it is financed by bonds, B^f and bank loans, L^f, according to the credit view.

$$I(r_L, r_B) = B^f(r_L, r_B) + L^f(r_L, r_B) \qquad (2.2)$$

where r_L is the interest rate in the credit market. Banks issue deposits, D^b, to finance three assets, namely reserves, R, bonds, B^b and loans, L^b.

$$D^b = R + L^b + B^b \qquad (2.3)$$

In this model the quantity of money is determined exogenously by the multiplier mechanism, $D^b = R/\mu$, where μ, is the required reserve ratio. Banks determine the amount of bonds and loan as assets by optimising their portfolios.

$$B^b = \varpi(r_L, r_B)R \qquad (2.4)$$

$$L^b = \mu(r_L, r_B)R = L^f(r_L, r_B) \qquad (2.5)$$

$$I(r_L, r_B) + G = S(y, r_B) \qquad (2.6)$$

where G is total government expenditures. The credit curve is obtained in the *IS-LM* framework by defining r_L in terms of r_B and R in the good market, $r_L = \phi(r_B, R)$. The

[15] The presentation of the model follows Freixas and Rochet (1999).

reserves appear in the equation of the good market, the *IS* equation. The money market is depicted by the traditional LM curve.

$$I(\phi(r_B, R),\ r_B) + G = S(y, r_B) \qquad (2.7)$$

In the model, an increase in reserves has two implications. Firstly, as in the money view, an increase in reserves leads the money supply to rise, then the *LM* curve shifts to the right, and eventually income increases and the interest rate declines. Secondly, as credit volume, investment, and income increase, the credit curve, *CC*, shifts upward (Figure 2.2).

This model implies that monetary policy can have real effects without substantially affecting interest rates. If banks have access to reserves, they can increase the credit supply to firms, which can in turn invest more without changing their demand for bonds. Contrary to the money view, special attention is given to loans on the assets side of the balance sheets of banks. Due to reserve requirements on deposits, the monetary authority directly controls the availability of bank credit and thus the borrowing and spending of bank dependent agents. In other words, a tight monetary policy reduces the real quantity of bank reserves through open market sales (assuming prices are temporally sticky), thus deposits shrink and this in turn induces banks to reduce lending. However, as we explained above, in modern economies money creation is no longer completely exogenous. Deposits supply depends not only on the fixed reserve requirement ratio but also on the interest rates, which is widely used as an instrument in controlling money supply, income, and other variables.

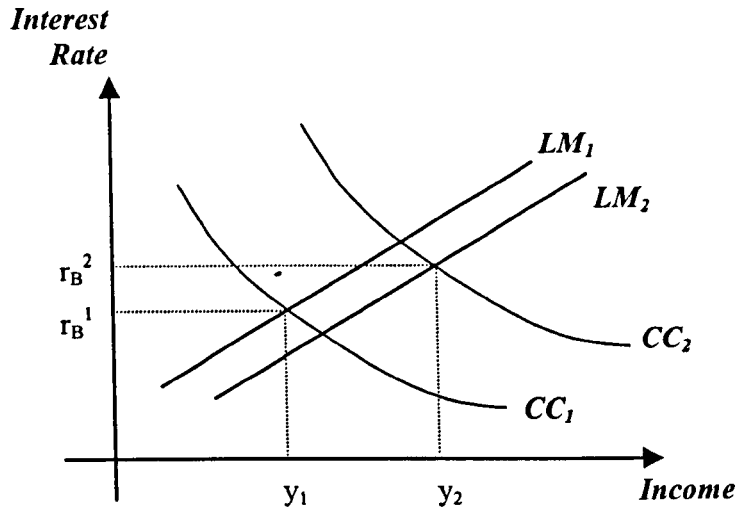


Figure 2.2: Credit Channel in IS-LM Framework

Kashyap, Stein and Wilcox's Attempt to Identify the Bank Lending Channel

Firms benefit by having a close relationship with banks because this relationship undermines the potential informational frictions and improves their reputation. Bank finance is special as it includes a monitoring process and has signalling implications for those firms that are more likely to finance their investment directly from the market. Therefore, even financially strong firms may need bank finance to a certain extent to be able to get finance from the market directly. In addition to the availability of internal finance, the composition of bank finance and market finance gives information about the extent of financial constraints that firms face and thus the severity of informational problems (see Sharpe, 1990; Rajan, 1992 and Boot, 2000).

Empirical evidence shows that supply of loans is procyclical –bank loans shrink during tight periods. It is important to identify the source of reduction of bank loans – whether it is sourced from loan supply or loan demand. A contractionary policy would reduce loan supply under two conditions: (i) securities and loans on the assets side of banks are not perfect substitutes; as reserves shrink banks cannot shift to securities without incurring a cost to maintain lending and (ii) banks cannot issue large certificate of deposits (uninsured deposits) to finance lending without paying a premium due to asymmetric information between banks and depositors. As explained above firms basically have two sources of external finance, bank loans, and market finance (bonds or

commercial paper or equity). A contractionary policy may lead to an increase in the cost of bank finance for collaterally poor firms and therefore they may reduce demand for external finance including bank loans which are vitally important for maintaining their investment. Issuing bonds or equity is potentially very expensive for collaterally poor firms, thus they would rather reduce their investment activity, while for those with ample collateral it is possible to maintain investment by issuing commercial paper, bonds or equity. At the aggregate level, one may expect that the ratio of bank loans to bonds on the liabilities side of corporate firms declines, as the monetary authority contracts reserves. That is, banks reduce their loan supply in parallel to the squeeze in the reserves thus the ratio of bank loans to market finance may decline. Kashyap, Stein and Wilcox (1993) illustrate this prediction by constructing a model that adopts the framework proposed by Bernanke and Blinder (1988).

Kashyap *et al.* (1993) tend to identify an independent lending channel by focusing on the mix and uniqueness of banks. Suppose that firms finance a fraction of their investment using bank funds, α. As we emphasised above, banks reduce inefficiencies in the financial market originating from adverse selection and moral hazard by monitoring the borrowers; therefore bank finance is unique in this sense. The investors benefit from their relationship with banks. The benefit relationship function, Φ, is shown as

$$\Phi = I^* f(\alpha) \tag{2.8}$$

where $f(.)$ is an increasing concave function and I denotes investment. The optimal fraction of bank financing, α^* is determined by the spread between loan rates, r_L and bonds rates r_B, that is,

$$\alpha^* = F(r_L - r_B) \tag{2.9}$$

where $F(.)$ is a decreasing function of the spread. Any shock, e.g. monetary shock that changes the relative costs of loans or bonds affects the firm's financing portfolio. The investor's net cost of capital, k, is formulated in the following form;

$$k = r_B + \alpha^*(r_L - r_B) - f(\alpha) \tag{2.10}$$

and investment demand depends on income, y as well as on capital cost,

$$I = I^d(Y, k) \tag{2.11}$$

where income is the sum of the investment and exogenous government expenditures. To simplify the model it is assumed that bank loans are financed completely with demand deposits. Money can then be used as the stance of monetary policy and an increase in the money supply, M, directly affects bonds rates as well as loan rates. Therefore the loan supply, L, also depends on the spread of loan and bond rates and on money supply through a reduction in the source of loans i.e. demand deposits, that is;

$$L^s = J(r_L - r_B)M \tag{2.12}$$

where $J(.)$ is an increasing function of the spread. Loan demand, $\alpha^* I$, and loan supply are in parity at the equilibrium. The following formulation enables us to observe the relationship between money supply and investment.

$$\alpha^* I = J(r_L - r_B)M \tag{2.13}$$

By taking total derivative, we can determine the conditions for the existence of the bank lending channel.

$$dL/dM = \alpha^* dI/dM + Id\alpha^*/dM \tag{2.14}$$

$$dB/dM = (1-\alpha^*)dI/dM - Id\alpha^*/dM \tag{2.15}$$

$$d\alpha^*/dM = F' d(r_L - r_B)/dM \tag{2.16}$$

$$dI = (I_y/dy)*dy + I_k dr_B + I_k \alpha^* (dr_L - dr_B) \tag{2.17}$$

The mix is going to disappear from these derivatives in the case of perfect substitution between loans and securities (bonds, commercial paper) as items of banks' assets and of non-financial firms' liabilities, therefore the change in investment is solely determined by income and bond rates. The hypothesis that loans and securities are imperfect substitutes as bank assets and firms' liabilities can be tested through adding the mix as an independent variable into the investment equation in addition to the interest

rate. Excluding the interest rate as an explanatory variable would not aid the detection of the existence of an independent lending channel of transmission. In other words, without using the interest rate as an explanatory variable together with the mix variable, it is unlikely to identify the proper impact of loans on investment.

The framework explained above provides a rather macro framework for the bank lending channel. New research focuses more on micro dynamics of banks and non-financial firms. Regulations concerning financial institutions, capital structure, and other bank specific characters have been modelled under imperfect financial markets to identify the lending channel (Fisher, 1999; Stein, 1998 and others). We will discuss this new perspective below by reviewing the empirical evidence in section 2.4.

2.3.2. The Broad Credit Channel: Demand Side

2.3.2.1. General Framework

Monetary policy affects not only market interest rates and the credit supply, but also the financial position of borrowers both directly and indirectly. The direct impact may arise in two forms. First, a rise in the interest rate as a result of an unexpected tight policy increases the interest expenses which, in turn, weaken the financial positions of firms through a reduction in cash flow and collateral net worth and thus firm activity. Second, a rise in the interest rate is also typically associated with a decline in assets prices for firms and households. The indirect impact, on the other hand, is a slowdown in economic activity resulting from a decline in consumption expenditures, which in turn reduces cash flow.

Firms tend to borrow from external sources (bank debts, issuing bonds and equities or other forms of finance) when they do not have enough internal funds to finance their investment projects. If firms (borrowers) do not have enough internal funds and collateral net worth, lenders may be reluctant to extent funds to these borrowers at a risk free interest rate because such transactions involve a risk: borrowers may fail to pay back debts. For example, this will be the case if there are informational problems between lenders and borrowers in the sense that lenders have less information about projects than

borrowers and therefore is more likely to be defrauded by borrowers.[16] Therefore, lenders either ration the supply of funds or impose higher interest rates on loans to capture the average risk of default. Informational asymmetries enlarge the wedge between actual lending rates and the market interest rate (the external finance premium).[17]

In modern economies, in addition to bank finance where borrowers pay a monitoring cost, market finance is another source of finance. Borrowers who are able to raise funds directly from the capital market at the market rate are expected to have higher net worth, therefore they are less likely to be subject to informational problems. On the other hand, borrowers relying on bank finance have relatively limited financial sources and thus have to pay additionally monitoring fees that ameliorate informational problems. There is a hierarchy among alternative sources of finance, from the cheapest to the most expensive; internal funds, market finance, bank finance. In practice, firms may finance their investment projects by a mix of bank, market, and internal finance.

The literature on this area has three basic implications: (i) imperfect information generates an extra cost for investors who borrow from the market and makes the external finance more expensive than the internal finance, (ii) the internal finance (net worth of firms) is not only relatively cheaper than the external finance but also reduces the cost of the external finance (iii) a fall in internal funds reduces the borrowers' spending, holding constant underlying investment opportunities. These results are linked to moral hazard, adverse selection, and other incentive problems.

The broad credit channel of monetary transmission focuses on the observations given in the previous paragraph. Internal cash flow and collateral net worth of firms are the main determinants of the external finance premium therefore stronger financial position undermines the impact of asymmetric information problems and reduces premiums on the external finance. However, financially constrained firms that face a high external finance premium tend to reduce investment and consumption spending to avoid

[16] Akerlof (1970), for the fist time, introduced the asymmetric information problem into the second hand car market, that is originally called the 'lemon problem'. Myers and Majluf (1984), Jaffee and Russell (1976), Stiglitz and Weiss (1981), Mankiw (1986) and others adopted this problem to the financial transactions.
[17] The market interest rate is often assumed to be risk free by theoretical models but in practice borrowing from the capital market includes a risk premium.

the high cost of external finance as a reaction to a tight monetary policy. This framework implies that the reaction of firms with a heterogeneous financial structure (constrained or unconstrained) to monetary policy shocks differ. Therefore, external shocks affect the investment demand as well as the distribution of wealth in the economy by changing the external finance premium.

A Simple Model on the Broad Credit Channel

We will present a simple model by Gertler and Hubbard (1988) to understand the basic framework in this literature. The model introduces agency problems in a basic financial framework. The model assumes two periods. In the first period, a risk-neutral borrower uses inputs to produce output, Y, in order to sell in the second period. There are two types of inputs, namely hard capital (say machinery), K, and soft capital, C, that is made up of organisational or maintenance expenditures. Soft capital is supposed to improve the productivity of hard capital. The production technology is risky and has 'good' and 'bad' outcomes. The likelihood of a good outcome increases with a sufficient amount of soft capital in the production process where sufficient is defined by an amount proportional to the quantity of hard capital.

$Y = f(K)$ with probability of a good outcome, π^g and *(2.18.1)*

$Y = \alpha f(K)$ with probability of a bad outcome, π^b if $C \geq vK$

$Y = \alpha f(K)$ if $C < vK$ *(2.18.2)*

where $f(K)$ denotes the production function, strictly increasing, and concave, twice continuously differentiable. K is the capital stock that is the investment in the two period model, $\pi^g + \pi^b = 1$, $0<a<1$ and $v>0$.

For simplicity, it is assumed that firms use an amount of soft capital of either vK or zero and it is always efficient to employ the soft capital ($(\pi^g + \pi^b \alpha) f'(K)/(1+v) > \alpha$). If markets are perfectly competitive, the Modigliani-Miller theorem holds i.e. the optimum level of capital is independent of the financial choice of firms. Investment is derived by the following profit maximisation problem, $(\pi^g + \pi^b \alpha)(K) - (1+v)rK$. Solving this for the first order condition gives the optimum level of capital.

$$(\pi^g + \pi^b \alpha) f`(K) = (1+v)r \qquad (2.19)$$

where r denotes the lending rate. Equation (2.19) tells us that the expected marginal benefit from an additional unit of K is equal to the marginal cost of investment. The traditional money view can be easily illustrated in this example. As the interest rate increases the investment demand declines.

Under asymmetric information, however, the solution is more complicated. The expenditures on hard capital are observable by lenders while only managers of firms have proper information on the soft capital. This creates an agency problem between lenders and firm managers because managers may be tempted to divert soft capital funds for personal benefits by investing at a gross return rate of r. In order to discourage such a temptation, lenders arrange the financial contract to mitigate incentives to defraud. Their optimum level of the capital in this case would be less than the desired capital derived under perfect information. The difference between desired capital and actual capital is negatively related with the net worth of the firm which is made up of liquid assets, W and the present value of collateralizable future profits, V/r. The firm is going to borrow as much as the amount of investment minus liquid assets, $(1+v)K - W$ and pay back an amount of p^g if the project has a good outcome and p^b if the project has a bad outcome. The firm is going to maximise expected profit,

$$(\pi^g + \pi^b \alpha) f(K) - (\pi^g p^g + \pi^b p^b) \qquad (2.20)$$

The lender can only raise funds if the expected return is at least equal to the opportunity cost of funds (gross interest rate times quantity borrowed),

$$(\pi^g p^g + \pi^b p^b) = r[(1+v)K - W] \qquad (2.21)$$

The design of the contract should take into account an 'incentive constraint' so that the manager's expected gain from the honest action exceeds the one from diverting the soft capital funds for personal benefit. That is,

$$(\pi^g + \pi^b \alpha) f(K) - (\pi^g p^g + \pi^b p^b) \geq (\alpha f(K) + P^b) + rvK \qquad (2.22)$$

Most of the time, contracts are designed in such a way that the firm has to pay all available assets when the outcome is bad to reduce the temptation for defrauding. A 'limited liability' constraint influences the contract:

$$P^b \geq \alpha f(K) + V \qquad (2.23)$$

Expected profit given in (2.20) is maximised subject to (2.21), (2.22) and (2.23) by selecting K, p^g and p^b. When the incentive constraint (2.22) binds, financial and investment decisions are no longer independent. We reformulate (2.22) by eliminating $p^g$and p^b using (2.21) and (2.23).

$$(\pi^g + \pi^b \alpha) f(K) - [r(1+2v)]K + r(W + V/r) = 0 \qquad (2.24)$$

As long as this equation holds, investment is an increasing function of a borrower's net worth, $W+V/r$. That is:

$$\frac{\partial K}{\partial (W + V/r)} = [(1+2v) - (\pi^g + \pi^b \alpha) f`(K)/r]^{-1} > 0 \qquad (2.25)$$

This model does not propose an alternative channel for the bank lending channel or the traditional money channel. It shows that if a firm has limited internal funds, it has to rely on external funds. A contractionary monetary policy leads to a further increase in the cost of external finance and reduces the net worth of the firm. Therefore, the firm tends to reduce spending on investment and the extent of reduction in the investment depends on the financial structure of the firms. Contrary to the money view, the broad credit channel predicts heterogeneous reactions of firms to monetary shocks.

2.3.2.2. The Financial Accelerator Theory

As we implicitly explained above agents exhibit heterogeneous reactions to external shocks over the business cycle. There are two kinds of asymmetries in the behaviours of the agents. First, the activities of financially constrained firms are more sensitive to external shocks than the activities of unconstrained firms. Take monetary policy shocks: an increase in interest rates will increase the user cost of capital for all agents in the first stage but in the second stage, for particular firms, there will be a further increase in their

cost of funds because of an increase in the external financial premium. In other words, the impact of monetary policy shock is amplified and propagated by the poor financial conditions of the firms; this mechanism is called the 'financial accelerator'. Second, firms react differently to the external shocks whether the economy is in a recessionary or in a recovery stage or whether there is a negative shock or a positive shock. This type of asymmetry in the behaviours of firms is implicitly connected to the first asymmetry. Negative shocks during recessions have a deeper impact on the activities of constrained firms. We will overview some seminal papers associated with the financial accelerator theory in the rest of this sub-section. The benchmark paper that will be reviewed are Bernanke and Gertler (1989), Bernanke, Gertler and Gilchrist (1996, 1998) and Kiyotaki and Moore (1997).

Bernanke and Gertler (1989) model the financial accelerator theory within the framework of the principal agent literature. This theory implies that small shocks may lead to large cycles by the pro-cyclical variation of sales, inventories and the short-term debt of financially constrained firms, which have limited access to credit markets. This model is one of the earliest examples that combines the micro foundations of business cycles with asymmetric information. The role of interactions between borrowers and lenders in the business cycles is analysed by introducing the 'costly state verification' approach.[18] Since only firms (borrowers) can observe the yield of their investment, lenders should pay a cost to verify the yield of investment. The verification cost leads to a wedge between internal and external funds (agency costs or external finance premium). High collateral net worth of borrowers implies low agency costs in transactions, and a lower premium on external funds supplied by lenders, and thus high investment and economic activity. The shocks that lead to fluctuations in the agency costs or the external finance premium can be seen as a source of real fluctuations. In this context, not only the productivity shocks as proposed by the real business cycle theory, but also the monetary shocks can lead to cyclical fluctuations in real variables.

The return rates on various financial assets differ based on the extent of asymmetry in the distribution of information in financial markets, which in turn induces the preference of investors towards the least costly financial sources to finance their

investment project. Since the contractual relationship between lenders and borrowers last more than one period, the borrowers' net worth should be evaluated in terms of not only their current situation but also in terms of expected future profits. Therefore, monetary policy shocks affect the duration and the depth of the business cycles that are unlikely to be predicted by the money view. The theoretical framework built by Bernanke and Gertler (1989) has actually formed the basis of the empirical studies that explain the variation in investment of firms by the heterogeneity in their balance sheets.

Fuerst (1995) constructs and quantifies a model within the spirit of Bernanke and Gertler (1989). He discusses the quantitative extent of the agency costs that propagate the initial impact of shocks in a real business cycle framework. The mechanism in this model operates in the following manner: high output implies a high entrepreneur wage and thus low agency costs (the moral hazard problem becomes less likely when the wages of entrepreneurs increase) and this then leads to a high capital accumulation and output growth in the future. Incorporating the financial aspects into the real business cycle framework does not change the implications of this approach for the propagation mechanism. Shocks lead to a change in agency costs and redistribution of wealth. Gertler (1995) made some modest modifications in the framework of Fuerst (1995) and produced some interesting results where the financial frictions have an important effect on output fluctuations as a result of technology shocks.

Similarly, Carlstrom and Fuerst (1997) construct a computable general equilibrium model in which endogenous agency costs play an important role in business fluctuations. In fact, they quantify the qualitative results of a model almost similar to the model constructed by Bernanke and Gertler (1989). An aggregate shock that transfers wealth from entrepreneurs to lenders will lower aggregate investment. Since wealth transfer increases the need for external finance and leads to greater agency costs, it propagates the impact of the shock. They conclude that output displays positive autocorrelation in the short run, that is, the investments decisions are delayed until agency costs reach the lowest level after a shock and this leads to a hump-shaped output behaviour.

[18] Townsend (1979) introduced the costly state verification in his model as a way of capturing the asymmetric distribution of information between borrowers and lenders in the economy.

Following Bernanke and Gertler (1989), the model built by Kiyotaki and Moore (1997) provide important insights about the accelerator theory even though the implications of monetary policy are not modelled explicitly. Kiyotaki and Moore (1997) attempt to understand the persistence impact of relatively small shocks on output and asset prices. It is assumed that the borrowing ability and the capital cost are limited by the discounted present values of the collateral value of the land. Therefore, all debts are secured and there is no default in the equilibrium. This framework is based on the assumption of the inalienability of human capital where the lenders would like to guarantee their loans back in the case of withdrawal of entrepreneurs from the project (farmers do not pre-commit to a project). The external finance availability is directly linked to the value of collateral assets, and current and future asset prices. Fluctuations in the prices of the durable assets affect borrowing ability and credit availability in the future. The shocks in the current period create cycles in future investment and output through a price mechanism.

The transmission mechanism in this model is defined as follows: given a fixed supply of land as collateral for debts and as a factor of production and given constrained and unconstrained firms, a temporary productivity shock reduces the net worth of constrained firms and therefore firms' borrowing ability and investment are limited by their reduced net worth in the current period. Subsequently, the output and revenue of these firms drop in the future and this impact is amplified and spills over into the whole economy. The contractionary impact of this process will continue with a decline in land prices that leads to a lower collateral value and thus further exacerbating borrowing constraints in the future. A further decline in the land price and in the user cost of assets induces unconstrained firms to increase demand for land and thus the economy enters into a phase of recovery and land prices tend to increase again. This model predicts that in an economy where credit limits are endogenously determined, even a sector specific temporary shock leads to persistent fluctuations in the aggregate output and asset prices.

The model constructed by Kiyotaki and Moore (1997) focuses on the collateral net worth of firms and asset prices through which external shocks create business cycles, that is, a shock that changes the value of colleteralizable assets, influences the cost of capital and thus investment. The model constructed by Bernanke and Gertler (1989), however,

concentrates on the agency cost (or external finance premium) arising from asymmetrical distribution of information among investors and creditors. In addition, in contrast to Bernanke and Gertler (1989), Kiyotaki and Moore (1997) assume that entrepreneurs are long-lived, thus they can examine dynamics of wealth redistribution in an environment of imperfect credit markets. Moreover, the contract structure in Bernanke and Gertler (1989) and Kiyotaki and Moore (1997) is different in the sense that the former uses the costly state verification cost that lead to agency cost where lending may exceed net worth and thus default is possible at the equilibrium, while the latter assumes that borrowing is constrained by net worth so that default cannot occur at the equilibrium.

Bernanke, Gertler and Gilchrist (1998) present a stochastic general equilibrium model that synthesises the leading dynamic New Keynesian frameworks including those of Bernanke and Gertler (1989, 1996) and Kiyotaki and Moore (1997). In this model, money and price stickiness are incorporated to capture the monetary transmission given the credit market imperfections where the link between net worth and the external finance premium is clearly established. The model also allows for a cost of adjusting the capital stock that affects the collateral net worth of firms, a monopolistically competitive retail sector and heterogeneity among firms in accessing capital markets. The model simulations also imply that the endogenous developments in the credit market in terms of prices and quantities amplify and propagate the impact of the small shocks over the business cycles.

Based on the model constructed by Bernanke, Gertler and Gilchrist (1998), Gertler, Gichrist and Natalucci (2001) extend the financial accelerator approach for a small open economy where money and nominal prices are assumed to be rigid downwards. It is claimed that the impact of the financial accelerator is much stronger under the fixed rate regime than the flexible exchange rate regime. Under fixed exchange rates the central bank adjusts interest rates to satisfy the target, and frequent changes in the interest rates, in turn, magnify the impact of the financial accelerator and thus the volatility of output will be higher under this regime. The impact of the financial accelerator will be deeper when domestic debts are in the form of foreign exchange because of the possibility of devaluation that weakens the balance sheets of firms by changing asset prices. A policy implication of this model is that a counter-cyclical monetary policy can mitigate a

financial crisis in general by adjusting interest rates given the level of aggregate demand, but the external conditions may constrain the stabilising role of monetary policy.

2.3.2.3. A Brief Survey on the Choice of Finance

The idea of imperfect financial markets is incorporated into the borrowing and lending activities of agents by introducing the concepts of moral hazard, adverse selection, and other incentive problems. Discussions on the source of finance (particularly whether it is obtained from internal or external sources) and its impact on the investment decisions of agents, have become an important research agenda in this context. Contrary to the Modigliani-Miller paradigm, intermediary lending (bank finance as well as other financial institutions' loans) and market finance (direct finance by issuing commercial papers, bonds or equity) have different characteristics including cost, attainability etc.

The literature on the choice between intermediary finance and varieties of market finance attempts to explain the mechanism behind the financial aspects of investment decisions. In this context, it is assumed that intermediary finance tends to alleviate the moral hazard problem through monitoring which is the main activity of intermediary institutions and reduces the extent of informational asymmetry. Young and small firms that are subject to severe informational problems face difficulties to finance their investment through financial markets directly. Therefore, they tend to raise funds from intermediary finance by paying a monitoring cost. In fact, these firms have difficulties in raising funds even through intermediary finance during tight periods when the latter has a limited supply. Overall economic activity and efficiency are very much related to the structure of financial markets and intermediary institutions as well as the financial positions of non-financial firms[19]. The model that we will develop in the next chapter is related to this literature.

Following Bernanke and Gertler (1990) that explicitly captures the interaction between banks' capital structure and lending constraints, Holmstrom and Tirole (1997) construct a model that examines the effects of financial intermediation in a framework

[19] Recently, in the UK even for small firms, as the informational frictions have become less relevant, the mix of market finance and intermediary lending has been altered in favour of the former.

with moral hazard where firms and intermediaries are financially constrained. All forms of shocks that reduce the value of capital in the economy in terms of credit crunches (a decrease in the capital of the banking industry), a collateral squeeze (a negative shock on firms' collateral) and saving squeeze (a decline in savings in the economy) influence negatively the lending potential of the banks and the borrowing ability of those firms that are less capitalised.

Firms that do not have enough capital need external funds for financing their investment project. This increases the likelihood of the moral hazard to the extent that a manager may choose a bad project to maximise his private interests. The moral hazard problem can be solved either by a high proportion of self-finance or by banks who monitor the activities of their clients. Well-capitalised banks and firms mitigate the negative impact of shocks, the intermediaries retain the lending process, and in turn the moral hazard problem becomes less severe. This model implies that in addition to the collateral net worth of non-financial firms, the magnitude of banking capital (the monitoring capital) is important in reducing agency costs that amplify the business cycle. The empirical studies that emphasise the importance of monitoring capital as well as financing constraints in the balance sheet of non-financial firms for monetary transmission are based on this theoretical framework.

The Holmstrom and Tirole (1997) model is closely related to the models developed by Repullo and Suarez (2000), Hoshi, Kashyap and Scharfstein (1993) who also study moral hazard framework where the role of firms' net worth in the choice of finance is discussed, and Diamond (1991) who emphasises the role of firms' reputation in the choice of finance. Contrary to others, Holmstrom and Tirole (1997) further assume that intermediaries are constrained in terms of capital[20].

Diamond (1991) constructed a theoretical model in which the interaction between a firm's reputation capital (a good track record), and intermediary and market finance is analysed based on the idea of delegating monitoring, first introduced by Diamond (1984). The model implies that firms that have high reputation capital (for example, in our model

[20] We will discuss in detail the issue of choice of finance in Chapter Three

firms that have a large size of collateral assets) tend to finance their investments through financial markets by issuing commercial paper while those firms that do not have enough reputation capital cannot even obtain intermediary finance. These firms can raise external funds only through an angel, joint venture capital or other forms of informal finance that are relatively expensive. Hoshi *et al* (1993) used this framework to analyse the role of ownership structure for raising external funds. Besanko and Kanatas (1993) allow a mixed finance through banks and market finance by constructing a model in which entrepreneurs may suffer from excessive monitoring by the banks and thus they mitigate this problem by relying on market finance.

Repullo and Suarez (2000) developed a model where the choice between market and intermediary finance is based on the net worth value of firms. The model introduces some aspects of the credit channel of monetary transmission and derives some empirical implications for it. Bolton and Freixas (2000) proposed a model in which bank debt, equity issue and bond financing coexist in an environment of imperfect financial markets. It is emphasised that the most constrained riskier firms prefer bank financing and unconstrained safer firms tend to borrow from bond markets, while the firms in between prefer to issue both bonds and equity.

2.4. Empirical Evidence

We will discuss the empirical implications of the credit channel in details in Chapters Five and Six where we test the impact of financial conditions of firms (interacted with monetary policy) on the mix, inventory investment and employment. In this chapter, we highlight some issues related to measuring the monetary policy stance and the identification of credit channels. In addition, we provide some examples of the empirical studies that complement the following chapters. We skip the empirical survey on the studies that adopt time series techniques such as VAR or Structural VAR. Instead we generally review the studies that adopt micro data analysis and panel data techniques related to the credit channel.

Early evidence suggests that it is the poor financial positions of firms that led to a severe economic crisis during the Great Depression (Fisher, 1933). When firms and banks

are highly leveraged, small shocks can lead to a deterioration of financial stance in terms of bankruptcies, which in turn generate a fall in investment, demand, and prices. This view implies that financial intermediaries play a crucial role for the efficient allocation of loanable funds and thereby economic development. Following Mishkin (1978), Bernanke (1983) analyses the importance of financial factors during the Great Depression. Their main conclusion is that monetary factors alone are insufficient to explain the depth, persistence and the severe impact of the Great Depression.

Early evidence that was given in the previous paragraph motivated empirical research on the link between the business cycle and monetary policy by taking into account financial factors that are closely associated with the credit channel. The empirical literature on the credit view of the monetary transmission may be classified into three main areas. First, quite a number of studies that use aggregate time series have tested the impact of credit aggregates on investment, output, and consumption by using VAR models and other time series techniques (Bernanke and Bilinder, 1992; Keshyap, Stein, Wilcox, 1993; Friedman and Kuttner, 1992 and 1993; Dale and Haldane, 1995; Bernanke and Gertler, 1995; Christiano, Eichenbaum and Evans, 1996 and many others are the first examples). This literature generally uses reduced form models as a theoretical base.

Second, the empirical studies on the determinants of bank lending are carried out by using bank level micro data in the spirit of the studies on the role of financial imperfections on investment decisions of non-financial firms (Kashyap and Stein, 1995; Kashyap and Stein, 1997; Hatakeda, 2000; Jayaratne and Morgan, 2000; Kashyap and Stein, 2000; Kishan and Opiela, 2000; Kakes, 2000; Bacchetta and Ballabriga, 2000). These studies find evidence that the structure of financial markets is important for the channels through which monetary policy transmits. Banks, for example, react in different ways to monetary policy shocks given their capital structure and other characteristics and this in turn affects real activity in the economy.

Third, the micro level data on the balance sheets of non-financial firms or households are employed to test the significance of financial variables for explaining fixed investment, inventory investment, consumption, and employment. The empirical evidence on firm level data confirm that the investment (fixed or inventory) decisions are

very much sensitive to firm specific financial conditions (like internal funds) as well as macroeconomic conditions (see, for example, Fazzari, Hubbard and Peterson, 1988 and 2000, Zingales and Kaplan, 1997 and 2000, Gertler and Gilchrist, 1994; Bond and Meghir, 1994; Guariglia and Schiantarelli, 1998; Guariglia, 1999 and 2000, Carpenter, Fazzari and Petersen, 1994 and 1998; Hu and Schiantarelli, 1998; Adung, 2000; Ndikumana, 1999; Vermeulen, 2002; Bond, Elston, Mairesse and Mulkay, 2003).

2.4.1. Monetary Policy Stance and Identification Issues in the Credit Channel

Empirical research in the area of monetary transmission mechanism is faced with two main challenges: measuring monetary policy stance and identifying the credit channel. First, there are difficulties in measuring the monetary policy stance, i.e. whether the policy is tight or benign. Financial innovations and liberalisation in the capital accounts broke the link between money and aggregate demand in many countries by the 1980s. This resulted in an unstable money demand function and policy makers were no longer able to derive proper policy implications by focussing on the monetary aggregates. Therefore, the interest was focused on alternative variables that reflect monetary stance that can be used as policy tools such as the money market interest rate, the lending rate, the exchange rate, and the volume of credit.

Since the link between monetary aggregates and aggregate demand disappeared, in developed economies, the interest rate that is derived from the central banks' interactions in the money market is generally used as a policy tool and it is expected that this rate affects relative prices and real activity through a number of channels. Empirical studies also suggest this rate as a variable that reflects the monetary policy stance. Bernanke and Blinder (1992) suggested the Federal Funds rates and the spread between Federal Funds and Treasury bonds as good indicators of monetary policy stance in the US. In addition, Friedman and Kuttner (1992, 1993) found evidence that the spread between the commercial paper rates and the risk free Treasury bill rate contains highly significant information about future movements of real income. Kashyap *et al.* (1993) confirm that the spread between prime commercial paper and Treasury bill rates have forecasting abilities for real activity. On the other hand, Romer and Romer (1990) developed an alternative technique called 'Romer dates' to measure monetary policy stance. Romer

dates show the particular times when the monetary policy is tight based on information derived from the Fed minutes.

The second challenge is related to some difficulties in identifying the monetary policy channels independently in empirical studies. First of all, there is a lack of proper data to test different channels of monetary policy. For example, theoretical models generally use real interest rates rather than nominal interest rates in analysing the link between money and real activity even though we may not observe real interest rates directly in the actual data.

Secondly, even if all theoretically relevant prices and quantities were readily observable, empirical inference about monetary policy would be still problematic because of the difficulty of distinguishing the actions of the monetary authority from their consequences. In other words, the monetary authority endogenously responds to the economic cycles; it loosens policy when the economy weakens, and tightens when the economy strengthens. Therefore, it is difficult to identify the impact of exogenous policy actions. The evidence shows that the correlation between the Fed rates and GDP in the US is weaker in recent years. One may think that monetary policy has become less effective. However, this evidence may also imply just the opposite because of simultaneity in the relation, that is, monetary policy has actually become more effective in the sense that it has dampened the GDP fluctuations (Kuttner and Mooser, 2002).

Thirdly, the identification of credit channel is empirically cumbersome. It is difficult to distinguish between supply and demand dynamics in the movement of credit aggregates. Kashyap *et al.* (1993) tend to identify the bank lending channel by considering demand and supply effects. Using US data they provide some empirical evidence that a tight monetary policy leads to a shift in the firms' external financing from bank loans to commercial papers. The decline in the banks' loans is due to a reduction in the supply of loans rather than a reduction in the demand for bank loans. This study tends to show that an increase in the volume of commercial papers (CP) relative to total short-term external finance after a tight monetary policy can be evaluated as evidence for the bank lending channel. Although the demand for external finance increases generally as a result of a contractionary policy, a decline in the bank loans is associated with a reduction in supply

rather than demand. In addition, according to the money view, the lending rate would decline due to an output-induced decline in the demand for credit, but this rate actually rises during tight periods. Espezel and Mizen (2000) apply the same framework to the UK data and confirm the existence of a bank lending channel in the UK.

The decline in bank loans and the rise in the issuance of non-financial firm's CP may be noted as evidence of the bank lending channel and an increase in the issuance of CP cannot be interpreted as a decline in the demand for bank loans. However, this argument does not explain the fact that most of the CP issuance is realised by large firms and not by small firms where a tight monetary policy constrains the activities of those firms mainly through balance sheet effects. Oliner and Rudebusch (1996) comment on Kashyap *et al.* (1993) and find new evidence by using micro data that does not confirm the bank lending channel. We will discuss this issue in detail in Chapter Five.

2.4.2. Further Evidence on the Bank lending Channel

Recent empirical studies have tended to use micro level information of economic agents to test the bank lending channel. This method allows researchers to incorporate informational problems and agency costs into the analysis. More specifically, as we explained above the reactions of banks with different financial positions to monetary policy are going to differ. The theory that we discussed in section 2.3.2 is valid not only for non-financial firms but also for banks. The lending behaviour of banks very much depends on their financial positions given monetary policy shocks, that is, the monetary transmission is very much related to the structure of the financial sector.

Hancock and Wilcox (1998) estimate the impact of changes in the capital conditions of banks and aggregate economic conditions on bank loans and the real activity of small firms by using US data for the 1989-1992 period. They document that a decline in small banks' loans, known as 'high powered loans', has a greater impact on economic activity than a decline in the large banks' loans. Similarly, a decline in the capital of small banks produces larger changes in economic activity than a decline in the capital of larger firm. Small and bank dependent firms, (high information-cost firms) are affected very much by bank loan contraction contrary to large firms that have high flexibility to switch between

banks and other external finance. Evidence shows that small firms are more likely to have a close relationship with small banks.

Kishan and Opiela (2000) find evidence supporting the credit channel in general and the bank lending channel in particular by using US data. In practice, it is difficult to identify whether, for example, a contractionary monetary policy reduces the loan supply or the loan demand. Kishan and Opiela tend to segregate banks by asset size and capital leverage ratio to provide evidence that small and undercapitalised banks may not be able to offset a drain in reservable deposits by selling large time deposits. A decline in the money supply through open market operations will then lead to a decline in demand deposits. If there are no informational asymmetries between banks and time deposit purchasers, the decline in demand deposits is compensated for by an equal increase in time deposits, therefore the loan supply remains at the same level. If, however, there are informational asymmetries between banks and time deposit purchasers, a risk premium appears on non-reservable or uninsured deposits issued by banks – deposit purchasers then expect higher return on their deposits. A credit channel becomes operative because some banks are unable to completely offset a Fed-induced drain of reserves with an increase in time deposits. It is found that loans of undercapitalised banks are the most responsive to monetary policy, and time deposits of these banks do not increase enough to compensate for the decline in reserves as a result of a contractionary policy, and therefore they do not extend new credits.

Jayaratne and Morgan (2000) emphasise that bank loans are constrained by the availability of insured deposits given informational frictions in the uninsured liabilities market. If information about bank loans is hard to observe by the supplier of the funds (households) then the banks face an extra cost in the capital market. This approach has some common points with the cash flow-investment model, which applies to non-financial firms. The insured deposits as balance sheet items of banks might be treated as cash flow (internal finance) while loans and uninsured deposits are considered as the investment and external funds of typical firms; respectively. Existence of a positive correlation between loans and insured deposits stemming from credit market frictions may be interpreted as a sign of a lending channel given an inelastic supply of uninsured deposits. This study claims that, in general, reliance on insured funds decreases and

issuance of uninsured funds increases as bank capital rises. Unlike large banks, the relationship between loans and deposits is very much determined by the leverage level of the small banks, since low capital banks depend more on insured deposits to finance loans.

Fisher (1999) develops a quantitative general equilibrium model to analyse the bank lending channel under the assumptions of an imperfect market and heterogeneous response of firms to monetary shocks. The study reports that in addition to a decline in the borrowing and sales of small firms, the spread between interest rates on loans paid by the bank-dependent firms and on those firms using the public debt market to finance investment rises during monetary contractions. Based on the model, some parameters that support the bank lending view are replicated by using US data whereas some others are not. However, in general, the steady state results of the calibrated models give reasonable parameters for the lending view. The differences in the results between small and large firms cannot be interpreted directly as evidence for the bank lending channel.

Kashyap and Stein (1995 and 1997) found evidence for the bank lending channel by using panels of balance sheet indicators of US and European banks, respectively. Kashyap and Stein (2000) used quarterly data of every insured US commercial bank from 1976 to 1993 to test the bank lending channel. In the US, small banks, which constitute a large proportion of these banks, have a low ratio of liquid assets. In order to avoid identification difficulties concerning the bank lending channel, this study tends to analyse the micro data at the individual bank level. To evaluate the impact of monetary policy on banks that differ in financial position and size may provide some valuable information in this context. This study generally supports the existence of a bank lending channel of the monetary transmission. The empirical evidence is summarised below.

Small banks generally have higher securities relative to loans on their assets side mainly because of precautionary intentions. This result may explain financial constraints that they encounter during a tight monetary policy period. On the liabilities side, they have very simple capital structure, mainly deposits and common equity and very limited borrowing from the Federal Fund market, whereas the large banks liabilities include a large amount of borrowing from the market in addition to deposits and common equity.

The study captures the impact of monetary policy on bank loans with a two-step procedure. Within the class of small banks, changes in monetary policy affects more the lending of those banks with the lowest ratio of liquid assets i.e. banks with a low ratio of securities to assets

Hatakeda (2000) claims that in the absence of intermediary institutions, problems of asymmetric information make financial markets incomplete. Financial intermediaries or banks contribute in reducing market imperfections and improve the allocation of resources by specialising in gathering information about loan projects. This study is based on Bernanke and Gertler (1987), who have shown that the availability of bank's internal funds should be an important determinant of bank loans when there are problems of asymmetric information between banks and depositors. In addition, they assumed that there is no substitute for bank loans as a source of finance for non-financial firms. This study, however, includes direct financing methods as well as bank loans, and these forms of financing are endogenously determined. It is found that bank loans depend on economic activity, bank capital, collateral value, and the market interest rate. When the liquidity constraint is binding, an increase in economic activity may affect bank loans negatively and a rise in the collateral value of bank has a positive effect on bank loans. An increase in the real activity may increase the likelihood of direct finance that leads to a decline in the demand for bank loans. In short, the study emphasises that the existence of informational problems in bank finance and its uniqueness are perceived as further evidence for the bank lending channel in Japan.

It is generally claimed that the bank lending channel is no longer effective because the reserve requirement ratio as a monetary policy instrument is becoming less important in determining deposits mainly due to the instability of money demand and financial innovations. As a result of financial deregulation and innovations, the importance of the traditional bank lending channel has most likely diminished over time (Romer and Romer, 1990). In addition, Bernanke and Gertler (1995) pointed out that the impact of monetary policy on housing has weakened because of the phasing out of interest rate ceilings and the introduction of innovations such as a liquid secondary market for mortgages in the US economy. Therefore, recent empirical studies on the impact of monetary policy on the

borrowing and spending capabilities of the agents that are subject to financial constraint focus on their balance sheet positions.

2.4.3. Further Evidence on the Broad Credit Channel

The empirical literature on the broad credit channel tends to use panels of firms, banks or households and test their reactions to monetary policy shocks considering their balance sheet positions, informational problems and agency costs. Quite a number of empirical studies have investigated the impact of financial frictions on the investment decisions of firms. As it is noted above, in imperfect financial markets, a real or monetary shock leads to changes in the balance sheets of firms, banks, and households and thus their activities. More specifically, a contractionary monetary policy reduces asset prices and cash flow, and in turn, degrades their financial positions by changing the collateral value and borrowing ability, which directly influence their investment and consumption decisions.

A line of empirical literature has developed around the debate between Fazzari, Hubbard and Peterson (1988) and Zingales and Kaplan (1997). The former study confirms the financial accelerator theory in the sense that investment of financially constrained firms is more sensitive to a change in internal funds made possible by a monetary policy shock. However, Zingales and Kaplan (1997) criticise this proposition and find opposite evidence. On the other hand, international evidence shows that investments are more sensitive to cash flow in relatively market-oriented economies like the UK and the US (Schiantarelli, 1996; Iturriaga, 2000; Bond, Elston, Mairesse, and Mulkay, 2003). These studies provide a useful discussion of international evidence on the impact of capital market imperfections on investment decisions. They use a variety of measures of financial positions like dividend pay-out behaviour, association with business groups, banks size, agency problems, and concentration of ownership. We provide detailed empirical literature on the cash flow-investment hypothesis in Chapter Six where we test the impact of monetary policy on inventory investment and employment by considering financial factors. Therefore, in order to avoid repetition we will not review this literature here.

On the consumption side, the permanent income hypothesis (*PIH*) implies that monetary policy can only influence consumption to the extent that it affects permanent

income. In fact, there is no evidence that monetary policy has a direct impact on permanent income and thereby aggregate consumption. However, it is argued that consumption is very much affected by the availability and the cost of credit. Financial liberalisation in the 1980s led to a consumption-led boom by creating new credit possibilities at lower cost in many countries. The recent empirical literature rejects the *PIH*, and emphasises that consumption is very much correlated with income (excess sensitivity) because of liquidity constraints. Therefore, the variables associated with credit conditions reflecting availability and cost of liquid assets tend to be used by empirical studies in order to explain variations in consumption.

Bacchetta and Gerlach (1997) test the impact of consumer credit on consumption by using time varying coefficient estimates for some major industrialised countries like the US, the UK, Canada, Japan and France. In multivariate regressions, credit growth is found to be a more important determinant of consumption than income growth. Ludvigson (1998) uses a VAR model to test whether the composition of automobile finance changes in response to innovation in the Federal Funds rate, and whether variation in this composition affects the sales of new automobiles. A mix variable parallel to Kashyap *et al.* (1993) – the ratio of bank automobile credit to bank automobile credit plus finance company automobile credit – is constructed for identifying the credit channel. The evidence presented in that paper supports the bank lending channel of monetary transmission rather than the balance sheet channel. In addition, Ludvigson (1999) employs a time varying liquidity constraint model in which the optimal consumption behaviours of individuals are analysed in the context of stochastically varying borrowing constraints. By using US aggregate data this study finds that *ex ante* consumer credit growth has a significant influence on consumption. The impact of forecasted credit growth and forecasted income growth on consumption are independent. In short, contrary to the life-cycle hypothesis, this study concludes that credit conditions that create a financial accelerator in the consumption sector, as observed in the corporate sector, play an important role in the consumption behaviour of households.

2.4.4. A Brief Review of Empirical Literature that Uses UK Data

The empirical studies of the credit channel literature for the UK give more weight to the balance sheet channel rather than the bank lending channel. More specifically, they

generally test the effect of financial constraints on investment decisions of non-financial firms. The studies generally focus on the relationship between the behaviour or structure of intermediaries and non-financial firms under different monetary policy regimes. More research is needed on the monetary transmission channel that captures the financial choice and structure of agents by adopting a micro level analysis in the UK.

Asymmetric information problems are very much relevant for the financing of small businesses. It is generally argued that while the owners of small firms have more information about the project return than creditors, the situation is different for larger firms where the information about financial performance of these firms is relatively available. Melanie and Wright (1999) examine the developments over the past decade in the financing of small business in the UK. They conclude that contrary to the theoretical expectations empirical studies provide little evidence to support the market imperfection theory for small firms since the recession in early 1990s. It is noted that small firms are now less dependent on the external sources, and in fact many the smallest businesses are net creditors to the banking sector and businesses can easily access a variety of financial products. On the other hand, Kohler, Britton and Yates (2000) use a panel of firms quoted on the UK stock exchange to test the importance of trade credits for monetary transmission. This paper shows that firms with direct access to capital markets extend more trade credit and receive less during recessions. That is, quoted firms supply net trade credit to unquoted firms. Therefore when monetary conditions tighten, trade credit may offset the contractionary impact of the reduction in bank loans. In short, the contractionary impact of monetary policy through the credit channel on real activities tends to be balanced by the trade credit extended by those firms having access to the capital market to the firms not having access to financial market and being financially weak.

Bond and Meghir (1994) investigate the response of investments to the availability of internal funds by applying the financial hierarchy approach to corporate finance. The empirical model uses a panel of UK firms to estimate an investment equation based on the Euler equation. The theory implies that internal finance is cheaper than external finance, and therefore investment and financial decisions are not independent. One problem with this approach is the assumption that firms should not simultaneously pay dividends and issue new shares. This assumption is found to be not valid for UK manufacturing firms.

For those firms paying fewer dividends, investments are more sensitive to the financial variables. This study emphasises that cash flow also affects the inventory investments of unconstrained firms. Their main finding is that there is no unique criterion for identifying financially constrained firms.

Guariglia and Schiantarelli (1998) Guariglia (1999) Guariglia (2000) analyse the link between internal finance and inventory investment using samples of UK manufacturing firms. It is found that financial constraints are important for inventory investment. Small (2000) uses a panel of UK manufacturing firms to test the impact of the cash flow on inventory investment for various types of firms. This study concludes that cash flow affects inventory investments of both constrained and unconstrained firms. Brigden and Mizen (1999) employ a structural dynamic model to analyse the interaction among investment, credit, and money for the non-financial sector. The study concludes that real decisions of the firms are very much dependent on their financial structure. It is found that lending is very much affected from the balance sheet items of the firms but not much from the lending spreads. This study confirms the existence of a credit channel for UK data and suggests that money, credit and investments should be modelled as a system.

2.4. Conclusion

As we discussed earlier, the transmission mechanism of monetary policy becomes a very complicated issue when we consider financial interactions within the asymmetric information and agency cost framework. Empirical and theoretical research show that informational problems and agency costs concerned with financial interactions are important sources of economic fluctuations. Financial innovations and institutional changes altered the nature of monetary transmission in developed economise during the last two decades.

Theoretically, there are many channels through which monetary policy transmits but the significance of these channels varies across economies and time. There are some difficulties in identifying these channels empirically because of simultaneity in supply-demand dynamics, the endogenous nature of policy actions, and in difficulties observing certain variables that are crucial for the analysis. Recently, theoretical and empirical attention has focused on the channels that consider micro level dynamics to identify these

channels. Especially, the credit channel both in its narrow and its broad sense has been studied very often to understand the link between policy shocks and business cycles.

Among the two main channels of the credit view, the broad credit channel plays a more significant role in business cycle fluctuations. Recent financial crises in relatively less developed financial markets confirm the importance of the financial accelerator mechanism that performs through underlying severe informational asymmetries, and high agency costs. In this context, monetary policy and the underlying transmission mechanism as well as information about the basic tendencies in financial markets become crucial in terms of macroeconomic stability and economic efficiency. The credit channel framework provides substantial insight for the analysis of business cycles and financial crises.

The theoretical and empirical studies on the credit view improved our understanding of the monetary transmission relative to those that followed the interest rate channel. Especially, the research in this area produced important policy implications for managing aggregate demand (macro aspect) and for efficiency of financial markets (micro aspect). First of all, studies that consider micro dynamics show us that monetary policy shocks, in imperfect financial markets, have some implications for the redistribution of wealth among agents. More specifically, the empirical evidence shows that the relative size of the banking sector expands during hyperinflation periods and shrinks during monetary stabilisation (Li, 2000). In addition, a substantial amount of empirical literature emphasises that the agents with relatively weak capital structure are more vulnerable to monetary policy, that is, small firms or banks encounter severe financial constraints during the recessions and this, in turn, leads to a redistribution of wealth. In this context, the studies that use micro level panel data on non-financial firms, banks and households may enable us to identify the implications of monetary policy properly. The studies that incorporate heterogeneous agents are extremely helpful for deriving implications about the redistribution of resources among agents that have different spending attitudes and financial structures.

CHAPTER THREE

External Finance and the Monetary Transmission: A Theoretical Framework

3.1. Introduction

The Modigliani-Miller's irrelevance theorem asserts that the performance of non-financial firms and thus aggregate demand is independent of the financial system. The standard *IS-LM* model is constructed based on the premise that asset holders choose between two alternative assets, namely money and bonds. In these models, bank loans and other forms of credit are viewed as perfect substitutes for bonds and it is assumed that financial markets operate without any friction. Therefore, early theoretical frameworks allowed only for the money view of the transmission mechanism according to which monetary policy generally affects investment and other economic activities through the interest rate.

Imperfections in financial markets have been analyzed within the context of asymmetric information and the incentive problem literature. Within this new framework the financial position of firms and households are important for understanding the impact of monetary policy on economic activities. The research in this area concentrates on more complex views of monetary policy transmission where financial market conditions play a central role. More specifically, recent literature has been increasingly focusing on the monetary transmission channels that work through the price of other assets and the credit channel.

Informational asymmetries and agency cost problems lead to a wedge between the costs of external and internal funds. This implies two basic results; (i) firms cannot without cost substitute external funds for internal funds and, (ii) debt, bond, and equity, as forms of external finance are not perfect substitutes. In fact the imperfect substitution among financial instruments has important implications for both the capital structure and the real activity of firms. The return rates on various financial funds differ according to

the extent of informational asymmetries in the corresponding financial markets. This gives rise to a *financial hierarchy* where firms choose the least costly source of finance to finance their investment projects.

In this chapter, we use a microeconomic framework that offers some insights into the coexistence of market and intermediary finance and also allows us to discuss the factors affecting the choice among various types of external finance. More specifically, we derive some implications for the monetary transmission mechanism through which the change in market interest rates affects intermediate finance versus market finance for firms with various characteristics. The model introduces intermediary finance following the spirit of Diamond (1984, 1991) where the role of intermediary institutions is to monitor their clients. Repullo and Suarez (2000) also discuss the credit channel in an environment where intermediary and market finance coexist, and their model has some similarities with the one in this study.

We will extend the model built by Hoshi, Kashyap and Scharfstein (1993) in which the optimal choice between market finance and intermediary finance is made within a financial environment where informational asymmetries are due to a moral hazard problem. In our version, we allow for a positive opportunity cost of finance (positive market interest rate instead of zero) so that we can examine the effects of monetary policy on the firms' choice of finance by altering the market interest rate through open market operations. With this new version of the model, we carry out some comparative statics that enable us to derive some implications about the impact of firm size, collateral assets (net worth), distribution of risk, project size, and project payoff on the choice of alternative types of finance. Analyzing the impact of a monetary policy shock (through changing the interest rate) on the financial choice of non-financial firms and its implications for real activity is the concern of this study.

In section two we develop the theoretical framework where we discuss the assumptions and basic features of the model. In section three, some predictions are derived from the model following some comparative static exercises. The last section is devoted to some concluding remarks.

3.2. Modelling the Choice between Intermediary Finance and Market Finance

In this section we present a model adapted from Hoshi *et al* (1993) to derive some implications regarding the types of firms that borrow from intermediary institutions and the types that borrow from financial markets. Hoshi *et al* (1993) analyse the role of ownership structure for raising external funds in Japan, and although our application is different, we adapt their approach for analysing the impact of monetary policy on firms' choice of finance and also the variation of this impact across firm characteristics.

This model uses the same framework as Diamond (1991) where the interaction between a firm's reputation capital (a good track record) and the choice between intermediary and market finance is analysed in the context of delegating monitoring setting. The model allows for coexistence of intermediary finance and external finance based on the idea that a financial intermediary monitors a firm more efficiently than numerous individual lenders. In other words, individual investors tend to delegate the monitoring activity to intermediary institutions that enable investors to diversify the investment risk. Suppose an entrepreneur borrows from numerous investors in the market. If all investors tend to monitor the borrower, the monitoring cost would multiply. However, if some investors tend to monitor, the problem of free rider appears and the remaining investors will benefit without paying any cost. In contrast, intermediary institutions have the incentives to monitor. This result was demonstrated by Diamond (1984) and Chant (1992) who showed that banks have incentives to monitor while individual investors do not.

We assume that the firm owns a certain amount of total assets and debt before it carries out an investment project that is completely financed by external funds. Total firm assets (A_T) consist of tangible collateral assets (A_C) and intangible assets. The firm's existing debt (D_E) is less than the collateral assets and thus it is risk free. Potential investment projects generate financial payoffs of π to shareholders as well as private benefit, β, to the managers. The manager's expected utility consists of a fraction, α, of the financial payoffs of the project, and the private benefit, $\alpha\pi+\beta$. If the manager is the owner of the firm ($\alpha=1$), he jointly maximises the financial payoff and private benefit and if his equity share is zero ($\alpha=0$), he maximises only the private benefit. There are two types of

projects, i = 1,2 and each project has a payoff X with probability p_i and zero with probability $(1-p_i)$. Project 2 (the good project) has a higher expected financial payoff than Project 1(the bad project), $p_2X > p_1X$, and the manager's private benefit is zero in Project 2 and it is a positive number, B, in Project 1. Both projects require an initial investment (project size), F. The private benefit is proportional to firm size $(B=bA_T)$, where $b>0$[1]. The manager chooses the type of project that maximises his/her expected utility. All parties are risk neutral. Finally, we impose the condition $(p_2 - p_1)X>B$, which implies that Project 2 is the socially efficient project.

Depending on the parameters of the model, the manager chooses the type of projects and type of finance. There are cases where the manager prefers Project 2, and the firm borrows from the market directly by issuing bonds or equity and thus the firm will not be monitored. However, there are also possibilities where the manager avoids being monitored and chooses bad projects that are financed directly through financial markets (the moral hazard problem). In the other case, the manager will borrow from an intermediary institution with a commitment of taking the good project. These two types of external finance are discussed in detail in the following sections.

Market Finance without Monitoring

In this case, the firm has only the market as a source of finance. The manager raises funds from the market without being monitored. Suppose the firm borrows F, and promises to repay D, where the existing debt is assumed to be senior to the new debt.[2] If the firm cannot meet its commitments, the lender can liquidate tangible collateral, A_C.

The manager's payoff from Project 1 is

$$\alpha[p_1(X - D + A_T - D_E) + (1 - p_1)(A_T - A_C)] + bA_T \qquad (3.1)$$

and the corresponding payoff from Project 2 is

[1] We follow Hoshi *et al.* (1993) by assuming that the private benefit is proportional to the size of the project and the size of the project is proportional to the size of firm.
[2] This assumption implies that existing debt rather than new debt is paid first in the case of default.

$$\alpha[p_2(X - D + A_T - D_E) + (1 - p_2)(A_T - A_C)] \qquad (3.2)$$

If the manager's expected utility from Project 2 is more than his expected utility from Project 1, he will choose the good project which is socially efficient. That is, if the difference between the shareholders payoffs for the good project and the bad project is not less than the private benefit from the bad project, the good project will be the socially efficient choice, that is,

$$\alpha(p_2 - p_1)(X - D + A_C - D_E) \geq bA_T \qquad (3.3)$$

If debtholders believe that the manager will choose Project 2, the lender's zero profit condition requires that,[3]

$$p_2D + (1 - p_2)(A_C - D_E) = F(1+r) \qquad (3.4)$$

Hoshi *et al* (1993) assumed that the opportunity cost of finance is zero ($r=0$). We introduce a positive market interest rate, ($r>0$), as the opportunity cost of funds. This is important since a major issue in this Chapter is the interaction between the monetary policy stance and firm-specific characteristics in determining the access to external finance.[4] Substituting (3.4) into (3.3) we find that the manager will have a proper incentive to choose the good project if and only if the following condition is satisfied.

$$\frac{\alpha(p_2 - p_1)}{A_T}\left(X - \frac{F(1+r) + D_E - A_C}{p_2}\right) \geq b \qquad (3.5)$$

Depending on the parameters, if (3.5) is satisfied the firm chooses the good project, borrows from the financial market and makes an efficient investment decision. If the incentive constraint (3.5) is not satisfied, the firm chooses the bad project and the new debtholders require a higher repayment, D_1. The lender's zero profit condition is

$$p_1D_1 + (1 - p_1)(A_C - D_E) = F(1+r) \qquad (3.6)$$

[3] Whether the repayment D to the new debtholder, who earns zero-profits, satisfies condition (3.3) is a critical question.

[4] Hoshi *et al.* (1993) assumed that the opportunity cost of finance is zero but this does not allow us to investigate the influence of monetary policy, which operates through changes in interest rates.

At this value of D_1 the manager would choose the bad project (the inefficient project) and his payoff would be

$$\alpha[p_1X + A_T - D_E - F(1+r)] + bA_T \qquad (3.7)$$

In short, in a world without intermediary finance, if the incentive constraint (3.5) holds, the manager chooses the good project and if it does not hold he chooses the bad project. In both cases, the manager borrows from the financial market.

Intermediary Finance

In this section a new group of investors endowed with a monitoring technology is introduced into the model. This technology enables them to observe the manager's project choice at a cost of m per project. Since the monitoring technology is costly for individual investors, the investors deposit their money in monitoring intermediary institutions, mainly banks. If incentive (3.5) is not satisfied, the firm will choose the good project by borrowing from intermediaries. Then if the manager chooses to borrow from an intermediary institution, the repayment of the loan, L must satisfy the following condition[5]:

$$p_2L + (1-p_2)(A_C - D_E) = (F+m)(1+r)^6 \qquad (3.8)$$

In this case, the manager's payoff is

$$\alpha[p_2X + A_T - D_E - (F+m)(1+r)] \qquad (3.9)$$

and the manager prefers the intermediary finance if his payoff in (3.9) exceeds that in (3.7). Then, the incentive for intermediary finance can be written as

$$\frac{\alpha(p_2 - p_1)}{A_T}\left[X - \frac{m(1+r)}{p_2 - p_1}\right] \geq b \qquad (3.10)$$

[5] In this case, the repayment to the monitoring institution includes return on loan as well as monitoring costs.

[6] In this case, the repayment to a monitoring institution includes both the loan return and the monitoring cost.

The firm issues public debt (borrows from the market directly) if either (3.5) holds or (3.10) does not hold, otherwise the firm borrows from intermediary institutions. The conditions for market finance can be rewritten as:

$$\frac{p_2X}{A_T} \geq \frac{p_2b}{\alpha(p_2-p_1)} + \frac{F(1+r)}{A_T} - \frac{A_C}{A_T} + \frac{D_E}{A_T} \qquad (3.11)$$

$$\frac{p_2X}{A_T} \leq \frac{m(1+r)p_2}{(p_2-p_1)A_T} + \frac{p_2b}{\alpha(p_2-p_1)} \qquad (3.12)$$

The conditions given in (3.11) and (3.12) are derived from (3.5) and (3.10) respectively, provided that the monitoring cost is sufficiently low. This requires

$$F(1+r) - A_C + D_E > \frac{m(1+r)p_2}{(p_2-p_1)} \qquad (3.13)$$

Below, the new equilibrium expression where intermediary finance feasible in an interval defined in terms of Tobin's q, is derived, given that the condition in (3.13) holds and the conditions for market finance in (3.11) and (3.12) are reversed. That is,

$$\frac{m(1+r)p_2}{(p_2-p_1)A_T} + \frac{p_2b}{\alpha(p_2-p_1)} \leq \frac{p_2X}{A_T} \leq \frac{p_2b}{\alpha(p_2-p_1)} + \frac{F(1+r)}{A_T} - \frac{A_C}{A_T} + \frac{D_E}{A_T} \qquad (3.14)$$

we will use p_2X/A_T as a profitability measure for our purpose. A_C/A_T and D_E/A_T are the proportions of collateral assets and the firm's leverage ratio, respectively.

Let us denote the lower critical point of the interval as Q_1 and the upper critical point as Q_2. Then we can define the critical points as:

$$Q_1 = \frac{m(1+r)p_2}{(p_2-p_1)A_T} + \frac{p_2b}{\alpha(p_2-p_1)} \qquad (3.15a)$$

$$Q_2 = \frac{F(1+r)}{A_T} + \frac{D_E}{A_T} - \frac{A_C}{A_T} + \frac{p_2b}{\alpha(p_2-p_1)} \qquad (3.15b)$$

Those firms with profitability measures below Q_1 use public debt to finance their investments in bad projects, while those firms with corresponding values above Q_2 use the same source to finance their investments in good projects. Firms with profitability measures between Q_1 and Q_2 use bank debt to finance their investments in good projects.

The value of the critical points may depend upon the financial structure of firms and the financial environment where lending and borrowing activities take place. Where the firm's financial structure is strong (i.e. characterized by high value of total assets and low gearing ratios, high probabilities of success of good projects, high manager's shares of equity, low private benefits, monitoring cost and market interest rates etc), the critical values would be low. In these cases the moral hazard problem is not serious and therefore the choice of socially efficient projects is likely. It is obvious that large and well-capitalized firms, whose critical points are relatively low, are more likely to choose the good projects that could be financed by either market or intermediary finance. On the contrary, small and poorly capitalized firms are expected to have high critical points that make the moral hazard problem more serious. The relative magnitude of demand for intermediate and market finance also depends on the distribution of firms according to their profitability.

3.3. Implications of the Model

This model enables us to observe only the change in the composition of external finance in terms of demand effects, which is associated with non-financial firms' financial structure. Firms with a high profile in terms of size, reputation, collateral etc., managers prefer good projects, while those in the middle profile, prefer again good projects but are monitored given a sufficiently low monitoring cost. In the monitoring case, the profits from the good project balance the cost of monitoring and the opportunity cost of private benefits. Since the good project is no longer optimal for the manager of a low profile firm, he borrows from the market directly and chooses the bad project. The firm that carries out the bad project through borrowing from the market is expected to be confronted with a higher borrowing cost and the possibility of default than the firm choosing the good project. The manager who wishes to obtain the private benefit has more information about the project than the individual investors and other shareholders. Therefore, he is more prone to borrow at a high cost relative to the manager that chooses

the good project. It is implicitly assumed that shareholders pay a high cost for external finance when the bad project is selected. In short, one can easily observe the link between the attractiveness of the project and the types of finance from the model. A firm with higher profitability is more likely to choose the good project. Therefore, a shock that influences the attractiveness of the project alters the composition of firm finance.

One important feature of the model is the prediction that both good and bad projects can be financed through the market directly; however, only good projects are financed through intermediary finance. The model predicts that a firm that does not have access to intermediary finance may issue bonds to finance its bad project. However, in the literature, it is generally assumed that the firm that does not meet the condition for intermediary finance is not able to issue bonds, because bond issuing is costly for financially weak firms that potentially choose bad projects. These predictions imply that the financial sources for good and bad projects are expected to be significantly different. Evidence shows that financially weak firms that do not get access to intermediary finance tend to finance their projects through informal or formal capital ventures, trade credit or through other informal ways such as family support.

The goal in this chapter is to determine the implications of changes in monetary policy on the financing options of firms. We are especially interested to know how these effects vary with firm characteristics, such as size, collateral, debt, risk and profitability. In the first part of this section we examine the impact of firm characteristics and in the second part the response to monetary policy conditions and the variation of this response with variations in firm characteristics. The former signs the partial derivatives and the latter signs the cross-partials.

3.3.1. Firm Characteristics

Firm Size

It is generally claimed that large well capitalized firms are able to finance their investment projects through financial markets at a relatively low cost, while small firms that have fewer collateral assets depend more on intermediary finance and have to pay a high external finance premium because they are more likely to be subject to a moral

hazard problem. The empirical literature has widely discussed the role of firm size in the monetary transmission mechanism through a credit channel (Gertler and Gilchrist, 1994; Oliner and Rudebusch, 1996). Small firms that have relatively limited collateral assets and weak balance sheet positions are negatively affected by a tight monetary policy. This is because they are unable to obtain external funds when they experience a decline in the present value of collateral assets that is a reflection of a firm's reputation. Since it is not costless to shift among different forms of finance, a shock that changes the composition of firm finance is likely to be especially influential over the investment and production decisions of small firms.

It is assumed that the private benefits to the manager are increasing in proportion to a firm's total assets. A firm that has relatively large assets includes also a large potential private benefit for the manager. In the case of market finance, this gives an incentive to the manager to choose bad projects as total assets increase at a given level of collateral assets, existing debt, and project payoff, the distribution of the risk, and project size. In other words, as the size of intangible assets relative to collateral assets increases it is more likely to choose bad projects, everything else remaining equal.

The impact of firm size on the equilibrium condition for intermediary finance can be analyzed using the model explained above. Suppose that firm size (S) is captured by total assets as well as by collateral assets and existing debt (A_T, A_C, D_E). A proportional increase in these variables (increase of firm size) will cause both the lower and the upper critical points of the equilibrium conditions given in (3.14) to shift leftward if all other variables as well as *the project size are kept constant*. The decline in the upper critical point would be larger than that of the lower critical point at a sufficiently low monitoring cost.

$$\frac{\partial Q_2}{\partial S} = -\frac{F(1+r)}{A_T^2} < 0, \frac{\partial Q_1}{\partial S} = -\frac{m(1+r)p_2}{(p_2 - p_1)A_T^2} < 0 \text{ and } \left|\frac{\partial Q_2}{\partial S}\right| > \left|\frac{\partial Q_1}{\partial S}\right| \qquad (3.16)$$

Suppose that firms are distributed normally in terms of firm profitability and intermediary finance is concentrated around the average of profitability, as in Figure 3.1, then an increase in the firm size will reduce the intermediary finance (N) relative to market finance for good projects (M_g). That is, the demand for intermediary funds

declines and more firms get direct finance at a lower cost and relatively fewer firms finance their projects from market funds by selecting bad projects (M_b).[7]

$$\frac{\partial M_g}{\partial S} > 0 \;, \quad \frac{\partial M_b}{\partial S} < 0 \quad \text{and} \quad \frac{\partial N}{\partial S} < 0 \qquad (3.17)$$

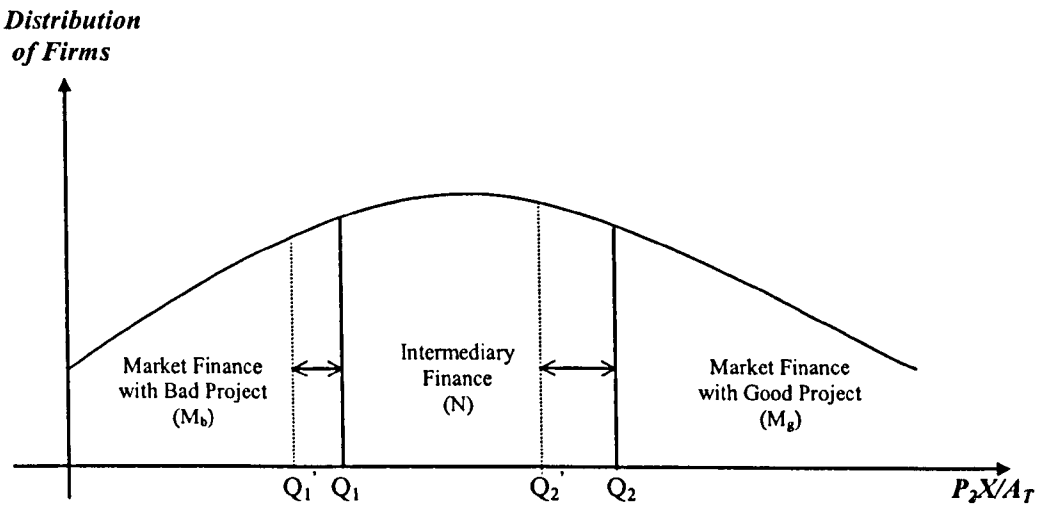


Figure 3.1: The impact of firm size on the type of finance (Project size is fixed)

However, if *the project size is proportional to total assets* as assumed in the original model, the upper critical point does not change while the lower critical point decreases, that is, the interval for profitability that satisfies intermediary finance expands (Figure 3.2). In both cases, whether the project size is proportional to asset size or not, an increase in the firm size raises the number of firms that choose good projects given a relatively low monitoring cost.

$$\frac{\partial^2 N}{\partial S \partial F} > 0 \qquad \frac{\partial^2 M_b}{\partial S \partial F} < 0$$

[7] Total market finance (M) is the sum of direct finance for good and bad projects ($M = M_g + M_b$).

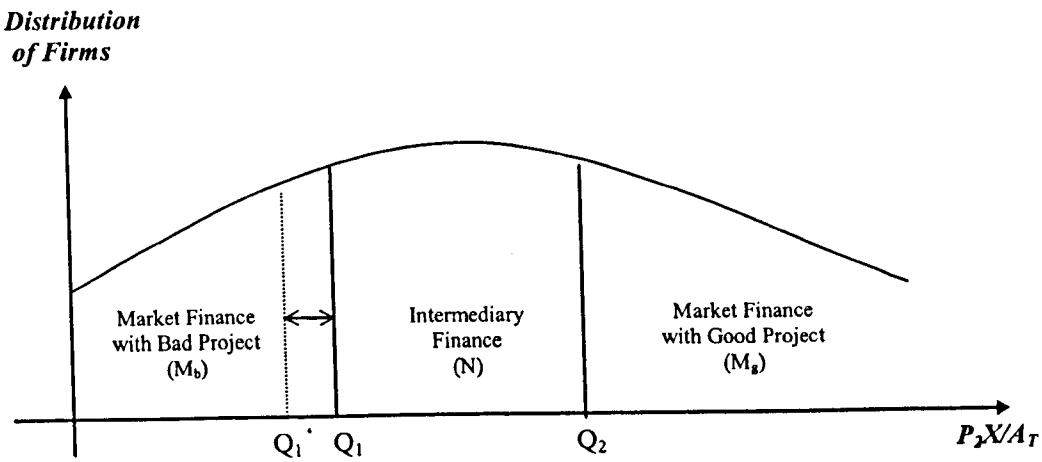


Figure 3.2: The impact of change in firm size on the type of finance (Project size is proportional to total assets)

Probabilities of the Success of Projects (Distribution of Risk)

A relative change in the project success probabilities may be interpreted as variability in the risk distribution. Let us then denote the risk factor term $(p_2 - p_1)$ by $\rho > 0$. In the formulation given in (3.14), an increase in the probability of success of the good project (Project 2), relative to the probability of success of the bad project (Project 1), an increase in ρ, (or a decline in risk) leads the critical points to shift to the left (Figure 3.3).[8] The decline in the lower critical points will be larger than the upper critical level in absolute value. This implies that a lower level of risk reduces the number of bad projects while it increases the interval for intermediary finance. The share of intermediary finance depends on the relative movement of critical points as well as on the distribution of firms. In short, in an environment where the risk is substantial, firms tend to choose the inefficient project, which in turn impedes investment and overall real activity.

$$\frac{\partial Q_1}{\partial \rho} = -\frac{bp_2}{\alpha \rho^2} - \frac{m(1+r)p_2}{\alpha A_T \rho^2} < 0 \qquad (3.18)$$

$$\frac{\partial Q_2}{\partial \rho} = -\frac{bp_2}{\alpha \rho^2} < 0 \quad \text{and} \quad \left|\frac{\partial Q_2}{\partial \rho}\right| < \left|\frac{\partial Q_1}{\partial \rho}\right| \qquad (3.19)$$

[8] Similar results are obtained for $\rho = p_2 - p_1$. An increase in risk (a decline in ρ) causes the moral hazard problem to be more serious and this increases the incentive to select the bad project.

The above imply that *ceteris paribus* a lower level of risk increases the number of firms that have access to low-cost market finance. In our model, under a uniform distribution, there is an increase in the interval of intermediary finance.[9]

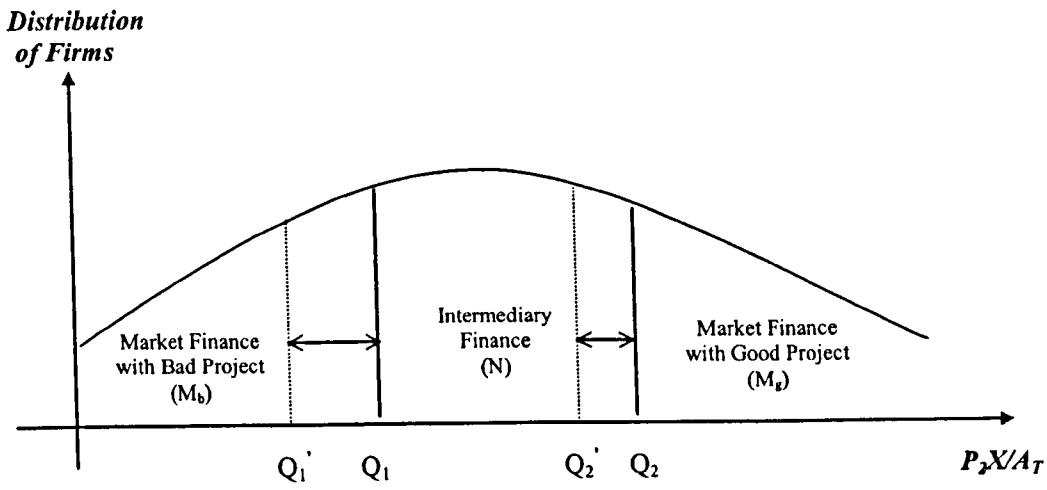


Figure 3.3: The impact of a change in probabilities of success on the type of finance

Collateral Assets and Debt

An increase in collateral assets relative to total assets is expected to improve the net worth as well as the cash-flow positions of all firms, which in turn stimulates real economic activity. A higher level of collateral assets, everything else remaining equal, causes the upper critical point to decline and thus intermediary finance diminishes in favour of M_g. In other words, a firm that has relatively abundant collateral assets can finance the good project directly from financial markets with a low cost (it tends to choose socially efficient projects). Since collateral assets do not appear in the lower critical point, intermediary finance will decline independently of the shape of distribution as a result of a rise in collateral assets and the firm with a high value of collateral assets will borrow directly from the market and avoid the monitoring cost (Figure 3.4).

Small firms' financial positions are relatively more sensitive to a change in their collateral assets. That is, the magnitude of the change in the upper critical point would be larger for small firms as a result of a marginal change in collateral assets. In relatively

[9] This point is dependent on the relative movement of critical points, and therefore the assumptions about the distribution of firms.

rich countries with developed financial markets where firms on average have large assets, the share of bank finance gets smaller, as only highly financially constrained firms raise funds from intermediary institutions. Similar results are reached when the net worth ($W = A_C - D_E$) is used instead of collateral assets.

$$\frac{\partial Q_2}{\partial A_C} = -\frac{1}{A_T} \text{ and } \frac{\partial Q_1}{\partial A_C} = \frac{\partial Q_1}{\partial W} = 0 \qquad (3.20)$$

$$\left|\frac{\partial Q_2}{\partial A_C}\right|_{SF} > \left|\frac{\partial Q_2}{\partial A_C}\right|_{LF} \quad \frac{\partial M_g}{\partial A_C} > 0 \text{ and } \frac{\partial N}{\partial A_C} < 0 \qquad (3.21)$$

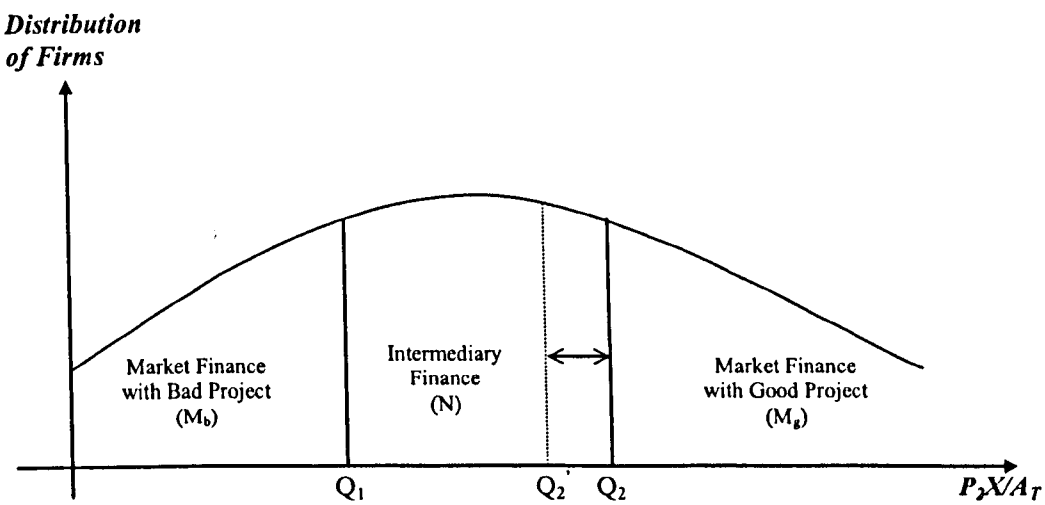


Figure 3.4: The impact of a change in collateral assets on the type of finance

Existing debt is another important variable that determines the strength of the balance sheet of firms. A firm that has a large debt is more likely to finance its good project through intermediary finance. The impact of debt on the equilibrium condition given in (3.14) is just the opposite of collateral assets. That is, an increase in existing debt causes the upper critical point to increase, thus the demand for intermediary finance relative to market finance increases. As in the case of collateral assets, the existing debt does not affect the lower critical point.

$$\frac{\partial Q_2}{\partial D_E} = \frac{1}{A_T} > 0 \text{ and } \frac{\partial Q_1}{\partial D_E} = 0 \qquad (3.22)$$

In addition to the variables discussed above, the interest rate, the project size, and the distribution of risk are the other variables that appear in the upper critical level and thus also play an important role in differentiating the external cost among forms of finance for a given project. These variables enable us to derive some empirical implications about the composition of external finance. Firms with profitability just below the upper critical point are no longer paying a monitoring cost as a result of an increase in the value of collateral assets (or net worth) of the firms. This leads to a reduction in the investment cost and thus to an increase in investment and real activity.

A shock that affects the net worth of firms positively induces them to issue commercial or corporate bonds that reduce the interest cost of firms by the amount of the liquidity premium. On the other hand, a negative shock reduces the present value of collateral assets while it increases the real value of existing debt. This increases the cost of issuing commercial paper for short-term finance, thus the demand for intermediary finance, which is more flexible for firm relative to bond finance, increases.

Project Payoff

By using an alternative presentation that is derived below, one can observe the impact of a change in the project payoff *(X)* on the critical points of the collateral ratio *(A_C/A_T)*. Good projects are chosen as the project payoffs rise, everything else remains equal. If p_2 is sufficiently low the composition of external finance changes in favour of bank finance as the project payoff increases.

$$\frac{bA_C}{\alpha(p_2-p_1)X-\alpha m(1+r)} \le \frac{A_C}{A_T} \le \frac{bp_2}{\alpha(p_2-p_1)} + \frac{F(1+r)}{A_T} + \frac{D_E}{A_T} - \frac{p_2X}{A_T} \qquad (3.23)$$

$$C_1 = \frac{bA_C}{\alpha(p_2-p_1)X-\alpha m(1+r)}, \quad C_2 = \frac{bp_2}{\alpha(p_2-p_1)} + \frac{F(1+r)+D_E-p_2X}{A_T}$$

$$\frac{\partial C_1}{\partial X} = -\frac{bA_C(p_1-p_2)}{\alpha\{(p2-pi)X-m(1+r)\}^2} < 0 \qquad (3.24)$$

$$\frac{\partial C_2}{\partial X} = -\frac{p_2}{A_T} < 0 \qquad (3.25)$$

Suppose that firms can be differentiated in terms of project revenue or profitability (p_2X) and the high technology firms are defined in such a way that their payoff is high but their probability of success of the good project is low relative to the average firm. Then, these firms are expected to be more bank-dependent, everything else remaining equal. As firms' payoff rises above the average the number of good projects increases, but if the risk is high enough (or there is a low p_2), bank finance is preferred. Especially in developed economies where the number of high technology firms has been increasing, the need for bank finance is expected to increase over time. However, since banks are not specialized in evaluating high technology projects (high risk-high growth projects), it is difficult for firms to raise intermediary funds by choosing such projects.

Project Size

The size of the investment project undertaken by the firm also determines the type of external finance. Since the project size appears only in the upper critical point, it does not affect the choice between bad and good projects while it affects the choice between intermediary finance and market finance for good projects. The model implicitly implies an optimal project size that satisfies $F(1+r) > A_C - D_E$. That is, the future value of the project evaluated in terms of market interest rate at the end of next period should be higher than the present net worth of the firm. This implies that intermediary finance is optimal for the firm when its net worth is less than the investment. If the project size is smaller than the minimum level satisfying $F(1+r) > A_C - D_E$, the firm no longer needs external finance and the project can be fully financed by internal funds.

If the project size is large relative to total assets, the firm is most likely to finance the project through intermediary finance. A firm that has relatively few assets cannot finance a large project through market finance. An increase in the project size leads the upper critical point to move upward. The movement in the critical point as a result of a marginal change in the project size would be limited for large firms *(LF)* relative to small firms *(SF)* in terms of total assets. That is, the selection of project size is more critical for small firms for raising funds through the market.

$$\frac{\partial Q_2}{\partial F} = \frac{(1+r)}{A_T} > 0 \qquad \left[\frac{\partial Q_2}{\partial F}\right]_{SF} > \left[\frac{\partial Q_2}{\partial F}\right]_{LF} \tag{3.26}$$

Expected Profitability

It is clear from (3.14) that p_2X/A_T plays a central role in the model. The numerator is equal to expected revenues while the denominator is equal to total assets thus the ratio is a measure of the expected rate of return or profitability[10]. The model predicts that firms fall into three groups according to their profitability (after controlling for other firm characteristics) profitability affects their access to various financing options. High-profit firms finance their projects by borrowing directly from the capital market at a low interest rate. Firms with moderate profits do not have access to low interest financing in the capital market and borrow from banks. Finally, low-profit firms that cannot raise funds from banks must find alternative forms of finance, if available. Empirical evidence among UK firms suggests that there is heterogeneity in the investment returns of firms when the distinction is drawn between financially constrained and unconstrained firms (see Basu and Guariglia, 2002).

This logic implies that there is a link between sources of finance and rate of return or profitability. An empirical test that confirms the link between profitability, as a proxy for p_2X/A_T, and forms of finance would offer some initial support for the theoretical framework.

3.3.2. Introducing Monetary Policy

It is generally accepted that the central bank controls monetary stance by altering market interest rates through open market operations. In the traditional money view of the monetary transmission, the interest rate affects real activity only through an increase in the cost of capital. However, according to the credit channel it also affects the present value of internal funds (net worth), which in turn determines the cost and the type of external finance given the informational asymmetries and incentive problems between lenders and borrowers.

[10] Hoshi *et al.* (1993) refer to this term as Tobin's Q because they use the Tobin's Q measure in the empirical implementation of their model.

The interest rate is introduced into the model in order to examine the implications of monetary policy for the transmission mechanism. First, we introduce a market interest rate as a measure of the opportunity cost of finance that allows us to measure the impact of monetary policy on the choice of finance. Second, the traditional balance sheet channel indicates that higher interest rates result in higher repayments, lower retained profits and therefore weaker balance sheets of firms (see Bernanke and Gertler, 1995; Bernanke, Gertler and Gilchrist, 1996). Therefore we assume that the net worth ratio, $(A_C - D_E)/A_T$, denoted ω, is a decreasing function of the interest rate, $\partial\omega(r)/\partial r < 0$. An increase in the interest rate requires a high repayment to the lender while it weakens the balance sheet of the firm (a decline in cash flow or net worth), which makes external finance more expensive[11].

$$\frac{m(1+r)p_2}{(p_2-p_1)A_T}+\frac{p_2 b}{\alpha(p_2-p_1)}\leq\frac{p_2 X}{A_T}\leq\frac{p_2 b}{\alpha(p_2-p_1)}+\frac{F(1+r)}{A_T}-\omega(r) \qquad (3.27)$$

A higher interest rate implies an upward movement of the upper and the lower critical points. The relative movement of the critical points depends on the *sensitivity of the net worth ratio to the interest rate*, the distribution of risk, total assets, the project size and the monitoring cost. If the net worth ratio were sufficiently sensitive to the interest rate, the change in the upper critical point would be larger. This implies that a higher interest rate increases the demand for intermediary finance more for those firms whose net-worth ratios are more sensitive to changes in the interest rate. If the net worth ratios of a group of firms are not sensitive to the interest rate (those firms that hedge against the policy changes), the demand of these firms for intermediary finance would be less relative to those that are financially weak[12]. This result confirms the financial accelerator theory in which the credit market conditions amplify and propagate the impacts of monetary shocks on firms' real activity when balance sheet variables are sensitive to these shocks (Bernanke, Gertler and Gilchrist, 1996)

[11] See Gertler and Gilchrist (1994), or Kashyap, Lamont and Stein (1994) for evidence consistent with the balance sheet channel of monetary policy.

[12] It is generally claimed that large and relatively strong balance sheet firms are not affected very much by policy changes.

$$\frac{\partial Q_1}{\partial r} = \frac{mp_2}{(p_2 - p_1)A_T} > 0 , \qquad \frac{\partial Q_2}{\partial r} = \frac{F}{A_T} - \frac{\partial \omega}{\partial r} > 0 \qquad (3.28)$$

Intermediate and market finance co-exist if the following expression, holds even when net worth is independent of the interest rate,

$$\frac{\partial Q_2}{\partial r} > \frac{\partial Q_1}{\partial r} \qquad (3.29)$$

This means that as interest rates decrease, firms that experience an increase in the ratio of market to intermediary finance should have higher rates of return compared to those firms that experience a corresponding decrease[13]. In addition, the above expressions suggest that since net worth affects only the upper limit, the more sensitive net worth is to interest rate changes, i.e. the higher $\left|\frac{\partial \omega}{\partial r}\right|$, the greater the effect of a change in interest rates on the upper limit. The firms whose net worth is more sensitive to interest rate changes are more likely to switch the sources of finance. Since the shift in the upper critical point is larger, few firms will have access to the market as the interest rate increases conditional on firm distribution. More specifically, an increase in the interest rate leads to a decline in the number of good projects while it increases the range of profitability values for the intermediary finance (Figure 3.5).

However, as the interest rate increases, the mix (ratio of intermediary finance to market finance) may rise or fall depending not only on the distribution of firms but also on the original values of the critical points that contain information about the characteristics of the firms and financial markets.

[13] A change in the interest rates affects both the upper and the lower critical points therefore without knowing the exact distribution we cannot make any claims about the changes in total market and total intermediary finance. However, we know that firms around the lower critical point (Q_1) are firms who have a low expected return from good project and firms around the upper critical point (Q_2) are firms who have a high-expected return from the good project. Therefore, after a decrease in the interest rates, firms around Q_1 should substitute intermediary finance for high-cost market finance and firms around Q_2 should substitute low-cost market finance for intermediary finance.

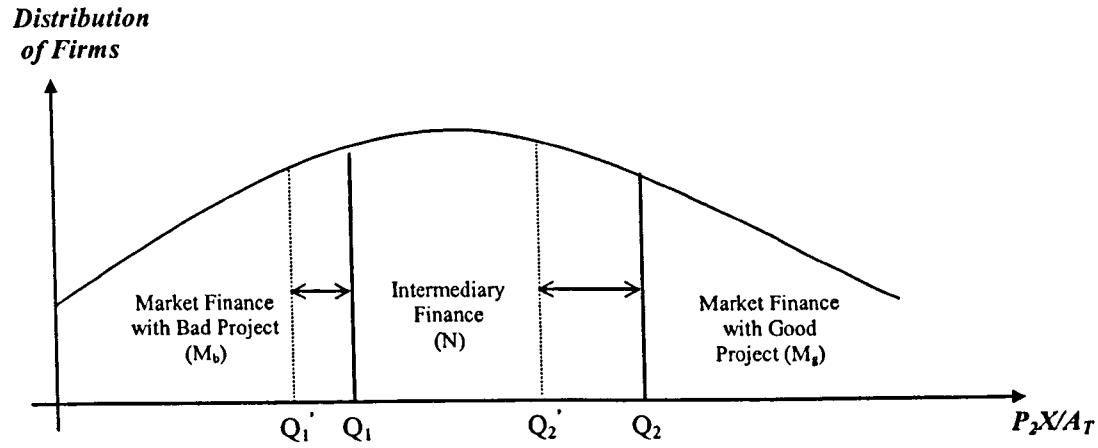


Figure 3.5: The impact of the interest rate on the type of finance (Normally distributed firms in terms of profitability)

If, for example, firms are distributed uniformly in terms of their profitability, the demand for intermediary finance is expected to increase as a result of a tight monetary policy whatever the values of the critical points are. That is, the ratio of intermediary finance to total external finance tends to increase as a result of an increase in the interest rate (Figure 3.6). However, banks avoid supplying loans to the firms that have financial difficulties during the tight policy periods, which leads to a 'credit crunch'.

$$\frac{\partial MIX}{\partial r} > 0 \qquad (3.30)$$

Monetary Policy and Size

This model supports the proposition that in economies where large and well-capitalized firms are dominant, a contractionary monetary policy is expected to have only a limited impact on overall economic activity. In fact, small poorly capitalized firms are more subject to default and their financial positions are more sensitive to policy shocks. Specifically, the change in critical points stemming from a tight monetary policy is relatively high for small firms and thus they are more likely to be subject to financial constraints. That is, they confront relatively more difficulties in satisfying the conditions for intermediary finance. This fact is supported by empirical evidence that indicates that small and poorly capitalized firms are more subject to financial constraints in tight

periods and thus their investments (especially inventory) slow down significantly more relative to that of large and well-capitalized firms.

$$\frac{\partial Q_1^{\,2}}{\partial r \partial A_T} = -\frac{mp_2}{\rho A_T^2} < 0 \;, \quad \frac{\partial^2 Q_2}{\partial r \partial A_T} = -\frac{F}{A_T^2} < 0 \qquad (3.31)$$

$$\left|\frac{\partial Q_1}{\partial r}\right|_{SF} > \left|\frac{\partial Q_1}{\partial r}\right|_{LF} \text{ and } \left|\frac{\partial Q_2}{\partial r}\right|_{SF} > \left|\frac{\partial Q_2}{\partial r}\right|_{LF} \qquad (3.32)$$

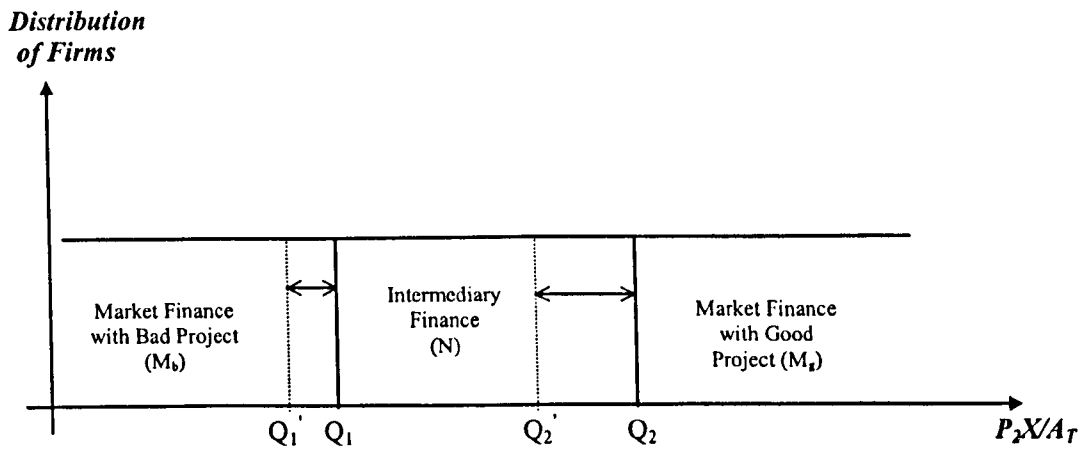


Figure 3.6: The impact of the interest rate on the type of finance (Uniformly distributed firms in terms of their profitability)

Assuming that the project size is proportional to asset size as in the original model, the impact is going to be only on the lower critical point, that is:

$$\frac{\partial Q_1^{\,2}}{\partial r \partial A_T} = -\frac{mp_2}{\rho A_T^2} < 0 \;, \quad \frac{\partial^2 Q_2}{\partial r \partial A_T} = 0$$

As firm size increases, the impact of a rise in interest rates on the composition of firm finance will be less significant. Smaller firms are more sensitive to the tightening of monetary policy and are more likely to switch from intermediary finance to other sources lower down the pecking order.

Monetary Policy and Riskiness

Access to intermediary finance when monetary policy is tight depends very much on the risk factor. The sensitivity of the lower critical value to a change in interest rates falls with ρ, (a higher ρ implies lower risk). The impact of monetary policy is more substantial for risky firms. For high-risk firms *(HR)*, i.e. high-technology firms, the change in the lower critical point with a policy shock will be higher relative to low-risk firms *(LR)*. That is, the demand for intermediary finance will be low for high-risk firms and thus the relative share of bad projects is expected to be higher for these firms.

$$\frac{\partial Q_1^{\,2}}{\partial r \partial \rho} = -\frac{mp_{\,2}}{\rho^{\,2} A_T} < 0 \quad \text{or} \quad \left[\frac{\partial Q_1}{\partial r}\right]_{HR} > \left[\frac{\partial Q_1}{\partial r}\right]_{LR} \qquad (3.33)$$

As the risk factor increases, i.e. ρ declines, firms are more likely to adopt socially inefficient projects. That is, the decline in the ratio of intermediary finance to market finance would be more severe for high-risk firms as a result of an increase in interest rates.

Monetary Policy and the Mix

The impact of monetary policy on the bank loan supply has been discussed in literature on the lending channel of monetary policy transmission. The credit channel becomes stronger when the bank loan supply is sensitive to policy changes. In fact, whether an independent lending channel exists or not, the broad credit channel implies that a monetary policy shock affects real activity by changing the wedges between external and internal finance as well as between intermediary finance and market finance. These effects on the cost of finance in turn substantially influence the investment decisions of firms that have to use external finance. In other words, as the collateral assets of firms that have profitability measures just over the upper critical point decrease (say as a result of a tight monetary policy), the firms that are on the margin tend to shift from market finance to intermediary finance where monitoring costs are lower (M_g declines). If the bank loans supply does not satisfy the increase in the demand for bank loans, then bank loans become more expensive as a result of rising lending rates.

Contrary to the theoretical framework so far discussed, the evidence from aggregate data shows that the mix variable (ratio of bank loans to the sum of bank loans and commercial papers) decreases with a tight monetary policy (Kashyap *et al*, 1993). This result can be interpreted as confirmation of the lending channel (a decline in the bank loans relative to bond issue). The present model may support the results of Kashyap *et al* (1993) if one allows for an increase in the premium related to the monitoring cost during contractionary periods when the lower critical point shifts up leading to a large volume of market finance. In other words, suppose that the monitoring cost is a decreasing function of economy-wide collateral assets, then a decline in the value of collateral assets may induce the mix to decrease and this fact does not necessarily imply the existence of a bank-lending channel. In countries where intermediary institutions are well organized and regulated in such a way that shocks have a limited impact on the monitoring cost, the impact of a negative shock on real activity is expected to be less significant.

$$\frac{\partial M}{\partial A_C} > 0\,,\ \frac{\partial MIX}{\partial A_C} < 0 \quad \text{and} \quad \frac{\partial^2 MIX}{\partial A_C \partial m} > 0 \qquad (3.34)$$

The argument that the volume of commercial paper (market finance) decreases (procyclical) or increases (countercyclical) during contractionary periods depends not only on the bank loan supply but also on monitoring costs, bank capital, the probabilities of success of good or bad projects, the project payoff, total assets size as well as the distribution of wealth and profitability. In fact, it is generally claimed that despite the counter-cyclicality of aggregate commercial paper, firm level commercial paper is pro-cyclical. That is, the characteristics of the commercial paper issuers play an important role in this contradiction. Firms with strong balance sheets and high cash flows can serve as intermediaries for small and financially weak firms that do not get access to bank loans during downturns through extending trade credits. This argument is supported by the fact that the portfolio demand for commercial paper (highly liquid and safe assets) issued by financially strong firms increases during contractionary periods – flight to quality.

3.5. Conclusion

The model that we used in this study is based on a simple moral hazard problem between entrepreneurs and suppliers of external funds, i.e., direct finance from the market

and intermediary finance in which the moral hazard problem is ameliorated through monitoring. The credit market equilibrium is based on the investment opportunities of firms. We derived some comparative statics allowing us to analyse the factors that play an important role in determining the composition of external finance. Since it is not costless to shift among different forms of finance, a shock that changes the composition of firm finance is likely to be influential over the investment and production decisions of firms. Incorporating firm heterogeneity into this framework enriches the predictions of the model where the distribution of firms in terms of their profitability is the cornerstone of our analysis.

In general, during tight monetary policy periods, the net worth of firms tends to contract because of a decline in the present value of collateral assets and an increase in interest payments. This expands the demand for intermediary funds, and in turn, distresses the firms that need external funds and, eventually, the lending rate increases for the given supply of intermediary funds. The moral hazard problem potentially becomes more severe as the lending rate goes up and firm managers tend to prefer bad projects to maximize their private benefits. Banks or other intermediary institutions overcome the moral hazard problem to some extent by rationing loans and by monitoring their clients.

Firm size, collateral assets, and the probability of success (distribution of risk) are found to be important factors that determine the form of finance. Small firms with few collateral assets depend more on intermediary finance that lessens the extent of the moral hazard problem. The model implies that an increase in the firm size, collateral assets and higher chances of success of the good project raise the possibility of financing the socially efficient project through market finance which is less costly. More specifically, the model supports the evidence that small and poorly capitalized firms that have few collateral assets and high risk are more subject to financial constraints under a tight monetary policy. Small firms' managers have a tendency of selecting socially inefficient projects (bad projects) to avoid paying the monitoring cost as a result of an increase in the interest rate (a change in monetary policy). Therefore, during recessions, a slowdown in the activities of small firms will be more severe relative to that of large and well-capitalized firms.

A tight monetary policy increases the demand for intermediary finance more for those firms whose net-worth ratios are more sensitive to changes in the interest rate. If the net worth ratios of a group of firms are not sensitive to the interest rate (those firms that hedge against the policy changes), the demand of these firms for intermediary finance would be lower relative to that of financially weak firms. However, financially weak firms are more likely to be subject to the moral hazard problem. Therefore, intermediary institutions are reluctant to extend funds to these firms.

In this chapter we employed a model that allows for a wide range of factors affecting the demand for external finance. That is, the model is generally based on the variables related to the financial positions of corporations. On the supply side, however, the financial positions of the banks and households become crucial for deriving a complete picture about the implications of financial market imperfections for the real activity. The inclusion of the financial structure of banks or households and the factors that affect fund supply behaviours will improve the framework that aims to understand the impact of monetary policy on firms' financial positions and thus real activity.

CHAPTER FOUR

A Descriptive Analysis of the UK Corporate Sector and the Data[1]

4.1. Introduction

The corporate sector plays an important role for the performance of real economic activity. Business fluctuations in this sector have close links with the overall business cycle. Specifically, the corporate sector has an important influence on the real economy as well as on the stability of the financial system through its links with the banking sector and financial markets. A healthier corporate sector in terms of collateral implies a well functioning financial sector and vice versa. For example, in the recession of the early 1990s in the UK, small non-financial firms that could not pay their bank loans back disrupted the functioning of the banking system. The literature investigating the link between monetary policy and corporate sector performance has been growing very rapidly as we discussed in other chapters.

Understanding the link between the corporate sector, economic performance and the financial system is an important step towards understanding business cycles. The theoretical and empirical literatures have intensively focused on this link and concluded that the depth and duration of recessions are very much related to reactions of corporate firms to external shocks, which depend very much on the financial positions of individual firms. Fisher (1933), Mishkin (1978) and Bernanke (1983) presented evidence that the indebtedness of non-financial firms played an important role in the Great Depression. More specifically, according to the debt deflation theory firms that are highly indebted during a phase of economic slow down, in order to avoid bankruptcy, tend to either sell their assets to compensate for the reduction in cash flow or to repay their debt, which in turn, leads to a decline in asset prices and net worth.

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[1] By corporate sector we mean non-financial firms.

By adapting moral hazard and adverse selection approaches to the credit markets, a number of micro and macro credit market models investigate the role of corporate financial structure for macroeconomic fluctuations. Mankiw (1976) shows how an increase in interest rates could cause a failure of financial markets and thus provoke financial crises in the presence of asymmetric information. Bernanke and Gertler (1990) conclude that firms without access to credit markets would reduce investment demand if their net worth were not high enough. In addition, Kiyotaki and Moore (1997) show that the extent of collateral assets determines the amount of external finance that firms can obtain.

In section two, we highlight some stylised facts about the UK macroeconomic environment, and their interaction with overall economic performance. We overview basic developments in the manufacturing industry and its importance for the UK economy based on some real and financial indicators during the 1990s. In section three, we provide information on the methodology by which we create the sample by using the FAME data set. In the same section, we also explain the basic trends and problems in the FAME sample used in the empirical analyses of the following chapters. In the last section we summarise.

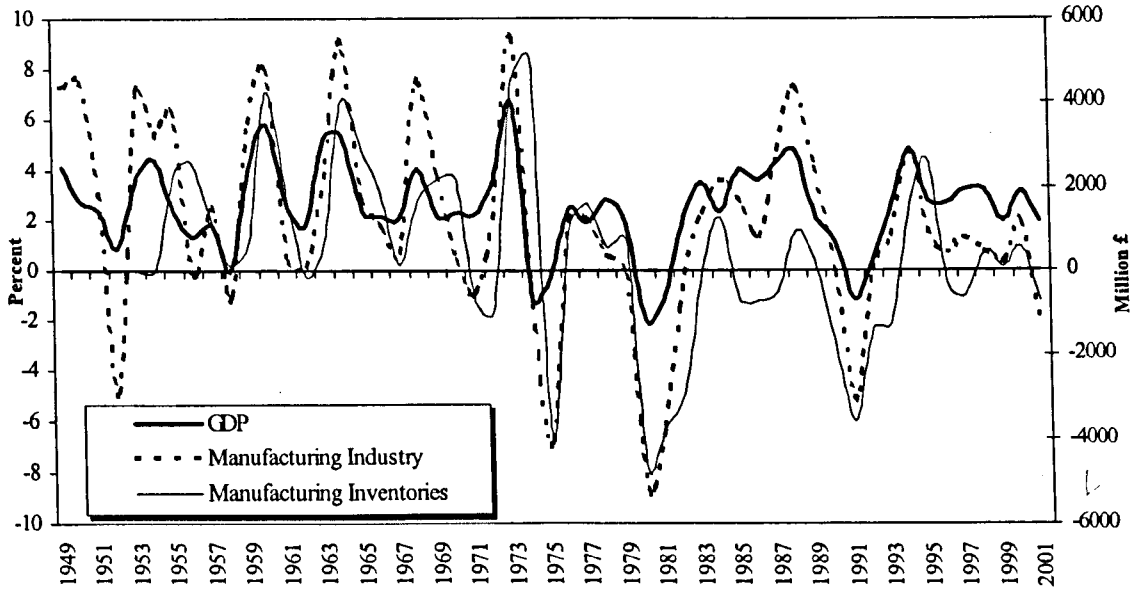
4.2. Business Fluctuations and the Manufacturing Industry

4.2.1. Some Observations

The growth cycles of the overall economy and the manufacturing industry exhibit quite similar patterns in the UK. The correlation coefficient between the manufacturing industry and the overall economic growth rates has been historically high, 0.85 during the 1949-2001 period and 0.90 during the 1970-2001 period.[2] A similar pattern can be observed among the growth rate of GDP, manufacturing inventories and business investments. As it is clear from Figure 4.1, the change in inventories is generally pro-cyclical as the empirical and theoretical evidence suggests.[3] Fluctuations in GDP are smoother than those of investment and the value added of manufacturing industry. This result implies that manufacturing industry as a component of aggregate activity is one of the most important sources of business cycle fluctuations in terms of sectoral decomposition. A large part of manufacturing output is made up of the goods whose demand has cyclical characteristics.

[2] It would not be wrong to derive some implications about the source of business cycle in the whole economy by analysing only the impact of external shocks on the manufacturing industry.
[3] See Blinder and Maccini (1991), Carpenter, Fazzari and Petersen (1994, 1998), Kashyap, Lamont and Stein (1994) and Gertler and Gilchrist (1994) for empirical evidence on US inventory investments and Guariglia (1999, 2000) and Schiantarelli and Guariglia (1998), Small (2000) for evidence on the UK.

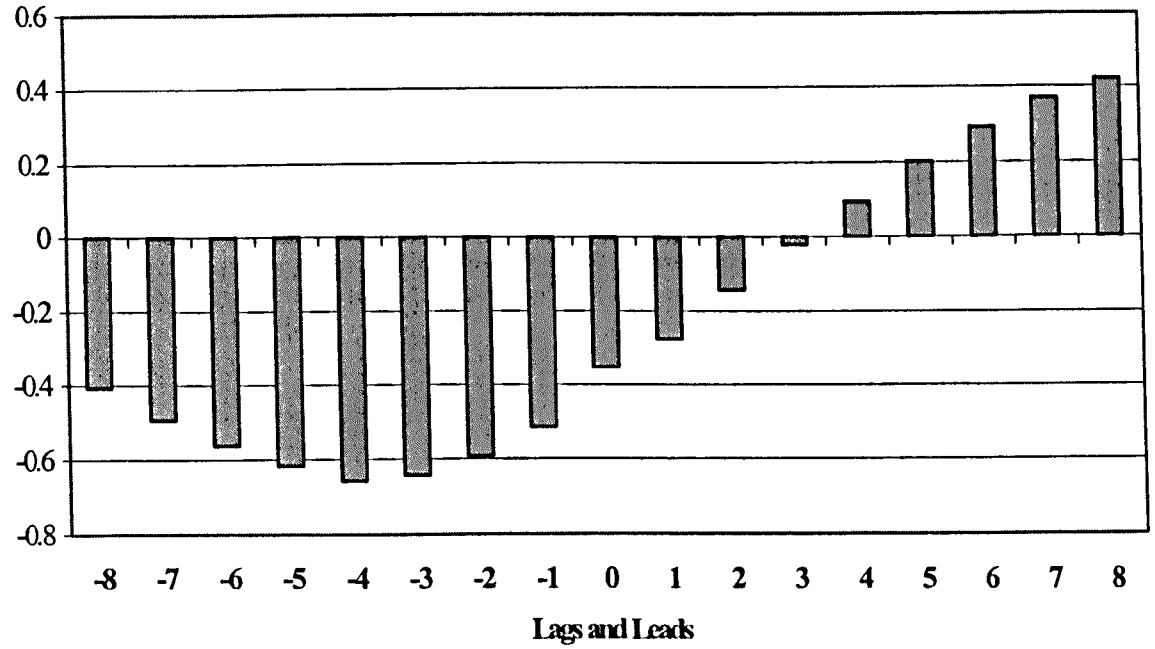
Figure 4.1: Growth Rates of Total and Manufacturing Value Added, Change in Manufacturing Inventories, at 1995 prices



Monetary policy is an instrument in managing aggregate demand and smoothing the fluctuations in the economy. The Bank of England loosens the money supply by reducing interest rates when the economy weakens and it tightens it as the economy strengthens. The endogenous character of the policy response makes it difficult to identify the effects of monetary policy separately from cyclical effects. Figure 4.2 shows the correlation between quarterly lags and leads of the base rate and the GDP growth rate. A negative correlation between lags of interest rates and the GDP growth rate may imply that an increase in interest rates is followed by a decline in the GDP growth rate. The negative correlation reaches its peak point after a one-year lag and diminishes gradually as the lag increases.

On the other hand, a positive correlation between at least a one-year lead of interest rates and the GDP growth rate may be considered as evidence that a boom in the economy is followed by an increase in the interest rate. This is consistent with a demand managing policy that undermines inflationary pressures. In addition, policy changes sometimes affect the economy more deeply than expected in the sense that a surprise rise in interest rates may lead to a recession whose deepness depends on the extent of inherited information asymmetries in the economy.

Figure 4.2: Correlation Between GDP Growth Rate and Lags and Leads of Base Rate, Quarterly, 1985-2001

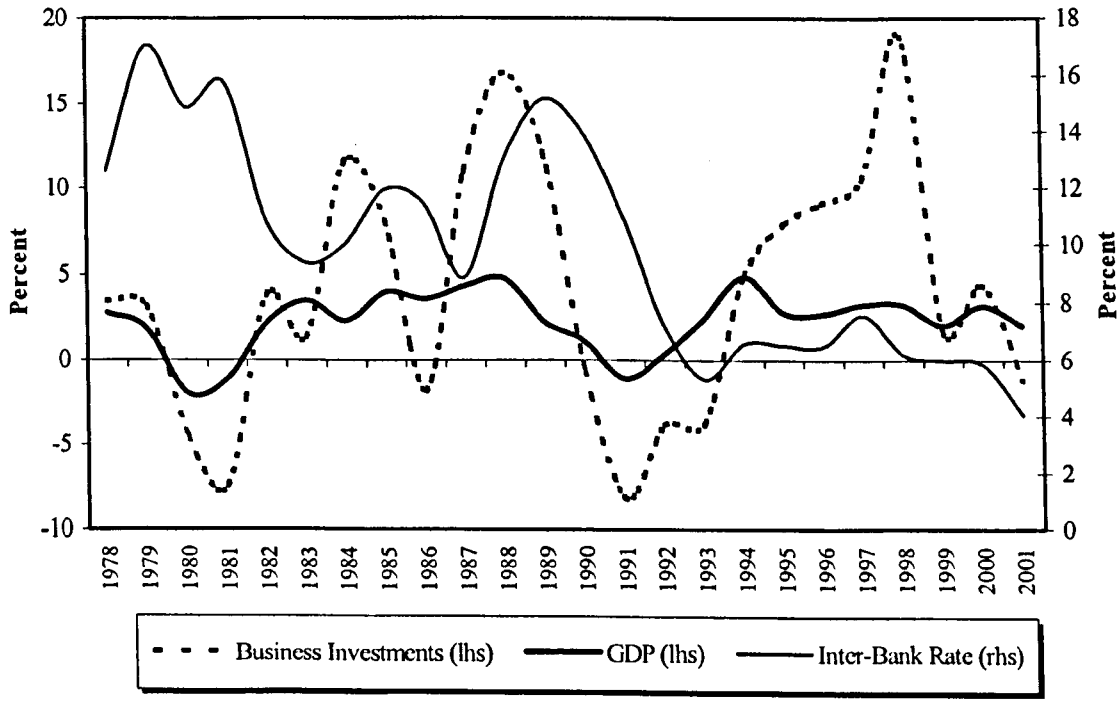


The factors explaining business investment fluctuations have been an important topic in both the theoretical and the empirical literature. According to the Modigliani-Miller theory, financial factors do not influence investment decisions. Recent literature that introduces imperfect information concludes that financial positions of corporate firms play a crucial role for investment decisions. This literature clearly implies that the financial positions of individual firms are very much sensitive to macroeconomic policies either directly or through financial markets. Well-organised and efficient financial markets are expected to smooth the negative impact of macroeconomic shocks on business investments (Leahy *et al.*, 2001; Tsuru, 2000).

Figure 4.3 gives an idea about the movements of investment and the interest rate. These variables exhibit opposite patterns especially before the recession of the early 1990s, but the pattern seems to be mildly pro-cyclical after the recession. In addition, there is also a noticeable shift in the amplitude of the cycle from 1990 onwards i.e. it is very muted and has a lower mean value. Business investment growth is highly subject to fluctuations compared to GDP growth, that is, the standard deviation of the former is calculated to be four times higher than the one for the latter during the period of 1978-

2001. Alongside a decline in the price of capital goods, the low interest rate is another factor that supported the rise in business investment after the recession. The real user cost of capital in the second half of the 1990s declined substantially parallel to a five percentage point fall in the real interest rate since 1994 (CBI, 2001).

Figure 4.3: Business Investments and GDP Growth, Inter-Bank Rates



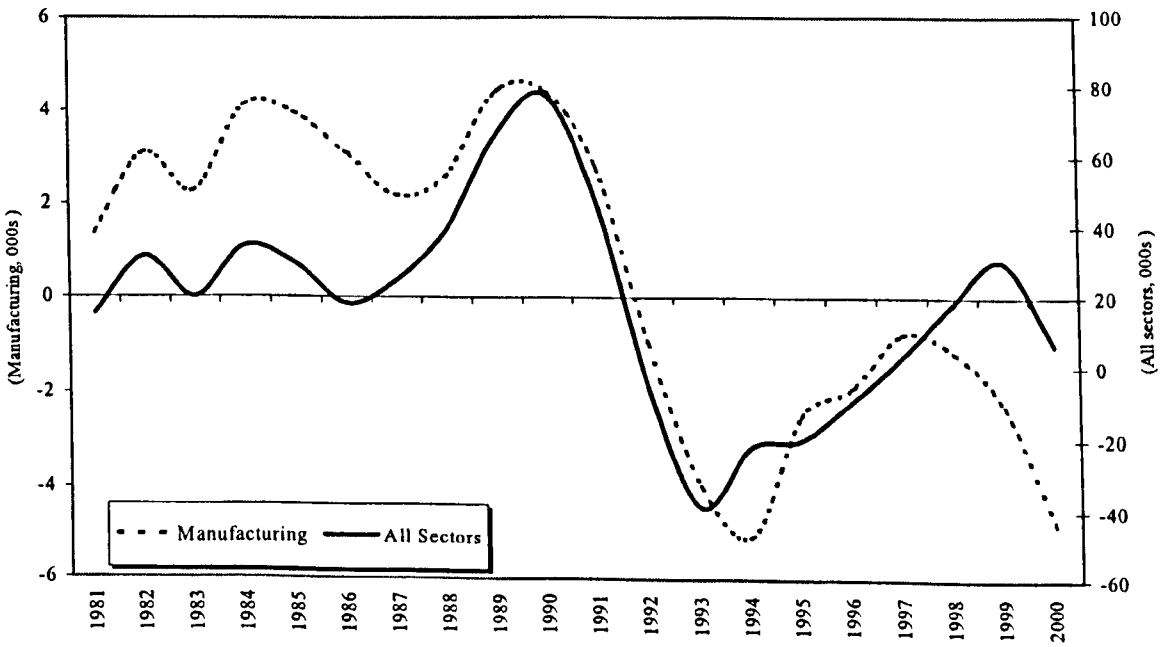
More specifically, a lower and stable inflation environment led to a fall in the cost of finance through the decline in the equity and the inflation risk premiums during the second half of the 1990s. Financial liberalisation let firms raise funds in a more competitive environment where monitoring cost declined, as a result of the improvement in the operations of the financial system and the fact that the corporate bond market became more liquid. In addition, a decline in government consumption has created additional funds in the capital market for business investment in the same period (Bakhshi and Thompson, 2002).

The theory of asymmetric information implies that the reactions of firms to the external shocks in an imperfect market environment are not homogeneous. In fact, firms that are financially strong in terms of net worth are supposed to be less vulnerable to negative shocks compared to financially weak firms who are highly dependent on

external funds. It is generally claimed that financial factors played a major role in the recession of early 1990s, because small non-financial firms were substantially dependent on external borrowing before the slowdown in the economy. Therefore, insolvency and liquidity problems that became serious during the recession in the early 1990s led to an increase in business failures. The financial position of corporations then played an important role in these business failures because it influenced banks' willingness to lend (Vlieghe, 2001; Lund and Wright, 1999; Hoggarth and Chrystal, 1998).

Two main reasons for corporate failure can be forwarded: firstly, a decline in the investment demand as a result of the reduction in cash flow (liquidity constraint), secondly a reduction of the net worth of firms as a result of increases in the real interest rates and in the cost of intermediation (insolvency). Figures 4.4 and 4.5 give information about the VAT registration-based business closures and start-ups during the recession in the early 1990s. Net business start-ups (start-ups minus closures) declined substantially and business closures increased proportionally compared to the total number of registered firms. These figures give a rough guide as to the extent of the destruction of small-scaled businesses during the recession. The closures were more widespread among young and small firms who encountered financial difficulty more frequently than large and mature firms. Another stylised fact is worthy of emphasis here: the slowdown in the business

Figure 4.4: Difference Between Business Startups and Closures

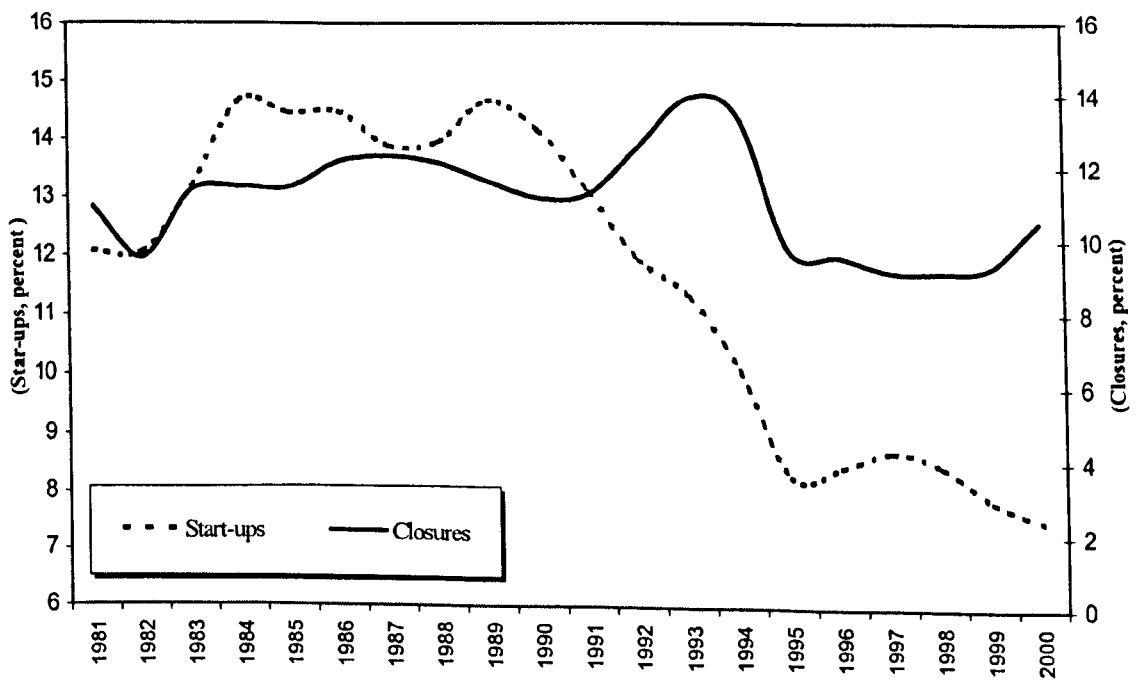


investments during the early 1990s was more dramatic compared to the one during the early 1980s recession. This fact is generally attributed to the high indebtedness of the corporate sector in the early 1990s relative to the previous recession (Hall, 2001; Hoggarth and Chrystal, 1998).

Since the real activity of small firms is more sensitive to financial constraints and to general economic slowdown, the small firm sector is important for understanding economic fluctuations. In fact, small firms make a significant contribution to overall economic production in the UK. For example, firms with 49 or fewer employees (including self-employed businesses) accounted for 38 percent of total turnover and 44 percent of total employment in 1999. These figures are relatively low for the manufacturing sector, that is, small firms accounted for only 29 percent of manufacturing employment and 19.3 percent of manufacturing turnover (Table 4.1).

There are also links to the financial sector since in the early 1990s recession, the banking sector suffered large losses from its loans to the small business sector. This fact highlighted that many small and young firms have been financed inappropriately in the past. In other words, although it is not easy to clarify the extent of business failures resulting from credit constraints or credit rationing, it is obvious that the failures are

Figure 4.5: Share of Business Startups and Closures in Total Stock at Year Start in Manufacturing Industry



widespread among small and young firms that are more likely to be subject to moral hazard and adverse selection problems (Lund and Write, 1999).

4.2.2. Finance for Small Manufacturing Firms

Small firms operate mainly in real estate business activities, construction, wholesale, retail and repairs sectors while only nine percent of them are in the manufacturing industry. It is obvious that macroeconomic conditions and the financial position of the corporate sector improved significantly after the early 1990s recession. It is generally claimed that small firms have been financed more appropriately recently compared to in the early 1990s. The rate of liquidation and bankruptcies in the period of 1993-1999 remained significantly below that of the period of 1990-1992. Firms tended to be more dependent on internal finance and became net creditors to the banking sector. While the proportion of debt finance declined as a source of finance, the proportion of asset-based and receivables finance increased significantly. In short, macroeconomic stability, diversification of financial products and high profitablity have improved the financial positions of small firms in the second half of 1990s.

Table 4.1: Businesses, Employment and Turnover in Manufacturing and Whole Economy (1999)

	Distribution of Total Based on Employment (Percent)				
	Total	***None***	***1-49***	***50-249***	***250+***
Manufacturing Industry					
No. of Businesses	332070	56.3	40.4	2.5	0.8
Employment (000s)	4334	5.3	23.6	20.7	50.4
Turnover (£m, Exl. VAT)	470427	1.5	17.8	16.3	64.4
All industries excluding finance					
No. of Businesses	3676940	63.2	35.9	0.7	0.2
Employment (000s)	21746	12.5	31.5	11.5	44.5
Turnover (£m, Exl. VAT)	1943880	4.7	33.0	13.3	49.0
			Share of Manufacturing in Total (Percent)		
No. of Businesses	9.0	8.0	10.2	32.3	36.1
Employment (000s)	19.9	8.5	14.9	35.9	22.6
Turnover (£m, Exl. VAT)	24.2	7.7	13.1	29.7	31.8

Source: http://www.statistics.gov.uk/statbase

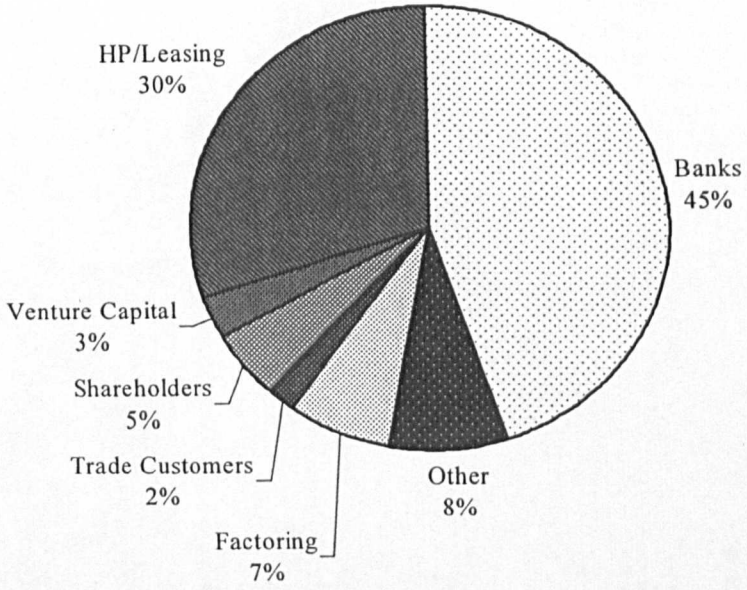
Traditional bank finance (overdrafts and term loans) remains the main component of external finance for small firms even though its share tends to decline as they increasingly diversify their source of finance. In the period of 1987-1990 bank finance accounted for 61 percent of external finance, while it declined to 47 percent in the period 1995-1997 (ESRC Center for Business Research, 1998). Outstanding small business loans declined gradually during the period 1992-1999, while small business deposits increased during the same period. In addition, overdraft lending declined gradually and term lending increased slightly during the same period. The net indebtness of small and medium sized enterprises (SMEs) fell and the ratio of deposits to lending increased from 56 percent in 1992 to 94 percent in 1999. Competition in the area of bank charges is fierce and the Bannock Bank Charges Index shows that, in real terms, bank charges have come down by over 30 percent since 1992 (Bank of England, 2000).[4]

Asset-based finance includes leasing and hire purchase and other products. The leasing industry exihibited a rapid expansion in the 1970s due to changes in the tax regime that encouraged leasing. In fact, the flexibility provided by leasing and hire purchase was the main reason for the rapid expansion of asset-based finance. Since the last recession, the proportion of external finance to small businesses accounted for by leasing and hire purchase has grown signifiacntly, and has been a substitute for debt finance in the commercial sector. Leasing and hire purchase provide businesses with access to finance without reducing their capital reserves or increasing their gearing levels. It is reported that this industry constitute 30 percent of external finance for SMEs and this proportion is lower for the large firms (Figure 4.6). Some surveys showed that a higher proportion of SME use asset-based finance in the UK than in any other EU country except Ireland (Bank of England, 2000).

Trade credit is another important source of external finance especially for small businesses. The trade debtors item of the corporate balance sheet constituted 35 percent of total assets (Bank of England, 2000). It is calculated that stocks and flows of trade credits were twice the size of bank credit in the UK and the US. Firms use trade credit as substitutes for bank credit when they reach their bank finance limit. Businesses may offer trade credit to their customers even when banks are not prepared to extend finance

[4] An index that is produced by Bannock Consulting shows bank charges for the banking services.

Figure 4.6: Sources of External Finance for Manufacturing SMEs, 1995-1997



because they have more information about their costumers and want to keep their costumers financially strong for their competitive advantage.

4.3. Data

4.3.1. A Brief Background

The FAME database will be used for the econometric analyses carried out in the next chapters.[5] The FAME covers all UK registered companies including those that have recently formed and up to 13 years of detailed information (modified accounts) about 500,000 British companies and summarised information for a further 1.3 million companies. The detailed information includes company profiles, profit and loss accounts, balance sheets, cash flow statements, ratios and trends, credit scores, complete lists of holding companies, subsidiaries and directors, shareholders, addresses, activity information, and miscellaneous information. The legal framework for the FAME database is summarised in the following paragraph.

[5] FAME stands for Financial Analysis Made Easy and is produced by the Bureau van Dijk Electronic Publishing.

The 1967 Companies Act introduced for the first time a requirement that all companies must file their annual accounts at Companies House. This Act abolished the previous exemptions about fileing accounts and auditing. However, in 1981, in implementing the EC Fourth Company Law Directive, the British Government introduced an exemption regime allowing small and medium-sized firms to file so called short-form accounts (abbreviation). After consultations the audit requirement for all companies was retained. A further consultation in 1993, following implementation of the provisions of the EC Eighth Company Law Directive, led to the first serious step in exempting very small private companies (with a turnover of £90,000 or less) from auditing, and introduced an intermediate exemption regime for private companies with a turnover of up to £350,000. Companies with a turnover between £90,000 and £350,000 were given the option of filing a simpler Audit Exemption Report (AER) instead of the full audit report. However, AERs were abolished in 1997 leaving two types of companies – those with a turnover above £350,000 who are subject to a full statutory audit, and those with a turnover of £350,000 or less who are exempt. The account-auditing threshold for small firms was increased to £1 million by July 2000. However this threshold is being reconsidered and a figure of £4.8 million has been suggested, the maximum amount for small firm threshold allowed under EU law (Department of Trade and Industry web site, DTI, 1999 and 2003)

Small charitable companies may claim audit exemption if their gross income is £90,000 or less. These firms are supposed to report accounts if their gross income is in the range of £90,000 and £250,000. In addition, parent companies do not need to prepare group accounts if the group of companies headed by that parent company is made up of non-public small or medium sized companies (DTI, 1999, 2003). There were 750,000 companies whose accounts were filed at Companies House by the end of 1999. Almost 70 percent of these companies have turnover below £350,000, which is the threshold for audit exemption (Table 4.2).

We now turn to the characteristics of the data. The FAME data set consists of balance sheets, profit-loss accounts and some important ratios based on firms' accounting thresholds referred to in the section 248 of the Companies Act 1985. In this framework, certain companies are permitted to deliver modified accounts to the Registrar of

Companies. Individual companies, which meet the criteria of small and medium-sized status, have some advantages of not preparing detailed accounts compared to large companies. For small-sized companies, filing a profit and loss account or details on turnover, and on the number of employees are not obligatory, however, they have to file abridged balance sheet information that obviously includes some items of assets and liabilities. On the other hand, medium-sized companies do not have to disclose turnover details. Currently, companies should satisfy two out of the three criteria given in Table 4.3 to be classified as small or medium sized companies.[6] These criteria are based on turnover, balance sheet (total assets) and number of employees.

Table 4.2: Distribution of Companies Registered with Companies House by Turnover

Turnover Interval	*Number of Companies*	*Percentage Distribution*
Up to £350 000	520,000	69.3
Over £350,000 to £1m	110,000	14.7
Over £1m to £2m	40,000	5.3
Over £2m to £3m	20,000	2.7
Over £3m to £4.2m	15,000	2.0
Over £4.2m	45,000	6.0

Source: Department of Trade and Industry

One may expect that this exemption system, which can be considered as a basis for the selection rule, allows for some missing observations in the company's accounts in the FAME sample. In fact, we observed some diversions in the selection rule explained above. For example, there is a number of missing observations in turnover even though firms are classified as large firms based on employment and balance sheet criteria. In addition, some small firms report almost complete information even though they are not obliged to do so. These diversions in the selection rule should be considered in the estimations. In Chapter Seven, we test the hypothesis of whether the problem of incomplete data significantly affect empirical results in Chapter Five and Chapter Six.

[6] The British government completed a consultation study that is aimed at adopting new criteria for small and medium-sized companies, which is consistent with EU law. New thresholds are supposed to be supportive for the small businesses by widening the range of firms subject to audit exemption.

There is no single definition for a small firm, mainly because of the wide diversity of businesses. The best description of the key characteristics of a small firm was given by the Bolton Committee in its 1971 *Report on Small Firms*. This states that a small firm is an independent business, managed by its owner or part-owners and having a small market share. The Bolton Report also adopts a number of different statistical definitions. It is recognised that the size is relevant to the sector, i.e. a firm could be considered small in relation to one sector where the market is large and there are many competitors, whereas a firm with similar proportions could be considered as large in another sector with fewer competitors. Similarly, it is recognised that it may be more appropriate to define size by the number of employees in some sectors but more appropriate to use turnover or assets in others.

Table 4.3: Definitions of Small and Medium Sized Firms

Criteria	*Small Size Companies*	*Medium Size Comp.*
Turnover[7]	Maximum £2.8 million	Maximum £11.2 million
Balance Sheet	Maximum £1.4 million	Maximum £5.6 million
Number of Employees	Max 50	Max 250

Source: DTI web page.

Of the entire business population of 3.7 million firms in 2000, only 25,000 enterprises are medium sized (50 to 249 employees) and less than 7,000 are large (250 or more employees). Small businesses, including those without employees, accounted for over 99 percent of businesses, 44 percent of non-government employment and 37 percent of turnover. In contrast, the 7,000 largest businesses accounted for 45 percent of non-government employment and 49 percent of turnover. The stock of enterprises is now at the same level for the sixth successive year following falls in 1992 and 1993. The business stock is 1.3 million higher than in 1980, the first year for which comparable figures are available. Most of the moderate growth in the business population between 1995 and 2000 has been in the number of 'micro' businesses employing fewer than ten people and in the number of one-person companies.

[7] We use turnover and sales interchangeably.

In February 1996 the European Commission recommended a single definition for SMEs to the member states. The European Investment Bank and the European Investment Fund adopted the same definitions for their programmes (Table 4.4).

Table 4.4: European Commission Firms Size Classification[8]

Criterion	*Micro*	*Small*	*Medium*
Maximum number of employees	9	49	249
Maximum annual turnover	-	7 m. euro	40 m. euro
Maximum annual balance sheet total	-	5 m. euro	27 m. euro
Maximum % owned by one, or jointly by several, enterprise(s) not satisfying the same criteria	-	25%	25%

Source: DTI web page.

4.3.2. Constructing the Sample and Some Key Observations

We have constructed a sample from the FAME Database that allows us some flexibility in analysing some aspects of the monetary transmission mechanism and the role of non-financial firms' financial positions for corporate sector activity. We limited the sample only to the firms in the manufacturing industry, which has quite a similar pattern of business cycles to the overall economy as explained in the earlier part of this chapter. We provide information on the financial accounts and ratios for more than 15 000 UK manufacturing firms using the web site of Bureau van Dijk Electronic Publishing, *http://fame.bvdep.com/cgi/template.dll*. This sample is extracted from the FAME Database based on the following criteria[9]:

- Firms whose primary activity is classified in the manufacturing industry according to 1992 SIC UK Code[10].

[8] To qualify as an SME, both the employee and the independence criteria must be satisfied and either the turnover or the balance sheet total criteria.

[9] The sample is based on downloaded figures during October and November 2001. The sample size is likely to change with downloading time because of the monthly revision of firm accounts.

[10] The sample also includes 940 firms (5.7 percent of total sample size) whose secondary activity rather than primary activity is classified in the manufacturing sector.

- All firms in the sample are established before 1990 and we want to make sure that firms are alive at the end of the sample period. This allows us to observe the maximum number of firms who report their balance sheet continuously over the period thus to identify the impact of monetary shocks on firms' choice of finance and real activity in the tight versus loose monetary policy regime periods.[11]

- All active firms in England, Scotland, Northern Ireland and Wales are included.

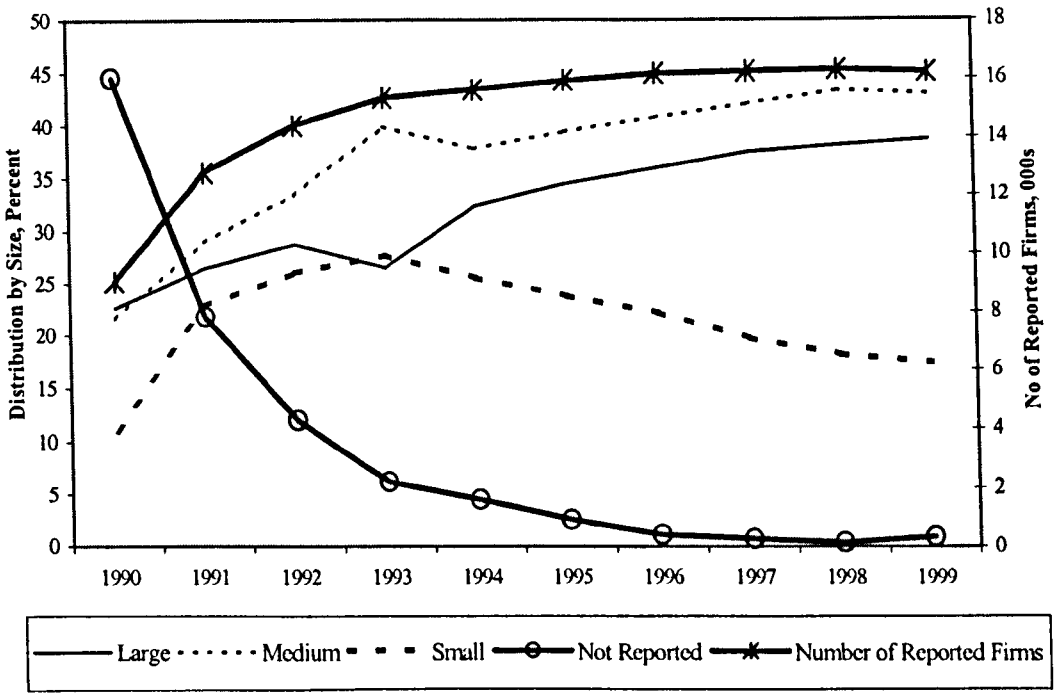
- We trim some variables used in the econometric models that we use in Chapters Five and Six. Details for trimming are explained in the Appendix.

Although the extracted sample includes some missing observations especially during the first couple of years of the sample period, it is consistent with the framework explained above. In other words, the sample is not a balanced panel, and we can not observe information about most of the firms whose turnover is under the threshold. In fact, there are quite a number of missing observations across variables, firms and years. The sample represents the upper tail of the population in terms of firm size distribution and this may limit the extent to which the sample represents the population. This sort of limitation in the sample can be evaluated using the framework of 'truncated and censored samples'. In our case we do not observe information of all firms in the manufacturing industry but only those that have their turnover over the exemption threshold. Nevertheless, the sample does include some information about some firms whose turnover is under £90,000, which is the upper threshold for totally exempted firms. In general, the FAME sample is an incomplete panel in nature: it is truncated and it includes missing observations even when some firms are in the limit of the selection rule or vice versa.

[11] Only three percent of the firms in the manufacturing industry stopped reporting during the 1990-1999 period. This may stem from either failure of the company or stopping reporting to the Companies House. An updated version of FAME data set shows that the share of firms that liquidated or bankrupt during this period is very low.

Figure 4.7 shows the distribution of firm size based on total assets. One can easily observe that the number of firms that report their balance sheet details increased sharply

Figure 4.7: Distribution of the Firms Across Size Based on Balance Sheet



in the first three years of the sample period. In the meantime, while the proportions of large firms and medium-sized firms increased, the proportion of small firms declined after 1993. Because this period coincided with a substantial improvement in the performance of the corporate sector after the recession, there was a change in the distribution of firms toward large firms category. There was also a change in the exemption regime in 1993. This might explain why the proportion of large firms in the sample increased.

Potential reasons for poor reporting observed for the period of 1990-1992 may be attributed to the following facts:

- As explained above the regime of exemption thresholds changed in 1993 and became effective by 1994. Before 1994, the exemption regime entailed auditing for all firms even though some initiatives had been taken to change this regime in the 1980s.
- The recovery in the economy by 1993 led to an increase in the size of firms and thus the number of firms eligible for reporting. The impact of the recession in the early 1990s is supposed to have affected the reporting efficiency for the firms that were financially in trouble.

- The company that collects the data possibly increased the efficiency of the data collection in the meantime. We contacted company experts and they confirmed again that published company accounts were taken from Companies House[12].

By the end of the sample period, only 9.4 percent of all firms reported for less than eight of those years. These firms generally belong to the small firm group in terms of average turnover and average employment. On the other hand, firms that reported every year in the sample (18.7 percent of sample size) are large firms with high turnover, total assets and employment. In addition, those firms that have large assets, employment and turnover are made up of relatively old firms. The correlation coefficient between age and firm size is positive even though it is not high during the sample period (0.08). Among the firm size criteria, employment has the highest correlation coefficient with the firm age (0.13) percentage point. While 58 percent of firms that reported for less than eight years have employment figures, 75.5 percent of them report turnover. The distribution of firms according to industry that report less than eight years is not significantly different from those of firms which reported eight years or more.

The time when firms report their balance sheets during the year also varies significantly. Almost 42 percent of firms with eight-year observations reported in December, while 18.2 percent and 8.6 percent of them reported in March and September respectively (Table 4.5). For consistency, we regard information provided by firms during

[12] There may be many reasons explaining the presence of missing observations. We got the following explanations from the Bureau van Dijk that organises data collection for the FAME Database.

- The company may not have been registered with Companies' House until more recently (i.e. traded in a non-limited form for several years prior to becoming a registered company).
- Data would not be available prior to registration. The company has not been legally required to file information until more recently – legislation in the period of 1994-1999 states that firms are only legally required to file if their turnover exceeds £350 thousands. Some companies falling outside these parameters still choose to file financial information, others do not. There can be a multitude of reasons; it is necessary to look at each example individually, as broad generalisation can be quite misleading.
- The company in question has not submitted that figure (it may not have to), that figure is not relevant to their operations (certain balance sheet items) or in a very few cases it may be a mistake. If the figure is given as zero that simply means the company in question has filled in that space with that figure. Some companies for example who don't have to file a turnover figure may put the figure zero whilst others may leave it blank. Some companies who are allowed to file abbreviated accounts chose not to file everything.
- There will always be mistakes with any database, and the FAME is not infallible. However there are also a number of companies who do not comply with the filing regulations, who file their accounts late and who generally make life difficult for information providers. Companies' House has also been known to make a few mistakes.

the first half of the calendar year as relevant for the previous year, while we kept the information for the current year for those firms that report after June. For instance, we used the annual information of the firms that report their balance sheet by the end of May in 1995 for the year of 1994[13].

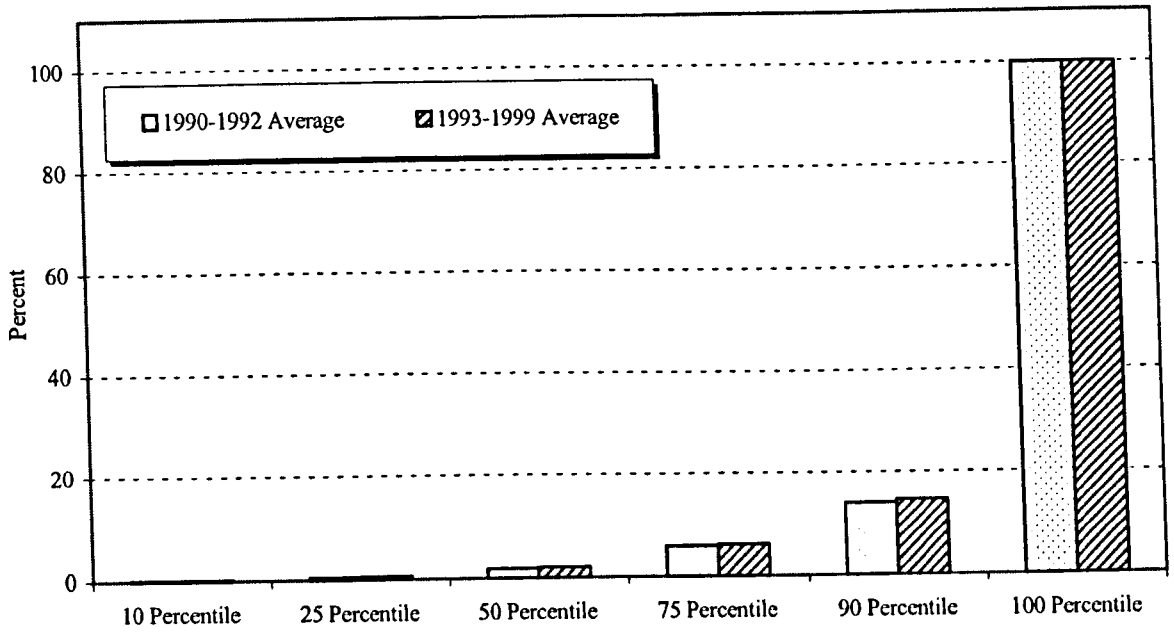
Although the distribution of turnover and employment across asset size remains stable during the sample period, as we emphasised above, the sample is biased in the sense that the largest 10 percent of the firms in terms of assets size realised around 85 percent of total turnover and 80 percent of total employment. Figure 4.8 shows the cumulative distribution of turnover share percentage across asset size percentile range. This figure confirms that the distribution of firms in terms of size is almost identical in the recession and recovery periods.

Table 4.5: Firms with at least Eight Observations by the End of 2000

	No of Firms	*Share in Total*
January	383	2.6
February	278	1.9
March	2685	18.2
April	758	5.1
May	422	2.9
June	1103	7.5
July	418	2.8
August	449	3.0
September	1271	8.6
October	462	3.1
November	315	2.1
December	6233	42.2
TOTAL	14777	100.0

[13]The reporting date is called 'statement date' when firms publicise their balance sheets.

Figure 4.8: Cumulative Distribution of Turnover Based on Asset Size



By comparing the sample and the population distribution of turnover, employment and businesses, one can easily observe the extent of the differences between the whole manufacturing industry and the Fame sample. Based on 1999 figures, while the turnover share of large and small firms in terms of the employment criterion constitutes 65.4 percent and 18.1 percent of the total industry, they were calculated to be 89.7 percent and 1.9 percent respectively for the FAME sample, respectively.[14] Similarly, while the employment shares of large and small firms are 53.2 percent and 24.9 percent in total manufacturing employment, these figures are 88.0 percent and 1.4 percent for the sample, respectively. In addition, the number of businesses employing at least 250 employees and less than 50 employees in manufacturing constitute only 1.8 percent and 92.4 percent of the total. These figures are quite different for the sample, that is, 21.9 percent and 27.8 percent, respectively. This result confirms Figure 4.7 where medium sized firms constitute the largest share of total firms in the sample.

Our database contains quite rich information about the credit ratings of firms. QuiScore is produced by Qui Credit Assessment Ltd. and measures the likelihood of

[14]In Table 4.1, the turnover, employment and businesses shares have been recalculated for firms in the manufacturing industry employing at least one worker in order to make possible comparisons with the sample.

company failure in the twelve months following the date of calculation. The QuiScore, hereafter rating score, is given as a number in the range 0 to 100[15]. For ease of interpretation, that range may be considered as comprising five distinct bands[16]. The rating score is intended to be a measure of the financial healthiness of the companies, and should be interpreted in conjunction with other information such as seasonal trends, product life cycles, competition, interest rates and other micro and macro-economic factors.

Band Name	*Score*	*Band Description*
The Secure Band	81-100	Companies in this sector tend to be large and successful public companies. Failure is very unusual and normally occurs only as a result of exceptional changes within the company or its market.
The Stable Band	61-80	Again company failure is a rare occurrence and will only come about if there are major company or marketplace changes.
The Normal Band	41-60	The sector contains many companies that do not fail, but some that do.
The Unstable Band	21-40	There is a significant risk of company failure: in fact companies in this band are on average four times more likely to fail than those in the Normal Band.
The High Risk Band	0-20	Companies in the High Risk sector are unlikely to be able to continue trading unless significant remedial action is undertaken, there is support from a parent company, or special circumstances apply. A low score does not mean that failure is inevitable.

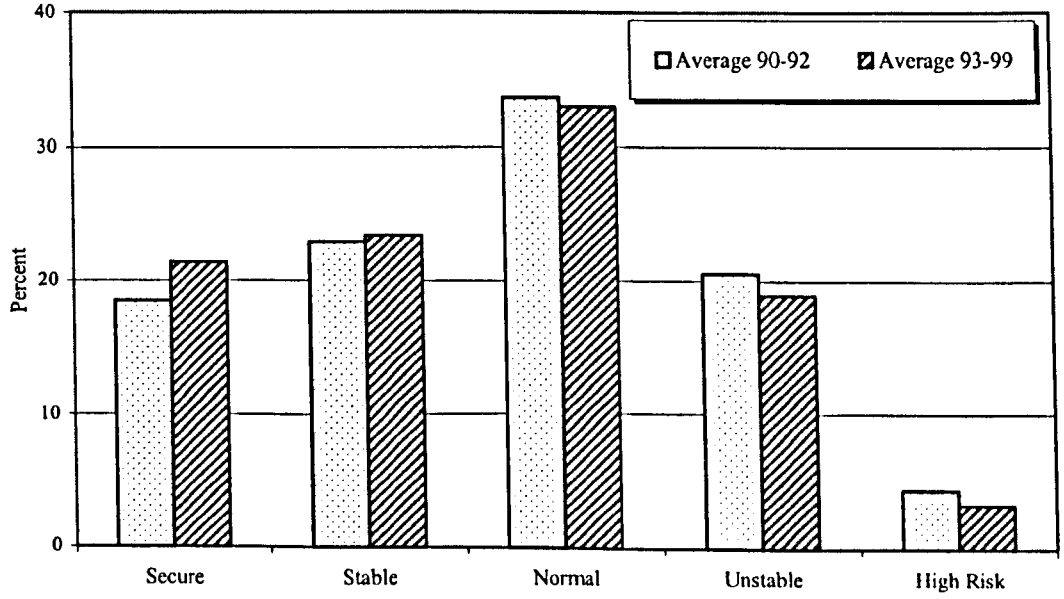
Source: Bureau van Dijk Electronic Publishing (BvD) web site.

The number of firms that report a rating score during the recession is relatively low and is consistent with the reporting of asset size. While only nine thousand firms reported this figure in 1990 it increased to fourteen thousand in 1992 and almost sixteen thousand firms reported it in the period of 1993-1999. The distribution of firms across rating score bands highlights the impact of the recession in the early 1990s on firms' financial health. While the shares of the firms in the bands of unstable and high risk are higher during the recession than the recovery period, the share of the firms in the secure and stable bands are higher during the upswing period. In other words, firms face a higher risk during recessions (Figure 4.9).

[15] Firm's analysis reflects the current economic conditions and includes post mortems on failed companies.
[16] The rating score is based on statistical analysis of a random selection of companies. To ensure that the model is not distorted, three categories are screened out from the initial selection: major public companies, companies that have insignificant amounts of unsecured trade credit and liquidated companies that have a surplus of assets over liabilities.

Large and old firms have, on average, high ratings confirming the fact that small and young firms having inadequate collateral assets and a poor track record and are more likely subject to financial difficulties during the period of slowing down. Figure 4.10 shows two stylised facts. Firstly, firms in the upper tail of total assets (large firms) have relatively a high credit score during the business cycle. Secondly, the average rating during the recession is lower than it is in the upswing period and the margin between the periods becomes wider as we move towards the lower tail of the size distribution.

Figure 4.9: Distribution of Firms across Rating Score Bands



Large firms in terms of asset size consist of generally old firms, and the average age of firms versus their size does not vary with the business cycle, except for the firms in the lowest tail of the size distribution. In other words, the average age of small firms during the recession is lower than during the recovery period implying that age may be an explanatory variable for the poorer performance of these firms (Figure 4.11).

Figure 4.10: Rating Score across Firm Size in the Business Cycle

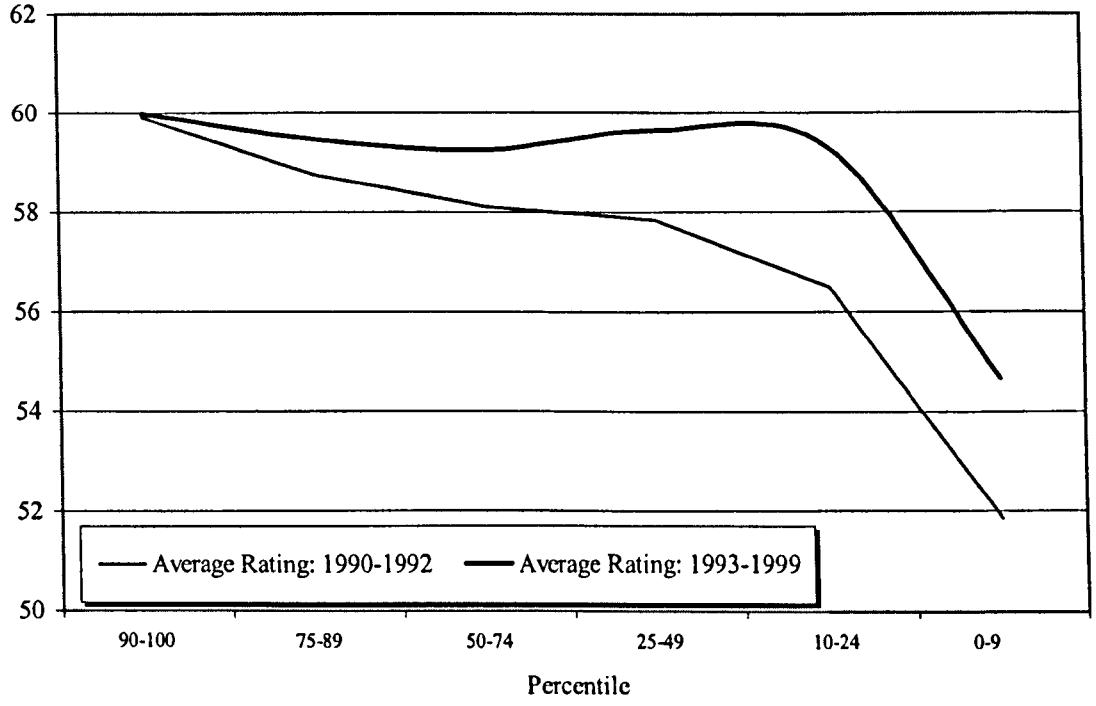
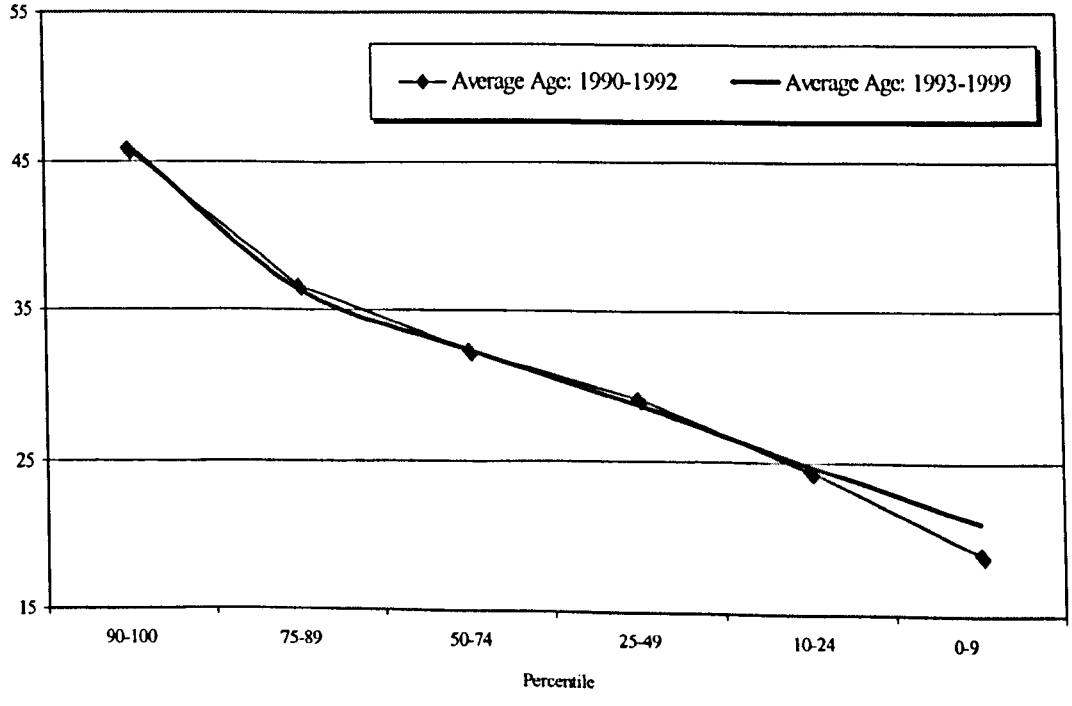


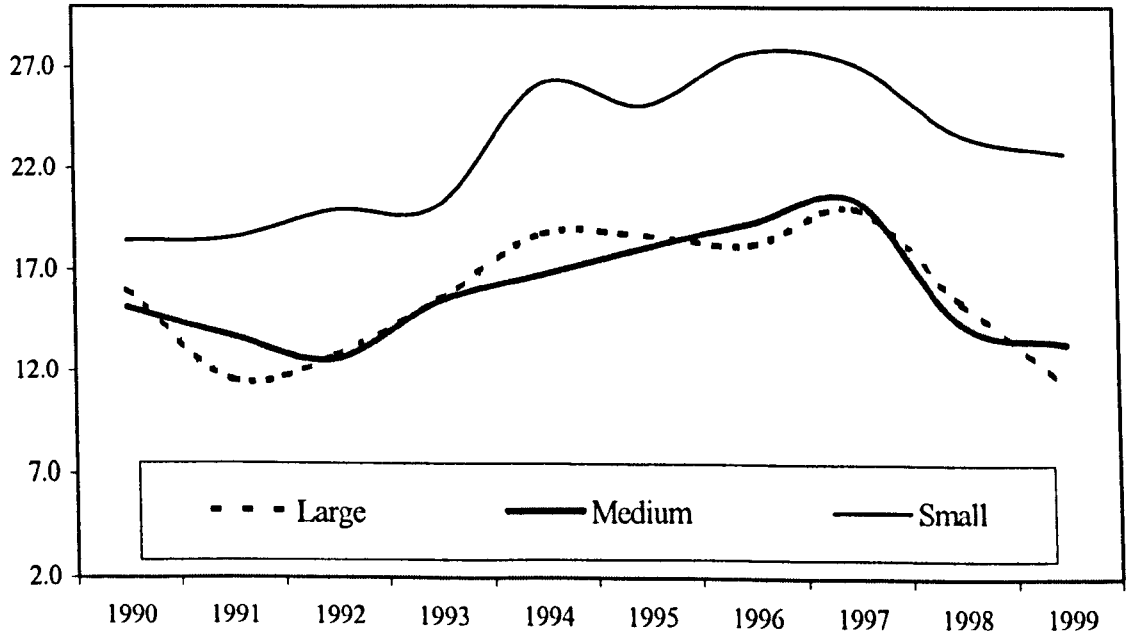
Figure 4.11: Average Age Across Firm Size in the Business Cycle



Variables such as profitability, capital gearing and liquidity of the firms are frequently used as indicators of financial health. Parallel to Benito and Vlieghe (2000) whose data consist of all quoted UK non-financial firm, we use the return on capital (the share of profit before tax in total assets less current liabilities) as a proxy for profitability which is expected to be equal to the risk-free real interest rate plus risk premium. On average, the return on capital for small firms is calculated to be higher than that of other categories during the 1990s. During the recession period, this variable was on average low for all categories of firms (by size) and has been declining since 1997 (Figure 4.12).

The profit margin, which is another proxy for profitability and reflects market power, is calculated to be higher for large firms except during the last two years of the period when profit margins of small firms exhibited an upward jump. As for the return on capital, the profit margin is low for all size categories during the period of the recession and has been declining since 1997. In addition, this database confirms Benito and Vlieghe (2000) results in the sense that the margin between distributions of upper and lower tails of profitability has been widening in recent years. This can be attributed to the high profitability performance of small firms who have a low capital stock.

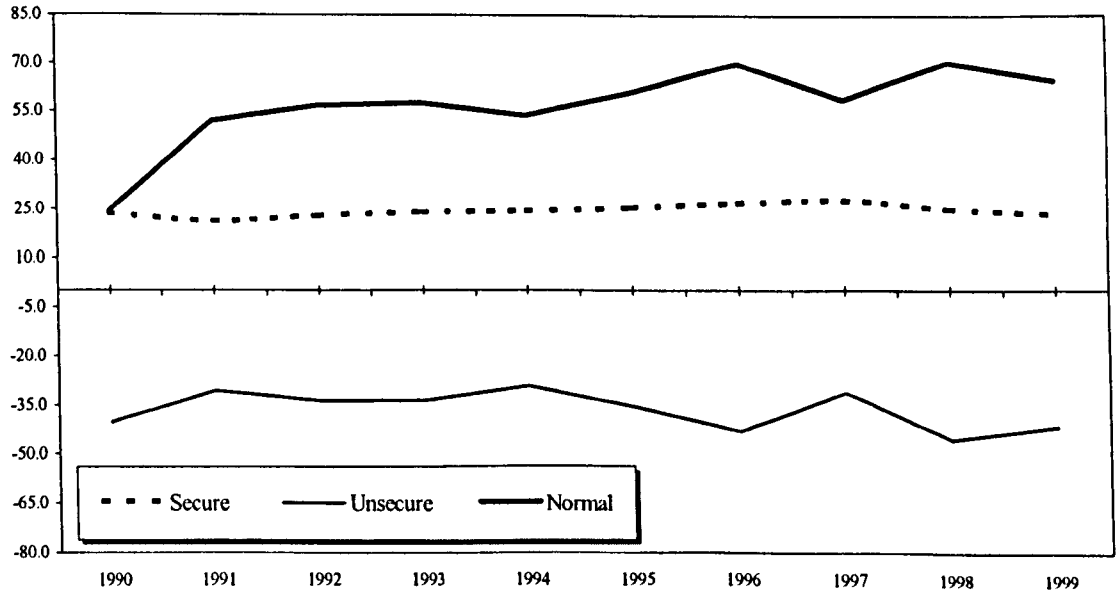
Figure 4.12: Return on Capital across Firm Asset Size



The distribution of profitability across age shows a quite interesting result; while the average profitability of old firms exhibited a flat pattern with a slight decline in recent years, the profitability of young firms increased during the period except for a slight decline recently. This result for young firms can be interpreted in the following way. First of all, young firms are more subject to informational problems implying that they are more prone to choose risky projects. Second, young firms may be more flexible in choosing new profitable technologies relative to old firms.

We extracted the profitability figures of firms across rating scores from the database. Figure 4.13 shows the extent of variation in the capital return across risk groups. Unsecured firms have consistently negative profitability implying that these firms involve a high risk of bankruptcy. On the other hand, normal firms have a very flat and positive return on capital while secure firms have very high positive and increasing return on capital during the period. This result implies that the rating scores variable is strongly linked with profitability.

Figure 4.13: Return on Capital across Rating Score Bands

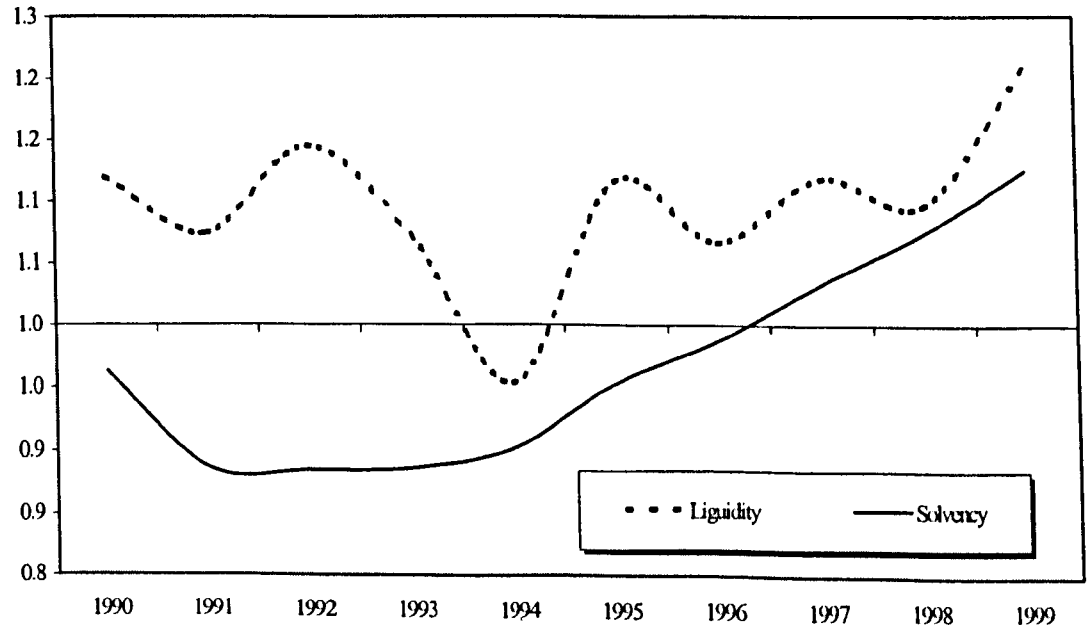


Evidence suggests that the lack of liquid assets has been an important cause of business failures. Keeping more liquid assets on the balance sheet as a financial buffer may avoid the risk of failure for the corporate sector. In this context, small firms with few liquid assets are more vulnerable to the risk of failure and thus it might be expected that they tend to keep more liquid assets. We used the liquidity ratio, the ratio of current assets

minus stocks and work in progress to the current liabilities, to compare the liquidity of firms across different size, age and rating groups. The data confirms the result that small firms tend to have a high liquidity ratio. Figure 4.14 shows that the average liquidity ratio of small firms (in the lowest 25 percentile of the size distribution) is higher than that of large firms (firms in the highest 25 percentile of size distribution) during the whole period, except 1994. An increase in the small firms' solvency ratio (the ratio of shareholder's fund to total assets) implies that small firms' ability to repay debts has improved since 1994. This result is consistent with the idea that small firms tended to improve their financial positions during the second half of the 1990s.

The relative liquidity of firms in the upper and lower tails of the age distribution remained more ore less the same even though the average liquidity ratio of old firms is calculated to be higher than that of young firms throughout the period. Similarly, the solvency ratio of old firms remained high, while that ratio for young firms increased rapidly during the period. In addition, secure firms in terms of rating score have very high liquidity and solvency ratios and the correlation coefficient between solvency ratio and rating score is over 0.50 on the average. However, the liquidity and solvency ratios of risky firms increased faster than that of secure firms during the sample period.

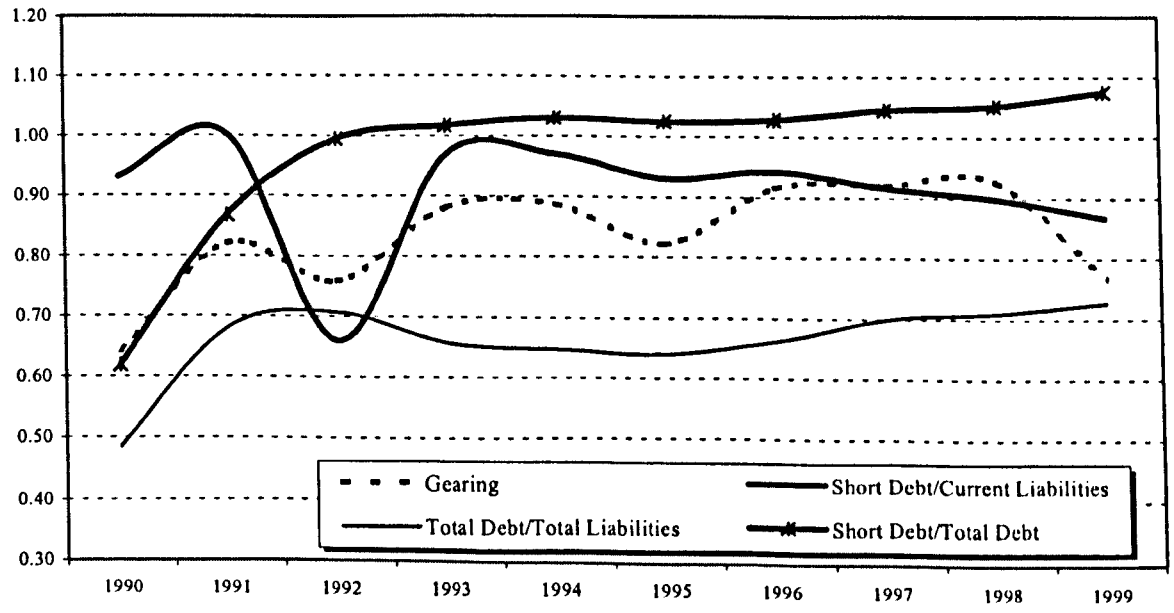
Figure 4.14: Liquidity and Solvency: Ratios for Small and Large Firms



Firm indebtedness is the concern of our empirical study that will be carried out in the next chapters. The data contains a wide range of information about the finance composition of firms, that is, firms liabilities are decomposed in terms of maturity as well as bank and non-bank debt classification. This variety enables us to compare the term structure of bank debt and gearing among various firm categories in terms of size, age and rating. Figure 4.15 indicates some features of firm finance across small and large firms.

The gearing ratio is defined as the share of total debt to shareholder equity and exhibits an increasing trend in favour of small firms during the period even though the average gearing ratio of large firms remained above that of small firms (the series in the figure are the gearing ratio of small firms relative to that of large firms). This figure implies that large firms can borrow larger amounts of debt relative to their equity. However the gap between the two groups has been narrowed. Nevertheless, the evidence suggests that banks are reluctant to extend credit to small firms who are weak in terms of net worth during slowdowns. The data implies that small firms improved their conditions in accessing bank funds, leasing and hire purchase and banks were more prone to lend to them during the 1990s. Some survey studies support the idea that small firms in recent years have not been confronted with serious constraints when attempting to access debt finance[17].

Figure 4.15: Comparing Some Debt Ratios of Small and Large Firms



[17] Kearns and Young (2002) conclude that although small quoted companies do not generally have access to bond markets and long term bank loans and they have difficulties in raising equity, there is no clear evidence of those having difficulties getting short-term bank finance.

Short-term debt finance relative to bonds, equity and long-term debt has been the most important source of finance for small firms in recent years. Issuing bond and equity involves a high cost for small firms in the sense that small firms are subject to greater informational problems. The average share of short-term debt in total debt for small firms was 60.5 percent in 1991 while it increased to 75.4 percent in 1999. In addition, the share of short-term debt finance has been higher for small firms, especially after 1992, and increased compared to that of large firms during the same period.

We observe that the share of short-term debt in current liabilities (including debt and non-debt finance) for small firms declined sharply during the recession compared to large firms. This implies that small firms faced more difficulties in having access to short term debts during this period. After the recession this figure increased sharply but declined steadily over time, confirming the fact that small firms rely more on internal funds or other forms of finance rather than short term debt in recent years. Large firms tend to prefer short-term debt finance relative to other short-term finance compared to small firms. In addition, the share of total debt finance increased faster for the small firms in recent years implying that small firms are not confronted with financial constraints in accessing short-term debt finance.

Young firms had a high gearing ratio during the period; the ratio also increased for old firms significantly over time. This result may imply that recently incorporated firms became less dependent on debt finance in recent years, and this may be attributed to the rapid growth of young firms' equity in a stable macroeconomic environment. The share of short-term debt in total current liabilities and of total debt in total liabilities did not change significantly for both young and old firms during the period even though a slight decline in these figures for young firms was observed by the end of the period. However, the relative share of short-term debt in the total debt witnessed a gradual rise for young firms during the period (Figure 4.16).

It is calculated that the average gearing ratio for risky firms is found to be fifteen times larger than the average gearing ratio for secure firms and it increased rapidly for risky firms in 1999. Although the short debt-total debt ratio for risky firms remained above that of secure firms during the period, these figures did not change much for risky

and secure firms. In addition, risky firms had a high average short term-current liability and total debt-total liability ratios during the period, but these ratios exhibited a declining path for risky firms relative to secure firms, implying that risky firms tended to substitute non-debt finance compared to secure firms (Figure 4.17).

Figure 4.16: Comparing Basic Debt Ratios across Age Groups

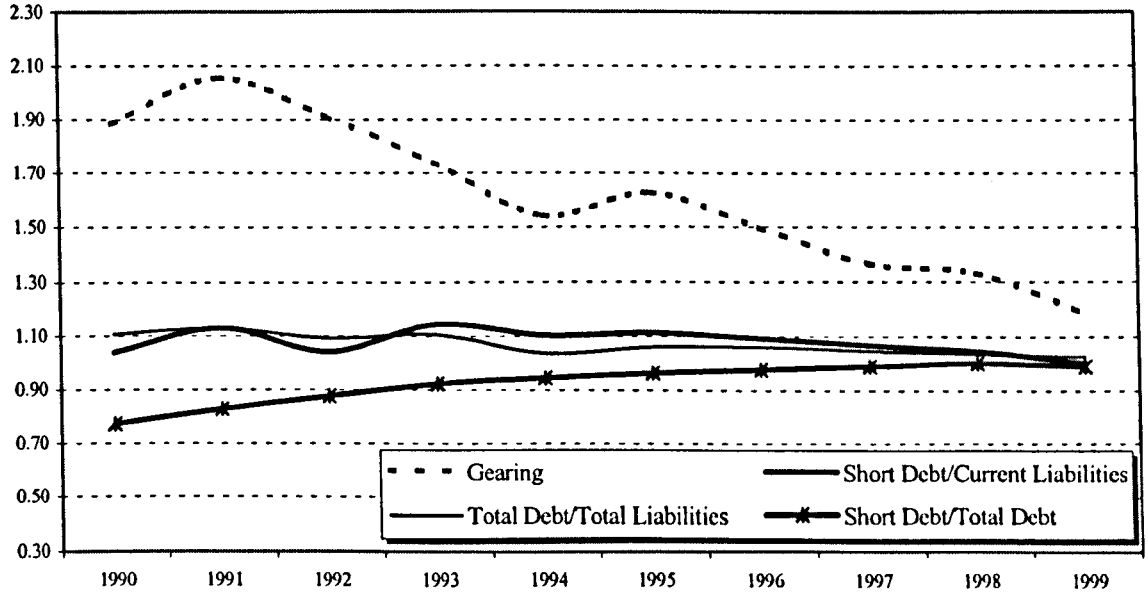
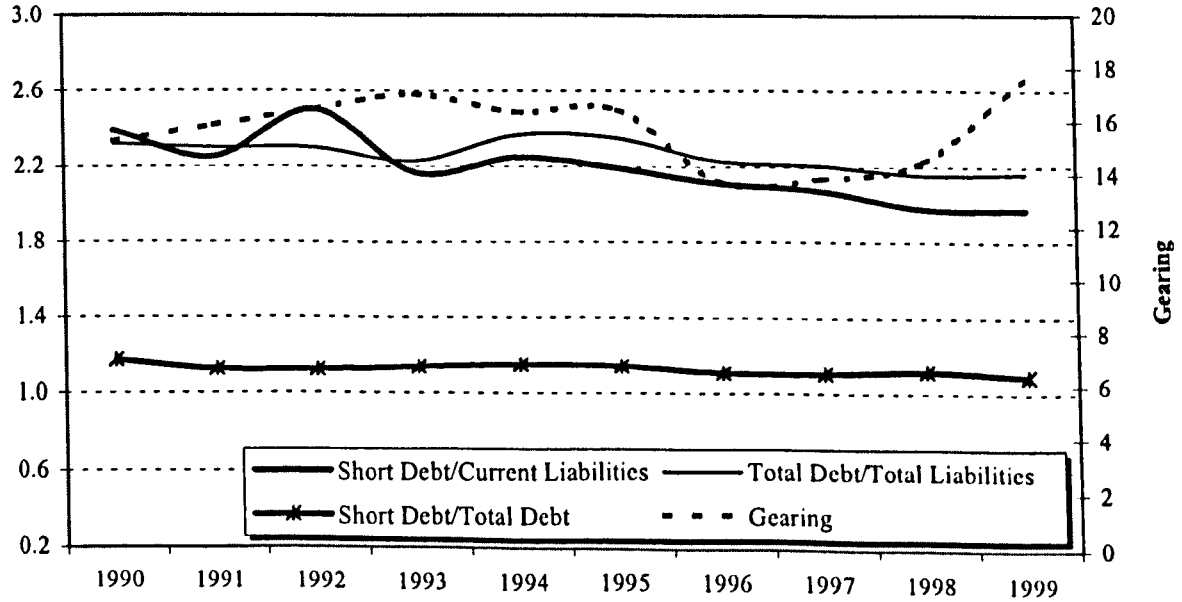


Figure 4.17: Comparing Some Basic Debt Ratios Across Rating Score Bands



The sensitivity of the composition of external finance to the monetary stance is one of the main concerns of this study. We summarise the distribution of the liability items in Table 5.1 in Chapter Five across asset size bands for the early 1990s recession period and the following recovery era. Although the average figures do not reflect information involved with the sample perfectly, this type of analysis gives us some preliminary results before carrying out econometric analysis.

4.3.3. Missing Observations Problem in the Sample

We discussed the incomplete nature of the FAME sample above. This motivated us to crosscheck key variables for some quoted firms in the FAME database with their corresponding figures in Datastream and One Source data sets. We extracted the figures for some basic variables of nearly 300 quoted firms from these data sets. These firms are mainly large with detailed reports and with a few missing observations compared to the rest of the sample. We compared the values of selected variables for these firms across the data sets to make sure that the figures from the FAME sample are not significantly different from those from Datastream and One Source[18]. The following points need to be brought to the reader's attention.

- Variables such as employment, profit, total sales, depreciation, trade debt and inventory investments are almost perfectly matched in all databases. Only two percent of 280 firms have different figures in FAME and Datastream. We crosschecked these mismatched figures with One Source; the evidence is mixed; in some cases the figures from the FAME were identical with One Source, while in some other cases, the figures were identical with the corresponding figures in Datatream (but employment and turnover figures in One Source are generally identical with those reported in Datastream). We may conclude that figures in the three data sets match for over 95 percent for most of the variables that we are going to use in the empirical study.

- Almost half of the firms have different total assets figures in FAME and Datastream. The difference between the total assets figures is generally very small

[18] Contrary to Datastream, the FAME and One Source data sets contain information also for unquoted firms.

and biased upward in FAME (it is expected that the difference generally originated from definitions) [19]. However, for some firms, this difference is large and biased upward in Datastream. This is because of missing observations for intangible assets in FAME. More specifically, the difference in total assets between the two databases is either zero or a very small negative number if intangible asset figures appeared in both databases, and it is positive and almost equal to the figure for intangible assets reported in Datastream when the corresponding figure is missing in FAME. [20] One Source's total assets figures are generally identical to those in FAME. The definition of total asset varies between Datastream and FAME, further aggregation as in total assets and total liabilities lead to a differentiation between data sets because of either definitions used or missing variables among components. On the other hand, for specific items such as employment, sales, profits, inventories, trade debt, the two data sets have almost identical figures.

- The impact of missing observations in intangible assets can be observed in shareholder equity i.e. the difference between total assets and total liabilities. For many firms shareholder equity is larger in Datastream as much as the missing value of intangible assets in FAME and therefore the two data sets seems to match quite significantly. This result also supports the definitional difference between the two data sets for total assets and total liabilities. It may be convenient not to use total assets in FAME as a variable reflecting firm size; instead turnover, tangible assets or employment may be better options.

- On the liabilities side, long-term debt and trade credit variables are almost identical in both databases, but there are some differences in short-term debt and total current

[19] In Datastream, total assets are defined as the sum of tangible fixed assets, intangible assets, investments (including associates), other assets, total stocks & WIP, total debtors and equivalent, cash and cash equivalents. Common adjustments to the as reported figure are - deferred tax, if shown as an asset, is offset against any deferred tax liability at item 312 - goodwill carried in reserves is transferred to intangible assets at item 344.- for European countries and Japan, treasury stock is shown as an asset rather than deducted from share capital and reserves. - advances on work in progress if disclosed as a liability by the company has been offset against stocks and work in progress (see also definition of item 364).- the as reported figure for current liabilities is increased by the amount of proposed dividends for those countries showing a balance sheet before profit appropriation. For total assets, the difference between the two data sets is expected to be originated from the contents of cash and cash equivalent in Datastream and bank and deposits, investment and other current assets.

[20] All variables are either zero or different from zero in the Datastream, while in FAME we cannot differentiate between zero and missing variable though there are many missing observations.

liabilities between the FAME and Datastream especially for relatively larger firms (firms are ranked by total assets from top to bottom)[21]. For long term debt, trade credits, short-term debt and current liabilities, as in the case of total assets, the One Source figures are generally identical to those in FAME especially for firms whose figures in FAME are not identical to those in Datastream.

- Variations in short-term debt among data sets seem also to be originated from the definitions used for this variable. For example, in Datastream, it is defined as the sum of bank overdrafts, loans and other short-term borrowing and the current portion of long-term loans, while in FAME it is the sum of bank overdrafts, group and director loans, hire purchase and leasing and other short term loans.

In short, for liabilities side figures, a few mismatches in long-term loans and trade credit, and quite a number of mismatches for current liabilities and short-term loans are observed between FAME and Datastream. One Source has similar figures to FAME for these variables. This is valid for total assets if intangible assets are not missing in FAME. For inventories, trade debtor, employment, profit and sale, both data sets have almost identical figures. In general the FAME data are quite close to Datastream for the given sample except for some variables for which the two data sets use different definitions (total assets, current liabilities, and short-term debt) and some missing variables such as intangible assets. The definitional difference between data sets does not imply that a particular data set is superior relative to others.

There is one problem with One Source although intangible assets for some firms are not missing in Datastream, they are missing in both FAME and One Source, but One Source puts zero for the missing observations while FAME puts blank. That is, not only FAME, but also One Source has some weaknesses relative to Datastream, but the former databases have some advantages compared to the latter in terms of the varieties of firms across size, risk, age, indebtedness, profitability etc.

[21] In Datastream, current liabilities includes current provisions, trade and other creditors, borrowings repayable within one year and any other current liabilities. After one year, trade accounts payable are also included. In FAME, however, current liabilities consist of trade creditors, short-term debt and overdraft and other current liabilities.

Since the sample used for comparing the three data sets are made up of mainly large firms that provide almost complete information, it does not represent the FAME sample that has many missing observations and variables for smaller firms. To understand the extent of the missing observation problem, as a first step we tested the empirical models by removing firms that are more likely to have missing observations from the sample. We found that this process did not change significantly the main implications of the empirical model compared with estimations that used the full sample. In addition, we replaced zeros with missing observations: although the coefficients changed slightly, the main implications of the models were still the same. Conversely, when we treated them as missing instead of using zeros, again the results revealed from the new sample were very similar to those of the original sample. In addition, to improve the FAME sample, we proposed to drop the year 1990 as it has a lot of missing observations and variables. More importantly, the estimation methodology that we use in Chapter Five and Chapter Six, consider firm specific effects that are expected to capture selectivity biases to some extent (Meghir, 1988; Bond and Meghir, 1994).

To see the extent of the number of missing observations or zeros in the data we give information about the observation rates for some key variables. In Table 4.6 we summarise the observation rates of some basic variables, for each size group, that are most likely to be employed in the empirical models in the next chapters. Almost 95 percent of firms in the sample reported some basic variables like total assets and rating score in the 1993-1999 period, while only 82 percent of them reported these variables in the 1991-1992 period. Around six thousand firms (on average approximately 40 percent of the unbalanced sample) reported all basic variables over the period. In Chapter Seven we use these sub-samples for estimating the empirical model with sub-balanced data in order to test for selectivity bias. We expect that high risky, small, young, highly indebted firms are less likely to report the basic variables relative to secure, large, old, low indebted and highly profitable firms, respectively. Particularly, firms that are in the high risk group reported less often basic variables over the period. In fact, this may help in understanding the selection mechanism where firm specific characteristics seem to be correlated with an unobservable selection mechanism. For example, less than 30 percent of risky firms reported the basic variables, while more than 60 percent of the large firms reported these variables.

Table 4.6: The Share of Observed Variables in the Number of Firms in the Sample by Years

Variable	*1990*	*1991*	*1992*	*1993*	*1994*	*1995*	*1996*	*1997*	*1998*	*1999*	*Average 1990-1992*	*Average 1993-1999*
Number of firms	16354	16354	16354	16354	16354	16354	16354	16354	16354	16354	16354	16354
Age	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total Assets	55.4	78.2	88.1	93.8	95.5	97.5	98.9	99.3	99.6	99.1	66.8	97.7
Rating score	54.8	76.9	86.6	92.5	94.4	96.5	98.0	98.4	98.2	97.6	65.8	96.5
Turnover	50.2	66.6	74.8	78.3	79.3	80.7	82.1	83.0	83.1	82.7	58.4	81.3
Employment	47.1	61.1	67.4	67.6	70.1	72.5	74.9	76.2	76.9	76.2	54.1	73.5
Profit after Tax	52.5	70.8	79.3	82.9	84.3	86.4	88.3	90.0	91.1	91.6	61.6	87.8
Interest Payment	45.8	61.9	69.1	72.0	72.6	74.9	76.6	77.6	78.3	77.6	53.9	75.7
Dividend	34.6	45.6	50.6	52.5	54.1	55.8	57.0	57.8	56.5	54.2	40.1	55.4
Tangible Assets	54.2	75.9	85.3	90.6	92.1	93.5	94.4	94.4	93.7	91.4	65.0	92.9
Investment	31.8	43.9	48.4	51.0	51.7	52.8	53.4	54.1	54.3	52.7	37.8	52.9
Stock and WIP	53.6	74.7	83.6	88.6	90.2	91.4	92.2	92.0	91.0	88.3	64.1	90.5
Tcreditor	52.8	70.0	76.9	79.2	81.1	83.1	84.8	86.1	86.1	85.1	61.4	83.6
Short Term Debt	45.8	67.2	77.7	80.9	82.2	84.8	86.0	87.3	87.1	86.2	56.5	84.9
Long Term Debt	36.9	52.5	63.4	66.5	65.7	67.2	67.8	67.9	67.4	65.3	44.7	66.8
Long Term Liabilities	50.6	69.7	77.7	82.0	83.2	84.2	84.8	84.2	83.3	80.9	60.1	83.2
Shareholder Equity	55.3	78.2	88.1	93.8	95.5	97.5	99.0	99.3	99.7	99.1	66.8	97.7
Solvency	55.1	77.6	87.2	93.0	94.6	96.7	98.1	98.6	98.7	98.2	66.4	96.8
Gearing	49.4	68.4	77.2	81.7	83.7	85.3	86.4	86.6	85.8	84.0	58.9	84.8
Rcapital	48.8	63.1	70.7	73.9	75.9	78.7	81.5	83.7	85.1	85.5	56.0	80.6
STDebt/Current Liability (%)	51.5	72.7	82.5	86.5	88.0	90.3	91.5	91.8	91.5	89.8	62.1	89.9
TDebt/Total Liabilities (%)	55.0	77.5	87.2	92.6	94.2	95.7	96.8	96.9	96.8	95.2	66.3	95.5
STDebt/Total Debt (%)	47.3	67.0	76.2	78.6	79.0	81.5	83.1	84.3	84.3	83.3	57.1	82.0

We created binary variables by putting one, if the respective variable is not missing and zero otherwise for selected variables, namely employment, total assets, sales, investment, inventories, credit rating, cash flow, the tangible assets-total assets ratio, apparent interest rate, the short tem debt-current liability ratio, the total debt-total liabilities ratio, and the short term debt-total debt ratio. We calculated correlation coefficients between these binary variables and the firm type dummies to find evidence on the link between firm characteristics and missing observations[22]. Firm type dummies reflect the upper and lower tails of distribution according to size, dividend payout ratio, credit rating, age, and indebtedness. In other words, two dummies are constructed for each firm type and respective definitions of these dummies are provided below. We report the correlation coefficients between selected variables and firm type dummies in Table 4.7 and those among firm type dummies in Table 4.8. The following highlights some of the findings.

- We calculate positive and relatively high correlation coefficients between the large firm dummy and the key variables. This correlation is generally positive but lower for small firms. The correlation between highly indebted firms and the same key variables are negative and relatively high. This result implies that large firms are more likely to report while highly indebted firms are less likely to report.

- Generally, the correlation coefficients between variables and firm characteristics are higher during the period of 1990-1992, namely the tight period when the data were reported poorly compared to the period of 1993-1999 when the sample is almost complete for most of the firms.

- Small firms are less likely to report employment and investment figures relative to large firms. Investment figures were generally reported very poorly, thus a very low correlation is observed among these variable and firm characteristics.

- In general, negative correlation coefficients for secure, young and highly indebted firms were obtained while positive correlation coefficients were observed for small, large, risky, old and low indebted firms. One may have predicted negative

[22] We classify firms into groups based on some criteria defined below.

coefficients for risky firms and positive coefficients for secure firms, but we have observed just the opposite.

- The correlation coefficients between small firms and firm groups such as risky firms, young firms, low indebted firms are positive and relatively high during tight periods except for the correlation between small firms and young firms while the correlation coefficients between small firms and firm groups such as large, secure, old and highly indebted firms are negative and high for secure firms during the tight period.

- The correlation coefficient between large firms and secure firms is negative as in the case of small firms implying that there is no clear relation between firm size and risk in terms of reporting figures.

- The correlation coefficients between risky firms (secure firms) and firm groups such as highly indebted and young are positive (negative) while they are negative (positive) between risky firms (secure firms) and firm groups such as old and low indebted firms.

- A negative (positive) correlation between young and low indebted (highly indebted) is observed.

Table 4.7: Correlation Coefficients between Firm Characteristics and Binary Variables

	Small	*Large*	*Risky*	*Secure*	*Young*	*Old*	*Hindebt*	*Lindebt*
Empdisc	-0.051	0.357	0.052	-0.180	-0.141	0.141	-0.231	0.002
Assetdisc	0.156	0.193	0.155	-0.315	-0.122	0.122	-0.389	0.160
Turnoverdisc	0.261	0.289	0.093	-0.217	-0.097	0.097	-0.221	0.020
Investdisc	-0.087	0.189	-0.035	0.001	-0.153	0.153	-0.135	0.052
MIX1disc	0.152	0.202	0.057	-0.234	-0.096	0.096	-0.424	0.174
MIX2disc	0.133	0.224	0.106	-0.282	-0.070	0.070	-0.354	0.019
MIX3disc	0.063	0.266	0.121	-0.299	-0.059	0.059	-0.322	-0.056
Tangdisc	0.143	0.197	0.064	-0.240	-0.094	0.094	-0.405	0.157
Stockdisc	0.108	0.193	0.068	-0.244	-0.092	0.092	-0.383	0.139
Scoredisc	0.126	0.186	0.175	-0.345	-0.131	0.131	-0.411	0.168
Cflowdisc	0.222	0.275	0.083	-0.228	-0.117	0.117	-0.295	0.058
Aintrdisc	0.057	0.227	0.122	-0.288	-0.030	0.030	-0.222	-0.128

Table 4.8: Correlation Coefficients Among Firm Characteristics

Whole Period (1990-1999)

	Small	*Large*	*LDiv*	*HDiv*	*Risky*	*Secure*	*Young*	*Old*	*Hindebt*	*Lindebt*
Small	1.000									
Large	-0.334	1.000								
Ldiv	0.007	-0.125	1.000							
Hdiv	-0.007	0.125	-1.000	1.000						
Risky	0.062	-0.020	-0.093	0.093	1.000					
Secure	-0.023	-0.007	0.078	-0.078	-0.479	1.000				
Young	0.131	-0.144	-0.049	0.049	0.111	-0.125	1.000			
Old	-0.131	0.144	0.049	-0.049	-0.111	0.125	-1.000	1.000		
Hindebt	0.066	-0.005	-0.167	0.167	0.458	-0.327	0.100	-0.100	1.000	
Lindebt	0.011	-0.080	0.083	-0.083	-0.240	0.398	-0.086	0.086	-0.379	1.000

Tight Period (1990-1992)

	Small	*Large*	*LDiv*	*HDiv*	*Risky*	*Secure*	*Young*	*Old*	*Hindebt*	*Lindebt*
Small	1.000									
Large	-0.358	1.000								
LDiv	0.109	-0.117	1.000							
HDiv	-0.109	0.117	-1.000	1.000						
Risky	0.085	-0.048	-0.102	0.102	1.000					
Secure	-0.044	0.020	0.102	-0.102	-0.497	1.000				
Young	0.159	-0.148	-0.047	0.047	0.156	-0.157	1.000			
Old	-0.159	0.148	0.047	-0.047	-0.156	0.157	-1.000	1.000		
Hindebt	0.074	-0.021	-0.172	0.172	0.463	-0.322	0.142	-0.142	1.000	
Lindebt	0.017	-0.079	0.100	-0.100	-0.255	0.400	-0.104	0.104	-0.382	1.000

Loose Period (1993-1999)

	Small	*Large*	*LDiv*	*HDiv*	*Risky*	*Secure*	*Young*	*Old*	*Hindebt*	*Lindebt*
Small	1.000									
Large	-0.327	1.000								
LDiv	-0.028	-0.127	1.000							
HDiv	0.028	0.127	-1.000	1.000						
Risky	0.054	-0.010	-0.090	0.090	1.000					
Secure	-0.015	-0.016	0.070	-0.070	-0.474	1.000				
Young	0.127	-0.146	-0.048	0.048	0.101	-0.119	1.000			
Old	-0.127	0.146	0.048	-0.048	-0.101	0.119	-1.000	1.000		
Hindebt	0.066	-0.002	-0.164	0.164	0.458	-0.329	0.089	-0.089	1.000	
Lindebt	0.004	-0.077	0.077	-0.077	-0.236	0.400	-0.080	0.080	-0.378	1.000

4.4. Conclusion

The British economy experienced a deep recession in the early 1990s. The high indebtedness of firms by the end of 1980s relative to the previous recession in the early 1980s made this recession more destructive in terms of economic activity. Monetary policy is an instrument in managing aggregate demand and smoothing the fluctuations in the economy. Although the endogenous character of the policy response makes it difficult to identify separately the effects of monetary policy from other cyclical effects, the increase in the base rate in the early 1990s contributed to this slow down. Eventually the economy was squeezed with a substantial decline in corporate investment and value added. Financially weak firms, especially small and young non-financial firms were hit more deeply by this slowdown. Small and young firms that could not pay their bank loans back disrupted the functioning of the banking system.

The recession early last decade was followed by a stable economic environment: lower and stable inflation led to a fall in the cost of finance through the decline in the equity and the inflation risk premium during the second half of the 1990s. Financial liberalisation let firms raise funds in a more competitive environment where monitoring costs declined as a result of the improvement in the operations of the financial system and the corporate bond market became more liquid. In addition, a decline in the government consumption created additional funds in capital markets for business investment during this period. Potentially fragile firms improved their positions and were supported by a relatively loose monetary policy during this period.

We use the FAME sample that offers information on a variety of firms in terms of size, age, risk, age, profitability etc. for these particular periods. This sample contains quite rich information that allow us to analyse the reaction of firms with different characteristics to the policy shocks even though there are problems of missing observations. The FAME sample is incomplete not only because of the selection mechanism but also because of the non-response nature of data. A close study of the sample shows that there is a correlation between firm characteristics and missing observations. Risky, highly indebted, small, young firms are less likely to report basic variables. In fact, this result is not surprising since the selection mechanism implies that

relatively large and mature firms are obliged to report. In other words, the sample is biased towards large and financially healthy firms.

We cross-checked key variables of some quoted firms extracted from FAME with their corresponding figures in Datastream and One Source data sets. We found some differences among data sets for some of the variables. The differences are mainly due to definitions and missing observations. The difference between the data sets does not imply that a particular data set is superior to the other. For our purpose the FAME sample is more useful in the sense that the number of firms and their variety allow us to test our hypotheses.

Binary Variables (one if observed, zero otherwise)

Empdisc	Employment
Assetdisc	Total Assets
Saledisc	Sale
Investdisc	Investment
MIX1disc	Ratio of Short Term Debt to Current Liabilities
MIX2disc	Ratio of Total Debt to Total Liabilities
MIX3disc	Ratio of Short Term Debt to Total Debt
Tangdisc	Ratio of Tangible Assets to Total Assets
Stockdisc	Inventory Investments and Work in Process
Scoredisc	Rating score
Cflowdisc	Cash Flow i.e. profit before tax plus depreciation
Aintrdisc	Apparent Interest Rate i.e. ratio of interest payment to total debt

Firm Chategories (one if satisfy criteria, zero otherwiswe)

Small	Based on Criteria of Department of Trade and Industry
Large	Based on Criteria of Department of Trade and Industry
LDiv	Upper 25% of dividend payout ratio distribution
HDiv	Lower 25% of dividend payout ratio distribution
Risky	Rating score (under 40 out of 100)
Secure	Rating score (over 60 out of 100)
Young	Lower 25% of age distribution (age<13 years)
Old	Lower 25% of age distribution (age>43 years)
Hindebt	Upper 25% of gearing distribution
Lindebt	Lower 25% of gearing distribution
HReturn	Upper 25% of return on capital distribution
LReturn	Lower 25% of return on capital distribution

CHAPTER FIVE

Financial Structure, Firm Characteristics, and Credit Channel of Monetary Policy

5.1. Introduction

The monetary transmission mechanism has traditionally focused on money, the *liabilities* side of the banking sector's balance sheet, rather than credit; yet a considerable body of literature has built up to explore the credit channel, operating through the *assets* side of banks' balance sheets. There are two principal lines of argument. The first is the traditional credit channel view supported by the twin-pillars of the balance-sheet channel (or broad credit channel) and the bank lending channel.[1] The balance-sheet channel argues that business cycles may be propagated to the extent that the state of firms' balance sheets affects their ability to borrow and to spend, and can give rise to the possibility of 'endogenous credit cycles' and accelerator effects (see Kiyotaki and Moore, 1995; Bernanke, Gertler and Gilchrist, 1996 and 1998; Gertler and Gilchrist, 1994).

The bank lending channel focuses upon bank loans as the primary source of loanable funds; the effects of a monetary contraction would be magnified by the reduction in loans supplied by banks as well as through the traditional money channel on output and loan demand (see Bernanke and Blinder, 1988; Kashyap, Stein and Wilcox, 1993; Kashyap, Stein and Lamont, 1994; Gertler and Gilchrist, 1994). Bank lending is often regarded as *special* because firms, and particularly small firms, are constrained in their ability to draw credit from other external sources. The absence of available substitutes gives rise to dependence on sources of funds from banks and imparts a particular leverage from bank lending to real activity. This is thought to amplify the demand side effects on expenditure decisions of the private sector. Therefore, the extent to which the traditional bank lending channel is important depends on the substitutability between internal and external sources of funds and between bank lending and other forms of external finance.

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[1] The Bank of England provides a full exposition of the transmission mechanism for the House of Common Treasury Select Committee, see Bank of England (1999).

The second argument on the credit channel stresses the importance of *relationship banking* (see Sharpe, 1990; Rajan, 1992 and Boot, 2000). Banks can be regarded as special because they form relationships with firms over time to diminish the effects of information asymmetries. Relationship banking involves forming multiple lender-customer interactions in order to collect and evaluate customer-specific information, often of a proprietory nature. The advantages this brings over arm's length lending allows for cross-subsidisation of loan rates in bad times (Berlin and Mester, 1999). Although this does not necessarily advantage banks over non-bank intermediaries, it can be used to justify the existence of banks (see Carey, Post and Sharpe, 1998; Berger, 1999; Boot, 2000). The upshot of this theory is that far from amplifying the monetary cycle, bank lending may mute it. Older firms may have had time to establish these relationships with banks and the banks may gain from their relationships with these firms. They can then use the informational advantages to maintain bank lending during a monetary contraction at low risk and low cost to themselves.

Differentiating between these two views of the credit channel is an empirical matter. At the macroeconomic level, it has been hard to identify either the traditional bank lending channel or the relationship banking model because bank lending is influenced by loan supply and loan demand, which are hard to distinguish with aggregate data. Positive correlations between bank loans and indicators of economic activity could arise from the demand side rather than from the supply side. Attempts to resolve this issue have led researchers to identify robust indicators of monetary policy shifts, which allow them to separate demand and supply effects. Since most of the studies use US data, these have been based on indicators such as the spread of the Fed Funds over Treasury Bill rates (Bernanke and Blinder, 1992) and the careful reading of Fed minutes (the 'narrative' approach leading to 'Romer dates', Romer and Romer, 1990).[2] Comparisons of the behaviour of bank loans with other sources of external finance ain time points when these indicators show that monetary contractions have taken place, have been a useful means of

[2] The bulk of the empirical studies are addressed to the United States, where a well-developed commercial paper market offers an alternative (non-bank) source of funds for corporations. A few studies have investigated Japanese firms, which draw loans from insurance companies as the main form of non-bank financing (see Hoshi, Schafstein, and Singleton, 1993), but firms in other countries have not received much attention.

determining whether bank lending and other sources of funds are substitutes (see Kashyap, Stein and Wilcox, 1993 and Oliner and Rudebusch, 1996).

This chapter examines the evidence during tight and benign periods of monetary policy in the UK corresponding to the tightening of 1990-92, where interest rates were increased in order to meet the external objective of monetary policy, and the period 1993-99, where the objective of monetary policy was inflation targeting, and interest rates were reduced as inflation fell to low levels by historical standards. It is possible to differentiate between firms according to size, credit rating, age, and indebtedness, and therefore, we can identify whether monetary policy tightening influences firms' liabilities composition according to their type. By using firm type dummies interacted with the exogenously determined monetary policy stance, one can then identify whether the effects of monetary policy tightening operate through a traditional credit channel, amplifying the effects of the direct money channel, or whether bank-firm relationships mute the effects. Firm type dummies separate the firms in to groups that represent the extremes of the distribution according to characteristics such as size, risk, age, and indebtedness. It is expected that firms at each extreme of the distribution will behave differently, because they are more, or less, likely to obtain credit from banks.

The chapter is organised as follows. Section two outlines the traditional bank lending channel argument, the concept of relationship banking and the explanations for the growth of non-bank finance. Section three explains the data sources and properties. Section four explains the methodology, and section five presents the empirical evidence. Section six concludes.

5.2. Corporate Credit and External Finance

5.2.1. Two Views of the Credit Channel

The Modigliani-Miller theorem asserts that a firm cannot increase its value by changing the composition of its liabilities. Modigliani and Miller (1958) show that the marginal investment decision depends only upon the expected rate of return of the project relative to some 'constant' average cost and not on the source of finance. There should not be a bias towards internal finance or any suggestion that firms should have preferences

between different forms of external finance. The Modigliani-Miller theorem holds within the context of perfect capital markets – it is a 'benchmark' framework – but if it holds there is nothing special about banks, no hierarchy of finance, and no bank lending channel.

Researchers have sought to investigate the behaviour of agents in imperfect capital markets relative to this special case. Myers and Majluf (1984) indicate that in a less perfect world firms may have a preference ordering over alternative sources of finance which ranks internal sources, based on retained earnings, above external sources, such as trade credit, bank borrowing, and non-bank finance. The reasons for this rank ordering are likely to be the additional costs associated with external sources of finance, which can be pecuniary or non-pecuniary, in the form of non-price terms and conditions which external providers of finance attach to credit provision.

Attention has focussed on the distortions introduced by taxation, transaction costs and imperfect information that give rise to an external finance premium. The first two of these explanations are plausible but difficult to justify empirically without specific knowledge of individual and institutional circumstances facing firms. Falling rates of corporation tax rates could potentially explain the shift away from bank finance towards equity finance, and one could also consider other taxes, but the explanatory power of taxes (such as capital gains taxation, affecting the return to shareholders, and investment tax credits) are 'highly sensitive to assumptions about the marginal investor's tax rate' p. 1441, Rajan and Zingales (1995). Equally, transaction costs, which arise because of the need to match the size, maturity and liquidity of funds and to meet the diversification requirements of (risk-neutral) lenders, could explain why external finance is more expensive than internal finance and why there may be cost differentials between bank and non-bank finance, but they are difficult to quantify.

Instead, concentration has focused on the uniqueness of bank finance. Under imperfect information borrowers have a better idea of their likelihood of defaulting on a loan than do lenders, see Jaffee and Russell (1976) and Stiglitz and Weiss (1981). This leads to adverse selection and moral hazard problems that create an external finance premium, which can vary in degree since some lenders (banks) may have information

advantages over others. Banks (as opposed to non-banks) can overcome the adverse selection and moral hazard problems because they can gain from ongoing depositor-lender relationships with firms. They can match their liability structure to the term to maturity of loans and gather information on financial background of companies (see Leland and Pyle, 1977; Fama, 1985; Himmelberg and Morgan, 1995). This reduces their exposure to costs incurred through adverse selection, Diamond (1984).

A further argument for the uniqueness of banks is the dispersion argument. Chant (1992) argues that holders of the marketable securities for any firm tend to be more dispersed than banks. The co-ordination and monitoring problems may result in higher costs of funds and even the possibility that funding may not be fulfilled *at all,* since those that incur the cost of monitoring only reap a share of the benefits. A bank, as a single entity providing a large proportion or all of the external funds for a project, would not face this problem to the same degree. Again banks would have advantages over non-banks in being able to co-ordinate lending to firms. Some firms can overcome these problems if they are willing to make information available to potential holders of marketable securities in order to alleviate the need for monitoring. The existence of a 'track record' may allow larger and more established firms to obtain funds from external sources at a lower premium than smaller firms. To the extent that small firms are disadvantaged in this way, we could explain the heterogeneity in bank dependency for different sized firms. Even large firms may be dependent upon bank finance if making information available in order to obtain non-bank finance compromises informational advantages they may possess over competitors.

Imperfect substitutability can also arise on the supply side since banks themselves might not regard bank loans and securities as perfect substitutes in their own portfolios, if the former are held for return whilst the latter are held for liquidity. When securities and loans are imperfect substitutes the response of the banking sector to a monetary tightening has a direct effect on the provision of loans. If this theory is correct, interest rate spreads do not represent true differentials in prices in substitutable sources of funds that can be exploited by firms. Rather, imperfect access to other sources of finance restricts substitution away from bank lending preventing arbitrage and allowing differentials between loan rates and other borrowing rates to persist. Under certain circumstances firms

may need to borrow from banks, even at higher rates if they cannot obtain funds elsewhere. Small and medium sized firms may be unable to access other markets for funds and therefore have a certain dependence on banks for external sources of funds (see Gertler and Gilchrist, 1994; Bernanke and Gertler, 1995). This provides a special place to banks in the credit market.[3]

5.2.2. The Effects of Monetary Policy Tightening on Firms' Financial Choice

Market imperfections can generate cycles in economic and financial activities. Fluctuations in the activity of financial and non-financial firms become more significant with a rise in the degree of informational problems. A contractionary monetary shock is expected to weaken the financial positions of financial and non-financial firms and it may undermine the ability of the borrowers to finance their investment through external funds as well as that of lenders to extend loanable funds. Poorly capitalized firms, whose balance sheets are weak in terms of net worth, will have to pay a high cost for external funds relative to large well-capitalized firms. In other words, an initial decline in the economic activity as a result of a tight monetary policy will have a large impact on the borrowing and spending decisions of the agents facing credit market frictions, such as small firms (Bernanke and Gertler, 1995).

Monetary policy may have some influence on the lending ability of banks not only through the broad credit channel but also through a lending channel in which banks cannot recover (without incurring a cost) the loss of insured deposits that tend to decline following a reduction in reserves by issuing large certificate of deposits to finance bank credits (uninsured deposits). In other words, a tight monetary policy is expected to reduce the supply of bank credits if insured deposits and large certificates of deposits on the liability side of the banks' balance sheet, and loans and securities on the asset side, are not perfect substitutes. In this framework, the extent of the reduction in the loan supply as a result of a tight monetary policy depends on the degree of informational asymmetry

[3] The classic statements of this view are given by Fama (1985). A contrary argument to this view is that deposit-taking intermediaries such as banks tend to hold a large proportion of their assets as non-marketable securities (loans) whereas other intermediaries e.g. mutual funds acquire mainly marketable securities (corporate debt, equity). For non-marketable securities, information *acquisition* is the responsibility of the lender whereas for marketable securities information *provision* is the responsibility of the borrower. This might suggest that banks would face more severe information asymmetries, not less.

between banks and the depositor, which, in turn, affects the cost of raising new uninsured deposits. As in the case of non-financial firms where financial position, net worth, and size affect their investments, these factors will also change the lending behaviour of banks and thus their loan supply (Kashyap and Stein, 1995; Stein, 1998; Kishan and Opiela, 2000). All this is to argue that with informational asymmetries, and the lack of close substitutes, monetary policy contractions will be amplified by credit market effects implemented by banks through the loan supply.

A contrary argument is proposed by Sharpe (1990) and Rajan (1992), who suggest that far from the credit channel *amplifying* monetary policy, it may in fact *mute it*. They argue that it is in the interests of both banks and firms to form workable relationships that can endure the cyclical variations of monetary policy. Indeed the *raison d'être* of banks is to provide such relationships. Relationship banking involves multiple lender-customer interactions over time and across products that allow the collection of customer-specific information (often of a proprietory nature), and the evaluation of the profitability of lending through multiple financial services. This creates conditions by which gains can be made over arm's length lenders, but the split does not necessarily correspond directly to that of bank/non-bank intermediaries (see Carey, Post and Sharpe, 1998; Berger, 1999; Boot, 2000). It may involve investment as well as commercial banks, and other financial intermediaries that can make use of proprietory information to offer favourable terms on loans, and offer other financial services such as letters of credit, cheque clearing, and cash management services. In assessing the impact of credit provision over the monetary cycle, relationship banking may allow the lender to offer cross-subsidisation of loan rates in bad times by charging marginally higher rates in good times (Berlin and Mester, 1999). It is assumed that banks primarily offer these facilities and this gives them a special place in the market for loans. Thus, the contraction brought about in monetary policy by higher interest rates may in fact be offset by the banks who allow lending rates to move counter to the policy rate over the cycle. Instead of bank lending declining with the monetary policy contraction, the relationship between bank and firm will allow the bank to maintain its lending (access to proprietory information lowers the risk of this activity and cheap funds e.g. deposits obtained through multiple financial services avoid the need to resort to costly wholesale sources). In short, there will be no amplification of monetary policy from the credit market.

The interaction between the change in the composition of firms external finance and monetary policy stance is investigated by Kashyap, Stein and Wilcox (1993) and Oliner and Rudebush (1996). The first study tests the impact of a tight monetary policy on the ratio of bank loans to the sum of commercial paper and bank loan, 'the mix', using aggregate data for the US. The monetary policy tightness is determined by reference to Romer dates (Romer and Romer, 1990), the Federal Funds rate and the spread between Federal Funds and Treasury bonds. The empirical evidence shows that the tight monetary policy leads to a shift in the firms' external finance from bank loans to commercial paper. The decline in the banks' loans is due to a reduction in the bank loan supply rather than a reduction in the demand for the bank loans. This result implies that loans and bonds as bank assets and loans and other forms of finance as corporate liabilities must be imperfect substitutes.

The main criticism of the Kashyap *et al.* (1993) paper is that it uses aggregate data and thus fails to allow for firm heterogeneity. Gertler and Gilchrist (1994) are able to analyse the different responses of small versus large manufacturing firms to monetary policy in an imperfect financial environment. The study emphasizes a substantial decline in the activity of the small size firms (mainly inventory demand) during a tight monetary policy. In other words, the responses of small and large firms to monetary policy differ considerably. The informational frictions that increase the cost of external finance apply mainly to younger firms with a high degree of idiosyncratic risk, and to those firms that are not well collateralised. Small firms rely on intermediary credits, while large firms generally use direct credits, including equity, public debt, and commercial paper. The financial constraints are likely to bind for small-scale firms during the recessions rather than in boom periods. Prior to recession periods, the short-term debt growth for large firm rises before declining as a recession sets in.

Based on the idea of firm heterogeneity, Oliner and Rudebusch (1996) comment on Kashyap, Stein and Wilcox (1993) and find new evidence from using micro data. Oliner and Rudebusch (1996) conclude that there is no evidence that monetary policy reduces the bank loan supply relative to non-bank finance after the mid-1970s. Although Oliner and Rudebusch (1996) confirm that the broad credit channel functions through informational asymmetries faced by firms for all loan types rather than only bank loans,

they argue that it is large firms rather than small firms relying more on bank finance, that issue commercial papers during a contraction. Kashyap, Stein and Wilcox (1996) reply to this comment and conclude that a contractionary monetary policy, which reallocates funds away from small firms towards large firms, based on the results of Gertler and Gilchrist (1994), does not work against the bank lending channel. In other words, distributional impacts of monetary policy should not be seen as an argument that rejects the bank lending view.

5.3. Data

5.3.1. Properties of Data

We construct a sample from the FAME Database that allows us substantial flexibility in analysing some aspects of the monetary transmission mechanism and in emphasising the role of non-financial firms' financial positions for corporate sector activity. We limit the sample to the manufacturing sector, which has a similar business cycle to the overall economy.

The data has an exemption structure that allows some missing observations in the company's accounts held on the FAME data set, and these are prevalent in the first three years of the sample period[4]. This means that the sample is not a balanced panel, in the sense that one cannot observe information about most of the firms whose turnover is under the threshold explained in Chapter Four. The sample also tends to represent the upper tail of the population in terms of firm size distribution because we do not observe information for all firms in the manufacturing sector with turnover below the exemption threshold. However, the sample does include some information about certain firms whose turnover is under £90,000, which is the upper threshold for totally exempted firms. This characteristic of the sample requires us to ensure that we cope with truncated and censored samples. The selection bias problem related to the sample and the tests used will be discussed in more detail in Chapter Seven. We will report the selection bias tests for the empirical model used in the same chapter.

[4] We provide details on exemption in Chapter Four.

Only two third of the firms in the sample reported their balance sheets in the period of 1990-1992, while balance sheet information was available for almost all of the firms (more than 15,000 firms) in the period 1993-1999. The distributions of firms across size categories in the sample and the number of reported firms by year are shown in Figure 4.7 in Chapter Four. The number of medium and large firms grew over the sample period in parallel with the increase in the number of firms that reported balance sheet items, while the number of small firms grew in the early 1990s but declined after the mid-1990s.

Figure 4.9 in Chapter Four records the distribution of firms across rating score bands and highlights the impact of the recession in the early 1990s on the firms' financial health. As expected the shares of the firms in the fourth and fifth bands, i.e. risky firms are higher during the recession (black column) than during the recovery period (shaded column), that is, the share of the firms in the secure and stable bands are higher during the upswing period. In other words, in the sample there are more risky firms during the recession than during the recovery. Other priors can be confirmed within the sample. For example, large and old firms have on average higher ratings than small and young firms, which have inadequate collateral assets and no track records. Small and young firms are more likely to be subject to financial difficulties in the period of slowdown, and this is reflected in the rating score. Similarly, Figure 4.10 in Chapter Four shows how the distribution of rating scores varies with the business cycle. First, there is a downward slope from right to left, indicating that the firms in the upper tail of total assets have relatively higher credit scores than those in the lower tail irrespective of the business cycle. Second, there is a noticeable downward shift in the entire distribution of rating scores during the recession when compared to the recovery period, with lower average scores evident throughout. Third, the margin between the curves grows as the asset size declines, with the largest firms virtually unaffected by the recession but small and medium sized firms significantly affected in accordance with their size.

Measuring the response of firms' external finance composition to the monetary stance is the main concern of this study. Some aggregated figures for the liabilities composition of firms in the sample are given in Table 5.1 across size (small versus large), rating (risky versus secure) and age (young versus old) for the early 1990s recession

period and the following recovery era[5]. This type of analysis provides us with some preliminary results that we might expect to obtain when a more rigorous econometric analysis is carried out in the following sections. The following stylised facts were uncovered from Table 5.1.

Current liabilities constitute the largest part of total liabilities for all firm groups and the share of current liabilities for small, risky and young firms is higher than their counterparts, namely large, secure, and old firms respectively. The share of current liabilities increases slightly after the recession for all firm groups. That is, the decline in trade credits has been over-compensated by an increase in short-term debt and other current liabilities. The increase in the share of short-term debt is more significant for small firms after the recession. The share of short-term debt is significantly higher for risky firms than that of the other firm groups, while secure firms have the lowest share of short-term debt among the other firm groups. These findings may confirm the fact that firms generally compensate the decline in the short-term debt, which is made up of mainly bank overdrafts, by switching to other short-term liabilities such as trade credit during the recession and this process is reversed as the economy recovers; the share of trade credit goes down during the recovery period.

Financially weak firms that are subject to moral hazard or adverse selection problems (as perceived by lenders; banks or other financial institutions) are less likely to have access to external finance especially in the period of a general slowdown in the economy. It is more likely for these firms to have access to bank finance during the recovery phases of the economy than during recessionary periods. Therefore, the ratio of short-term debt to total current liabilities for financially fragile firms is likely to decline during the recession, either because of the decline in the potential supply of bank loans for these firms or because of an increase in alternative finance (such as trade credits) to keep firms in operation. Financially strong and large firms may supply trade credit to their small financially weak customers (firms) to undermine the negative impacts of lack of credit supply on their customers and activity. In short, it is expected that a tight monetary policy resulting in a high external finance premium for financially weak firms would lead to a decline in the ratio of short-term debt to total current liabilities.

[5] Details about the classification of firms across size, rating and age are given in the following subsection.

Table 5.1: The Composition of Firm Liabilities across Firm Groups (Percent)

	Small	*Large*	*Risky*	*Secure*	*Young*	*Old*
1990-1992 Average (1)						
Current Liabilities	**85.31**	**78.05**	**83.48**	**81.65**	**80.86**	**79.96**
Trade Creditors	29.73	31.44	26.50	30.90	32.29	29.34
Short-Term Debt	21.31	27.19	36.02	15.59	23.81	22.29
Total Other Current Liabilities	34.27	19.42	20.96	35.16	24.75	28.33
Long Term Liabilities	**14.69**	**21.95**	**16.52**	**18.35**	**19.14**	**20.04**
Long Term Debt	10.96	14.37	12.61	11.10	10.52	13.18
Total Other Long Term Liab.	3.73	7.58	3.91	7.25	8.62	6.87
1993-1999 Average (2)						
Current Liabilities	**86.08**	**79.87**	**85.16**	**82.58**	**80.95**	**81.93**
Trade Creditors	25.39	25.14	22.56	22.79	25.08	24.80
Short-Term Debt	24.79	28.46	38.48	17.56	25.12	24.30
Total Other Current Liabilities	35.91	26.27	24.12	42.23	30.74	32.83
Long Term Liabilities	**13.92**	**20.13**	**14.84**	**17.42**	**19.05**	**18.07**
Long Term Debt	10.40	14.40	11.83	10.89	11.18	11.31
Total Other Long Term Liab.	3.52	5.73	3.01	6.52	7.87	6.75
Ratios (1)/(2)						
Current Liabilities	**0.99**	**0.98**	**0.98**	**0.99**	**1.00**	**0.98**
Trade Creditors	1.17	1.25	1.17	1.36	1.29	1.18
Short-Term Debt	0.86	0.96	0.94	0.89	0.95	0.92
Total Other Current Liabilities	0.95	0.74	0.87	0.83	0.81	0.86
Long Term Liabilities	**1.06**	**1.09**	**1.11**	**1.05**	**1.00**	**1.11**
Long Term Debt	1.05	1.00	1.07	1.02	0.94	1.16
Total Other Long Term Liab.	1.06	1.32	1.30	1.11	1.09	1.02

Source: The FAME sample

This result may be valid for the ratio of total debt to total liabilities provided that total debt is more pro-cyclical than total liabilities. This seems reasonable since through the bank lending channel all sorts of loans may be influenced by a change in the monetary policy stance. However, the same result for the ratio of short-term debt to total debt may not be straightforward. It is more likely that the short-term loans react more quickly to a change of monetary policy than long-term loans. The overall effect is expected to be pro-cyclical if the short-term debts are reacting faster than long-term debt.

5.4. Methodology

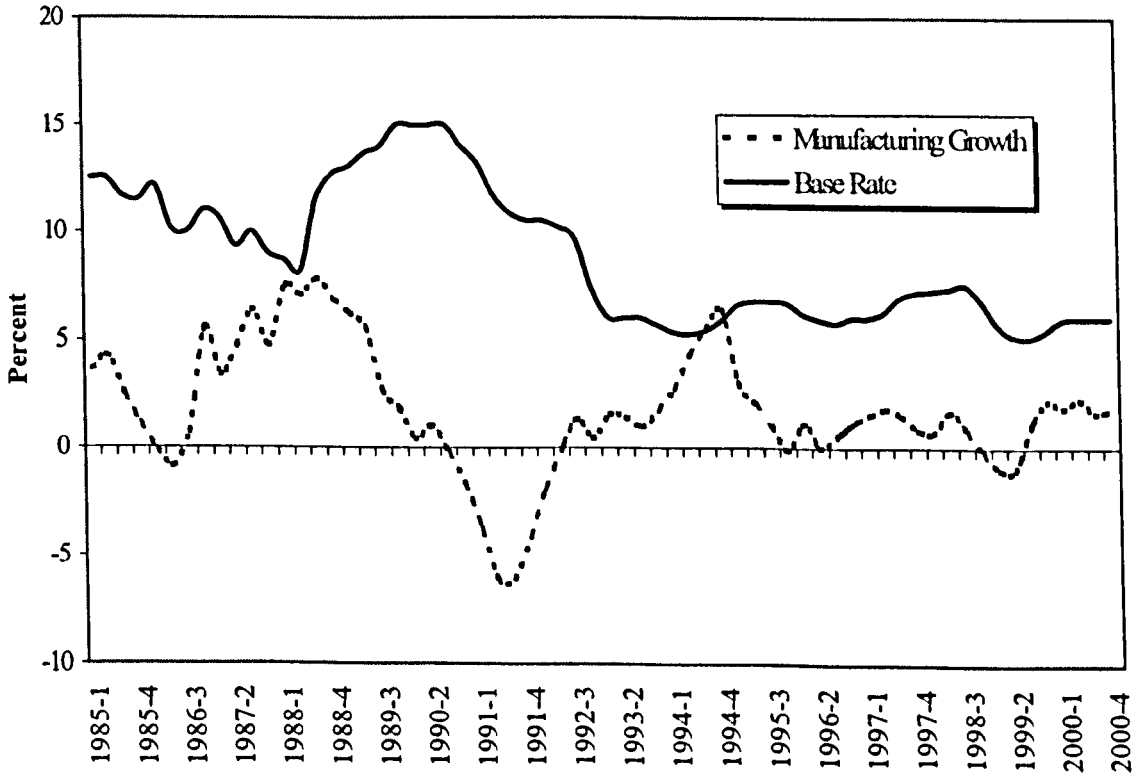
5.4.1. Basic Background for Testing the Hypothesis

This study seeks to determine whether firms with different characteristics respond to the monetary policy stance heterogeneously. For example, small and financially weak firms may have difficulties obtaining relatively low external premium funds during tight periods. Therefore, they would tend to substitute more costly funds to finance risky projects that increase the extent of moral hazard and adverse selection problems. Alternatively, a general increase in the demand for bank funds in tight periods may raise the possibility of financial constraints for small and weak firms who have limited collateral. In this context, differentiation in the reaction of the firms' liabilities composition to the monetary stance across different firm groups can be evaluated as evidence for a broad credit channel. In addition, one can derive some information about the bank lending channel even though there are difficulties over observing the supply side. In fact, the overall decline, for example, in the short-term bank finance to total current liabilities ratio in tight periods across firm groups with different characteristics may be taken as evidence for the bank lending channel.

Our approach here is to explain the mixture of liabilities that a firm draws upon over the cycle with a combination of environmental (monetary policy determined) conditions and firm specific characteristics. We use three different measures of the liabilities composition of firms. The first one is the ratio of short-term debt to current liabilities *(MIX1)* by which we tend to find evidence for the bank lending channel in the line with Kashyap *et al* (1993) as well as for the broad credit channel as Oliner and Rudebush (1996) suggest. We use two additional variables, namely the ratio of total debt to total liabilities *(MIX2)* and the ratio of short-term debt to total debt *(MIX3)* to test the impact of monetary policy on the firms' liabilities composition considering liabilities terms and types. Unlike *MIX1* and *MIX2*, testing the impact of monetary policy on *MIX3* may not provide direct evidence for the bank lending channel but it gives an idea about how firms' liabilities react to the policy and therefore it may provide evidence for the broad credit channel.

To capture the effects of external events, we divided the sample into two different time periods corresponding to tight and benign monetary policy (policy regime periods). The first period relates to the period when monetary policy in the UK was dedicated towards maintaining the exchange rate within its target zone in the Exchange Rate Mechanism during 1990-1992. This period coincided with a recession, tightening monetary policy and a harsh environment for existing and new corporate borrowers (Figure 5.1). Nevertheless, high interest rates in Germany after reunification and the perceived weakness of sterling as a currency contributed to keep interest rates high during this period. The second period, 1993-1999, when followed the recession, witnessed a period of sustained economic growth, a fall in unemployment and inflation, and low interest rates. The corporate sector experienced an improvement in net worth and borrowing conditions were less constrained.

Figure 5.1: Base Rate and Manufacturing Growth



The financial mixes are explained by variables that control for exogenous conditions such as monetary policy stance, age, demand and other cyclical conditions and for the financial position of firms such as the gearing ratio, tangible asset ratio, credit

rating, and real tangible assets[6]. Some of these variables are used to test the implications of the moral hazard model presented in Chapter Three.

Shifting between types of finance with different terms and structure involves a cost for firm groups that are subject to informational asymmetries. For example, firms with poor collateral and reputation are less likely to get long-term bank loans and funds from the market directly. Financially strong firms can easily borrow from the market directly without incurring an external finance premium. On the contrary, our model suggests that financially weak firms that are more subject to informational asymmetries might have to pay an external finance premium for their borrowing transactions. This offers them incentives to choose risky projects in order to maximize the private benefit of the managers.

We categorise firms and run regressions by considering size, age, rating, and indebtedness, to emphasise the importance of firm heterogeneity that reflects the extent of financial imperfections. This allows us to compare small with large firms, young with old firms, risky with secure firms, low-indebted with high-indebted firms, high capital return with low capital return firms and to determine how the explanatory variables influence the mix when monetary policy is tight compared to when it is benign.

We generate firm type dummies to identify the impact of monetary policy in our empirical model by considering the lower and the upper tails of the distribution for the respective firm characteristics. We do not include the firms in the middle of the distribution for each firm type in order to focus more on the firms in the tails. For example, in our empirical analysis, we test the impact of monetary policy on the various financial mixes for the most risky versus the least risky firms, that is, we do not capture the impact of monetary policy for the moderately risky firms. By this method, it is thought that the credit channel of monetary policy is better identified for more financially constrained versus less financially constrained firms. The firms that are financially constrained, i.e. small, risky, young and high indebted firms, are more likely to be subject to informational asymmetries than those that are financially unconstrained, i.e. large,

[6] As we explained in Chapter Four, the FAME sample includes a lot of missing observations for the item of intangible assets. We prefer to use real tangible assets in our econometric estimations by subtracting intangible assets from total assets to avoid biases resulting from missing observations.

secure, old and less indebted firms therefore firms in the former group are more sensitive to tight credit conditions.

Firm type dummies are created based on two classification methods. First, firms are allowed to switch across firm categories over time, that is, the criteria of splitting the sample into groups are applied to the sample for every year. For example, a firm may shift from the 'small' group to the 'large' group or vice versa over time. By this methodology, it is intended to use the time dimension of the sample that allows us to gain valuable insights. Second, we use pre-period figures of 1991 as thresholds for categorising firm into groups to avoid the endogeneity bias concerning the change in status of firms over time. That is, firms are not allowed to switch across firm categories as the economic and financial conditions change. We only report the findings with the first method even though they do not differ significantly across the splitting methods.

We generate size dummies based on the criteria given in Table 4.3 in Chapter Four where firms should satisfy at least two criteria out of three (total asset, turnover and employment criteria) to be classified into the small or the large group while firms in between are classified as medium sized firms and we do not consider a dummy variable for this group. Small firms meet at least two out of three following criteria; turnover below £2.8 million, total assets below £1.4 million and number of employee below 50 and similarly, large firms meet at least two out of the three criteria; turnover above £11.2 million, total assets above £5.6 million and number of employees above 250.

The sample contains rich information about the credit ratings of firms. The credit rating score measures the likelihood of company failure in the twelve months following the date of calculation. The credit ratings are scaled in the range from 0 to 100. For ease of interpretation, that range may be considered as comprising five distinct bands, the details of which are reported in the previous chapter. Clearly firms in bands one and two are quite secure, while firms in band four are four times as likely to fail as the firms in band three, and are therefore quite risky. Firms in band five are almost certain to fail unless action is taken immediately. Firms whose rating score figures are at most 40, were labelled *risky* while those having rating score over 60 were labelled *secure.* We use this variable to generate dummies for risky and secure firms to compare the reaction of the

mix to risk as monetary policy changes. The rating score is highly correlated with the variables that reflect the financial healthiness of firms such as solvency and gearing; the correlation coefficients are around 0.80 and -0.50, respectively over the whole period. Therefore, in our empirical analysis we also use the rating score as an explanatory variable that reflects the financial healthiness of firms.

We have the information about the year of incorporation for all firms. Firms are classified according to their age in order to measure the importance of a track record for the composition of firm external finance. The firms in the lowest quartile (lower 25 percent) of the age distribution are classified *young* while those are in the highest quartile (upper 25 percent) are classified as *old.* We use the respective dummies in the regressions to identify the credit channel. Again, we do not use a dummy for the firms in the middle of the age distribution. We classify firms as *highly-indebted* or *low-indebted* if their gearing ratio figures are in the highest or lowest quartile of the distribution, respectively. The following subsection explains the methodology for estimating the responsiveness (elasticities) of bank-based and market-based finance to explanatory variables controlling for the monetary policy stance, the financial positions of firms and firm specific effects.

5.4.2. The Model

The empirical model is based on Kashyap *et al.* (1993) and Oliner and Rudebush (1996). We also consider the implications of the moral hazard model studied in Chapter Three where the composition of the firm's financial source is determined by monetary policy, the probability of having good and bad projects, gearing, collateral, monitoring cost, and project size as well as the distribution of firms in terms of investment opportunities.[7]

The model constructed by the Kashyap *et al.* (1993) is very much similar to the one in Bernanke and Blinder (1988) even though Kashyap *et al.* (1993) focus more on the firms' composition of finance. The model assumes a representative firm that can choose between two sources of finance in raising funds for investment, i.e. banks loans, L, and

[7] The model in Hoshi *et al.* (1993) is modified in Chapter Three so that the impact of a change in monetary policy on the liability composition of the firms can be tested.

commercial papers, *B*. The details of this model are discussed in Chapter Two. We summarise the basic predictions of the model below.

One can observe the main implications of Kashyap *et al.* (1993) model by studying the following derivatives:

$$dL/dM = \alpha^* dI/dM + Id\alpha^*/dM \qquad (2.14)$$

$$dB/dM = (1-\alpha^*)dI/dM - Id\alpha^*/dM \qquad (2.15)$$

$$d\alpha^*/dM = F' d(r_L - r_B)/dM \qquad (2.16)$$

where M, I, α^*, r_L and r_B denote money supply, investment, the mix, lending rate and paper rate, respectively. The impact of a change in the monetary stance on supply of loans and bonds is a function of the mix. The impact on the mix is a function of the wedge between lending and commercial paper rates given the assumption of imperfect substitutability between loans and commercial paper both as bank assets and corporate liabilities.

Equation (2.14) implies that when the loans and bonds as bank assets are perfectly substitutable, then, the effect of money supply on bank loans depends only on the change of investment as a result of the monetary shock. If the loans and bonds are not perfectly substitutable, the weight of bank finance changes because of the non-zero loan and bond rate spread. Equation (2.15) implies that monetary tightening will have opposite impacts on bond finance; a reduction in money supply reduces investment and thus the demand for all source of finance as well as bond finance, but the demand for bond finance may increase as a result of substituting bond finance for loan finance. Therefore, the proposition that monetary policy shocks affect the mix is valid if the bond and loans are not perfect substitutes as given in equation (2.16).

From the investment demand equation, $I = I_d(Y,k)$

$$dI = (I_y/dy)^* dy + I_k dr_B + I_k \alpha^* (dr_L - dr_B) \qquad (2.17)$$

The term on the right hand side disappears in the case of perfect substitution between loans and bonds and thus a change in the investment is determined only by income and the bond rate. The hypothesis that loans and bonds are imperfect substitutes as firms' liabilities can be tested by adding the share of short-term bank loans in total short-term finance (mix variable) as an independent variable into the investment equation in addition to the interest rate variable. Excluding the interest rate as an explanatory variable would not allow us to verify the existence of an independent lending channel of transmission. In other words, without using the interest rate as an explanatory variable together with the mix variable, it is unlikely that one could identify the impact of loans on investment properly.

Kashyap *et al.* (1993) explain the mix by using its lags, lags of monetary policy stance and GNP growth to control for cyclical factors other than monetary policy for the aggregated data. In order for the bank lending channel to operate, the supply of bank loans should decline relative to the supply of other debt (the mix declines), after a monetary contraction. They find the evidence for the bank lending channel, where the mix declines as a result of the monetary contraction.

Oliner and Rudebush (1996) criticise the empirical method used by Kashyap *et al.* (1993) and use disaggregated firm level data instead to explain the mix in their analysis. This enables them to identify the impact of the monetary policy stance on the mix for large and small firms. They find the evidence that for large firms short-term debt expands after a monetary contraction, while it declines for small firms, therefore they decompose the sources of change in the mix as the 'shift' and the 'fixed' components. The shift component represents a reallocation of short term credit from small firms to large firms under the tight policy, while the fixed represents the change in the mix because of change in the relative supply of various loan types keeping the share of the short-term debt for the respective firm groups fixed. Using disaggregated data, Oliner and Rudebush (1996) find evidence that the decline in the mix originates from the shift in the composition of the debt across firm groups not from the decline in the supply of the short-term debt relative to other loans. Therefore, the decline in the mix at the aggregate level should not be interpreted as direct evidence for the bank lending channel. However, the decline in the mix across firm groups can be considered as evidence for the bank lending channel if the

debt shares across firm groups remain fixed. They also claim that the shift in the composition of the various debt categories is considered as evidence for the broad credit channel.

We combine the idea of Kashyap *et al.* (1993) with the predictions from Hoshi *et al.* (1993) to test whether firm heterogeneity is important for explaining the behaviour of liabilities of firms over the business cycles. We introduce the base rate into our empirical model to measure the impact of monetary policy on the composition of external finance. The theoretical model implies that the change in the composition of external finance depends on the firm's collateral, debt, asset size, probability of good and bad projects (riskiness), monitoring cost, interest rate, project size, ownership structure, and the distribution of firms in terms of investment opportunities. We adopt this theoretical framework to test the hypotheses associated with the credit channel of monetary transmission. In this context, we specify our base line empirical model using the following function.

$$MIX=f(MPS, MPR_p, MPS*TYPE_j, MPS*TYPE_j*MPR_p, MPS*MPR_p, TYPE_j, SIZE, SCORE, AGE, COL, GEAR, GDP, YEARD) \quad (5.1)$$

where *MIX*, *MPS*, *MPR*, *TYPE*, *SIZE*, *SCORE*, *AGE*, *COL*, *GEAR*, *GDP*, and *YEARD* denote three alternative mixes, monetary policy stance variable, the monetary regime dummies, the firm type dummies, real assets, credit rating, the age of firms, the ratio of tangible assets to total assets, gearing ratio, the GDP growth rate and year dummies, respectively. $MPS*TYPE_j$, $MPS*TYPE_j*MPR_p$, and $MPS*MPR_p$ are interaction terms that capture the impact of firm types and monetary regime periods. We provide detailed explanations for these variables below.

As defined above we use three different measures of the financial mix (*MIX1*, *MIX2* and *MIX3)* as dependent variables in our regressions. Two-time period dummies are assigned to reflect two different monetary policy regimes, MPR_p, namely tight monetary policy period of 1990-1992, *TP*, loose monetary policy period of 1993-1999, *LP*, respectively.

TP= 1 if t=1990-1992 *LP =1 if t=1993-1999*

= 0 otherwise *= 0 otherwise*

We only provide the estimation results with the *TP* dummy interacted with the monetary policy variable and firm type dummies to avoid redundancy as *TP =1- LP.*

MPS shows two alternative monetary policy stance variables, namely the cumulative index of the Bank of England's base rate, *BRATE* and the apparent interest rate i.e. the ratio of interest payment to total debt, *ARATE.* The first variable is calculated by adding the percentage changes in the base rate to the previous year value starting from base year, *1990=100.* Bernanke and Blinder (1992) proposed the Federal Funds rates as a variable to reflect monetary stance along side the spread of the Federal Funds rate over Treasury Bill rates and the careful reading of Fed minutes (the 'narrative' approach leading to 'Romer dates', Romer and Romer, 1990) and this variable is widely used by researchers in this area. One shortcoming of this variable is that it is firm-invariant i.e. theree is a single rate for all firms having different characterises for a given year. However, in this study by using different financial variables and firm-specific fixed effects in a panel data framework, the extent of this shortcoming is likely to be eliminated substantially.

Contrary to the cumulative base rate, the apparent interest rates, as a measure of monetary stance instead vary across firms and time. This variable reflects the extent of the external finance premium. Some firms are more likely to incur a high interest payment relative to their total debt because they are supposed to be financially weak and risky and not able to find cheaper external finance. Although this variable is not controlled exogenously by the Bank of England (it is endogenous in the sense that it reflects the financial conditions of firms as well as the interest rate), it does provide evidence about the extent of the asymmetric information problem in the financial transactions given firm heterogeneity. On the other hand, since apparent interest rates are calculated based on the interest payments that are incurred for past debts they hardly represent changes in the current interest rate. Therefore, *ARATE* is less likely to reflect monetary shocks compared to the *BRATE*[8].

[8] Results for estimations with the apparent interest rates are given in the Appendix.

There are quite a number of studies that classify firms as less financially constrained firms and more financially constrained firms, which is consistent with the methodology used by the financial constraint literature. This sort of taxonomy is crucial for the hypothesis of credit channel of monetary transmission, as it helps to measure the extent of variations in the reaction of firm groups to monetary policy, if any. In this study, small, risky, young and highly indebted firms are supposed to have a higher sensitivity to changes in monetary policy relative to large, secure, old and less indebted firms.

Firm type dummies *(TYPE)* consist of eight different binary variables reflecting eight different firm characteristics i.e. small, large, risky, secure, young, old, highly indebted, and less indebted. We could use only one dummy for each firm characteristic, namely size, rating, age, and indebtedness (as in case of monetary regime dummy) to carry out our regressions but instead we use two dummies for each firm type to capture the reactions of firms in the tails of the distribution. For example, for the size we carry out estimations by using interactions for both small and large firms as we do not intend to measure the reactions of the middle sized firms. This method enables us to identify the reaction of firms in the tails of firm distribution for a particular type of firms[9].

$TYPE_j = 1 \quad j = 1 \ldots.8 \quad$ *and zero otherwise*

$MPS*TYPE_j$, $MPS*TYPE_j*MPR_p$ and $MPS*MPR_p$ are the interaction terms that are vitally important for this study. They enable us to do inferences about the impact of monetary policy on firm's financial behaviour considering different monetary policy regimes and a great extent of firm heterogeneity. Interaction terms in the first group show the extent to which the impact of monetary policy differs across firms with different characteristics, while the second group is made up of interaction terms that consider both monetary policy regime and firm characteristics interacted with the monetary stance variable. The third group identifies the impact of monetary policy across the tight policy regime period.

[9] We intend to use the firm type dummy (*TYPE*) among the explanatory variables but since the software dropped it in some regressions (due to collinearity), and the estimated coefficients are not generally significant therefore we do not report the estimation results where *TYPE* is used as an explanatory variable.

This conventional method, *the interactions terms approach*, enables us to have a more parsimonious model with a larger sample size and thus greater degrees of freedom. Interaction of monetary policy stance with firm type, *MPS*TYPE*, or with both firm type and sub-periods $MPS*TYPE*MPR_p$ do the same job as in the split sub-samples. In the case of the interaction terms approach it is implicitly assumed that the impacts of control variables on the dependent variable do not change across firm characteristics. For robustness, we also carried out separate estimations by using the firm type dummies as part of interaction terms for all explanatory variables.

SIZE is the variable that reflects the activity level of firms. We use two alternative variables for this purpose, namely the logarithms of real tangible assets and real sales. The estimation results for alternative *SIZE* variables do not differ significantly but we only report the results for the real tangible assets *(RASSET)*, which have relatively fewer missing observations. *SCORE* is the credit rating score and as explained above it reflects the credit risk. *GEAR* denotes the gearing ratio and reflects the indebtedness of firms. *COL* is the ratio of tangible assets to total asset showing the collateral level of the firms. We think that these firm specific variables, namely *RASSET, SCORE, GEAR* and *COL* are more likely to be endogenous even though the correlation coefficients between error terms and these variables are not significant.

AGE, GDP and *YEARD* show the age of firms, the growth rate of gross domestic product that is invariant across firms to control for the business cycle, and the time (year) dummies, respectively. Time dummies control firm invariant cyclical effects (as *BRATE, GDP*, and *TP* do) therefore using these variables in the same regression leads the software (Stata) to drop three time dummies automatically as a result of collinearity. We tend to use *BRATE, GDP* and *TP* to capture the cyclical factors instead of time dummies to avoid this problem as *BRATE* is the key variable for our analysis and it should be used as an explanatory variable rather than time dummies. In fact, the estimation results do not differ significantly if time dummies are also included as explanatory variables but in this case some of dummies drop out from the regression due to collinearity [10]. Therefore, we carry out estimations and report the results without using time dummies to avoid complications

[10] If we use the age of firm as an explanatory variable in the regression with time dummies, we also loose one time dummy.

originated from collinearity between some crucial explanatory variables_(*GDP*, *AGE* , *BRATE)* and the time dummies [11].

We summarise the basic statistics of the variables employed for estimating the empirical model in Table 5.2 and Table 5.3[12]. We report the number of observations, mean, standard deviations and minimum and maximum values for each variable based on firm groups according to size, age, risk, and indebtedness in Table 5.2 while we provide the same statistics for sub-samples considering the monetary policy regime in Table 5.3. The means of *MIX1* and *MIX2* are larger for large firms while the mean for *MIX3* is larger for small firms. However, all versions of the mixes are larger for risky firms than secure firms. As expected, *MIX1* and *MIX2* are much higher for highly indebted firms as compared to less indebted firms. Large, secure, old and less indebted firms have high ratings relative to their counterparts, namely small, risky, young and highly indebted firms. Risky firms have a high gearing ratio relative to other firms. Similarly, large, secure, and old firms have high real asset size and high tangible asset ratio on average relative to their counterparts. The apparent interest rate and gearing ratio have very high standard deviations and their maximum values are very large relative to their mean even though we trim variables both in the upper and lower tails of their distribution.

In Table 5.3, we calculate the figures for the whole sample and sub-periods that reflect the monetary policy regimes. Means for *MIX1*, *MIX2*, *MIX3*, *SCORE* and *GDP* growth rate are higher in the loose period than the tight period while the means for *BRATE*, *ARATE*, and *GEAR* are higher in the tight period than in the loose period.

[11] Detailed definitions of the variables used in the regression are provided also in the Appendix.

[12] To deal with outliers we trimmed some variables with extraordinarily large and small numbers. The trimming procedure for each variable is explained in the Appendix that provides detailed definitions for the variables. The basic statistics provided in Table 5.2 and 5.3 are calculated based on the trimmed figures.

Table 5.2: Basic Statistics across Firm Characteristics

	MIX1	*MIX2*	*MIX3*	*ARATE*	*SCORE*	*RASSET*	*AGE*	*GEAR*	*COL*
Small Firms									
Obs	24,420	24,420	22,006	24,420	24,367	24,419	24,420	24,420	24,005
Mean	28.21	34.89	69.97	8.89	58.40	6.89	23.70	141.55	0.29
Std. Dev.	25.68	26.56	34.52	17.99	21.49	0.77	18.85	265.93	0.21
Min	0.00	0.00	0.00	0.00	1.00	2.33	1.00	0.25	0.00
Max	100.00	100.00	100.00	121.00	96.00	12.80	124.00	2497.94	1.00
Large Firms									
Obs	39,480	39,480	38,240	39,480	39,425	39,480	39,480	39,480	38,947
Mean	33.45	41.51	68.64	8.68	60.10	10.27	38.85	160.24	0.32
Std. Dev.	25.54	25.22	34.09	15.89	20.09	1.34	27.61	284.97	0.19
Min	0.00	0.00	0.00	0.00	1.00	0.63	1.00	0.25	0.00
Max	100.00	100.00	100.00	121.00	96.00	18.64	136.00	2494.57	1.00
Risky Firms									
Obs	23,392	23,392	22,415	23,392	23,392	23,379	23,392	23,392	22,870
Mean	43.46	48.34	76.44	8.02	31.90	8.28	25.51	362.27	0.29
Std. Dev.	27.06	25.84	29.23	13.78	7.55	1.57	21.19	418.43	0.20
Min	0.00	0.00	0.00	0.00	1.00	0.63	1.00	0.25	0.00
Max	100.00	100.00	100.00	121.00	40.00	16.29	135.00	2499.19	1.00
Secure Firms									
Obs	57,356	57,56	49,362	57,356	57,137	57,355	57,356	57,356	55,977
Mean	21.91	29.74	66.32	7.85	78.72	8.60	34.94	47.71	0.33
Std. Dev.	23.52	26.15	37.21	17.55	11.24	1.64	25.17	114.22	0.20
Min	0.00	0.00	0.00	0.00	61.00	1.55	1.00	0.25	0.00
Max	100.00	100.00	100.00	121.00	96.00	18.64	135.00	2491.47	1.00
Young Firms									
Obs	29,973	29,973	27,254	29,973	29,907	29,968	29,973	29,973	29,372
Mean	28.69	37.19	64.33	8.33	54.91	8.10	8.48	171.25	0.31
Std. Dev.	25.88	26.68	35.44	15.85	19.68	1.54	2.66	291.62	0.20
Min	0.00	0.00	0.00	0.00	1.00	0.84	1.00	0.25	0.00
Max	100.00	100.00	100.00	121.00	96.00	16.24	12.00	2499.19	1.00
Old Firms									
Obs	30,976	30,976	28,132	30,976	30,926	30,976	30,976	30,976	30,329
Mean	29.84	37.09	69.01	7.95	64.14	9.20	66.94	120.73	0.34
Std. Dev.	26.21	26.77	34.86	15.95	20.21	1.80	17.84	247.60	0.20
Min	0.00	0.00	0.00	0.00	1.00	3.71	44.00	0.25	0.00
Max	100.00	100.00	100.00	121.00	96.00	17.72	136.00	2491.47	1.00
Highly Indebted Firms									
Obs	30,846	30,846	30,418	30,846	30,704	30,837	30,846	30,846	30,054
Mean	47.21	58.37	65.53	6.03	41.69	8.66	27.61	424.81	0.33
Std. Dev.	25.86	21.26	34.16	8.61	14.62	1.72	22.89	400.75	0.21
Min	0.00	0.00	0.00	0.00	1.00	2.46	1.00	142.40	0.00
Max	100.00	100.00	100.00	121.00	96.00	17.72	135.00	2499.19	1.00
Less Indebted Firms									
Obs	30,876	30,876	22,392	30,876	30,824	30,876	30,876	30,876	30,168
Mean	9.20	10.78	76.95	10.71	77.60	8.16	34.21	7.06	0.28
Std. Dev.	16.34	16.72	35.15	25.41	16.81	1.39	24.23	4.98	0.18
Min	0.00	0.00	0.00	0.00	1.00	0.84	1.00	0.25	0.00
Max	100.00	100.00	100.00	121.00	96.00	18.64	132.00	17.41	1.00

Table 5.3: Basic Statistics across Periods

	MIX1	*MIX2*	*MIX3*	*ARATE*	*SCORE*	*RASSET*	*COL*	*GEAR*	*BRATE*	*GDP*
Whole Period: 1990-1990										
Obs	126,112	126,112	114,556	126,112	125,893	126,097	123,614	126,112	126,112	126,112
Mean	29.56	36.77	68.69	8.11	59.78	8.48	0.32	138.29	41.08	2.26
Std. D.	25.79	26.37	34.35	15.91	20.47	1.61	0.20	258.84	23.51	1.60
Min	0.00	0.00	0.00	0.00	1.00	0.63	0.00	0.25	15.30	-1.38
Max	100.00	100.00	100.00	121.00	96.00	18.64	1.00	2499.19	100.00	4.66
Tight Period: 1990-1992										
Obs	31,165	31,165	28,449	31,165	31,087	31,162	30,750	31,165	31,165	31,165
Mean	28.45	35.89	66.11	11.41	58.13	8.50	0.33	142.28	76.46	-0.19
Std. D.	25.58	25.95	37.44	20.32	20.68	1.64	0.19	266.02	15.86	0.90
Min	0.00	0.00	0.00	0.00	1.00	0.84	0.00	0.25	59.80	-1.38
Max	100.00	100.00	100.00	121.00	96.00	17.60	1.00	2498.72	100.00	0.79
Loose Period: 1993-1999										
Obs	94,947	94,947	86,107	94,947	94,806	94,935	92,864	94,947	94,947	94,947
Mean	29.92	37.06	69.53	7.02	60.32	8.48	0.32	136.98	29.47	3.07
Std. D.	25.85	26.51	33.22	14.00	20.37	1.60	0.20	256.43	10.29	0.72
Min	0.00	0.00	0.00	0.00	1.00	0.63	0.00	0.25	15.30	2.41
Max	100.00	100.00	100.00	121.00	96.00	18.64	1.00	2499.19	46.40	4.66

5.4.3. Estimation Techniques

A panel data set includes information about individuals (firms, households or industries) at different points in time. It is generally claimed that the studies employing only the cross-section or time series cannot control for individual specific unobservable effects. If the individual specific unobservable effects that are not specified in the regression (the omitted variables), are correlated with the explanatory variables, the estimates of coefficients will be biased since the individual specific unobservable effects are considered as a part of the disturbance term. Consider a simple production function model in which log-output is explained in terms of log capital, log labour and managerial ability. Managerial ability is typically unobservable and affects the investment and employment decisions of the firms. A regression using a cross-section sample causes the factor elasticities (coefficients of explanatory variables) to be biased as managerial ability is not observable and it may be correlated with the explanatory variables. However, it would be possible to control for the managerial ability by introducing time invariant individual effects in panel data models.

We employ panel data methods to test our hypothesis where firms with different characteristics react heterogeneously to monetary policy shocks and where firm specific factors may be important for these heterogeneous reactions. Panel data methods allow us to capture firm heterogeneity over time, which is important for analysing the credit channel of monetary policy. Firm specific effects are omitted under the *pooled ordinary least square (OLS)* estimation which leads to biased estimates if unobservable individual specific effects are correlated with the explanatory variables in the model.

A standard model of panel data is specified in the following form;

$$y_{it}=X_{it}\beta+\lambda_t+\alpha_i+\varepsilon_{it}, \qquad (5.2)$$

where i = 1,2,...., N refers to a cross section unit (firms in this study), t = 1,2,.....,T refers to time period. y_{it} and X_{it} denote dependent variable and the vector of non-stochastic explanatory variables for the firm i and year t, respectively. λ_t represents firm-invariant time-specific effects, α_i is time invariant unobservable firm specific effects and ε_{it} are the disturbance terms that vary with time and across firms. Restrictive assumptions on the nature of firm specific-effects lead to various panel data models. The nature of the data and the specification of the model are important for the selection of an estimation method. There are basically two main panel data models, namely fixed effects and random effects.

In the fixed effects model as specified above, each cross-section unit has its own intercept, α_i. The fixed effects approach considers the firm specific time invariant fixed parameters as regressors. The stochastic disturbance terms have an independent and identical distribution with zero mean and constant variance and are independent from X_{it}. In the cases where the firm specific effects are correlated with the vector of regressors, the fixed effects models still provide consistent estimators. However, since there are too many parameters in the fixed effects model there will be an efficiency loss in the estimations. The fixed effects model is estimated by using a dummy variable for each individual to capture the individual specific effects. Panel data sets usually have a large number of individuals and small number of time periods. The dummy variable method entails large number of dummy variables in the regression which is not very parsimonious. There are many methods in the literature that transform the observations to

remove these dummies from the regression to obtain a parsimonious model. The 'within groups' and 'between groups' are widely used transformation techniques. The former uses time variation within each cross section unit while the latter uses only variation between the cross-section observations. Models with transformed variables provide consistent *OLS* estimates.

$$y_{it} - \bar{y}_i = (X_{it} - \bar{X}_i)\beta + (\varepsilon_{it} - \bar{\varepsilon}_i) \text{ (Within transformation)} \qquad (5.3)$$

$$\bar{y}_i - \bar{y} = (\bar{X}_i - \bar{X})\beta + (\bar{\varepsilon}_i - \bar{\varepsilon}) \text{ (Between transformation)} \qquad (5.4)$$

On the other hand, in the random effects model λ_t and α_i are assumed to be random, that is, time and individual specific effects are assumed to be a part of the disturbance term, $v_{it} = \lambda_t + \alpha_i + \varepsilon_{it}$, where these terms are distributed identically and independently, have zero means and constant variances. Therefore, the X_{it} are independent of λ_t, α_i and ε_{it} for all i and t. If the sample is drawn from a large population, the random effects model is the most suitable approach for estimation, because it is more likely that firm-specific terms are distributed randomly across cross-sectional units, that is, there should be no correlation between firm-specific terms and explanatory variables (the fixed effects model is an appropriate specification if we want to do inference about specific set of individuals). One can write the random effects models as follows:

$$y_{it}=X_{it}\beta+v_{it}, \quad v_{it} = \lambda_t + \alpha_i + \varepsilon_{it} \qquad (5.5)$$

where the individual disturbance, α_i, is a component of v_{it} and is invariant over time and assumed not to be correlated with the explanatory variables, $E(X_{it}, \alpha_i)=0$, in order to have consistent estimates in the random effects model. However, this condition, $E(X_{it}, \alpha_i)=0$, does not have to hold in the fixed effects model in order to have consistent estimates. The estimates of the fixed and random effects models become identical as T become large.

Under the random effects specification, the Generalised Least Square estimates are asymptotically efficient. On the other hand, the fixed effects estimates which are more sensitive to the errors in variables are unbiased and consistent but not efficient. Unlike the

fixed effects model, the estimates for random effects model will not be consistent if the individual effects are correlated with the independent variables. We rejected the hypothesis of no systematic difference between coefficients obtained from the random effects and fixed effects models by using the Hausman test. This means that the random effects estimates are efficient but not consistent; therefore we use the method that gives consistent results which is the fixed effects model. Only results obtained from fixed effects estimations are reported in the next section. We also provide the Hausman statistics for the fixed effects estimations.

We also employ an approach to consider the possibility of endogenous explanatory variables. The instrumental variable two stage least square (*IV-2SLS*) procedure is carried out in order to remove biases originating from the endogenous explanatory variables. This estimation procedure involves instrumental variables that are independent of the disturbance term and lead to unbiased coefficients, that is, if any explanatory variable is not independent of the disturbance term, the estimated coefficients are biased. Therefore, we also use the fixed effect estimates of the *IV-2SLS* procedure, which are robust compared to those of the fixed effects model.

The decision on candidates for possible endogenous variables is critical in this analysis. We assume that firm specific variables, such as *SCORE, RASSET, GEAR,* and *COL*, are all endogenous. Rating score is calculated based on the variables that either reflect or affect the financial position of firms, including solvency, gearing, cash flow, interest cover, monetary stance, therefore it is reasonable to consider this variable as endogenous. Similarly, firm size, indebtedness, or collateral position of firms may be endogenous to the model as liabilities positions of firms may be important for these variables[13].

The difference *GMM* procedure produces consistent and more efficient estimates for models that have a dynamic structure (lags of dependent variables) and endogenous variables. We prefer not to use this estimation procedure in this chapter as the underlying

[13] In fact, the correlation coefficients between the lags and level residuals and endogenous variables are negligible except for the correlation coefficient between the lag residual and *SCORE*, that is, 0.05 in the fixed effect estimation.

transformation (the first difference) in this procedure and using the lags of dependent variable lead to loss of observations for the entire tight money period therefore we can analyse the impact of monetary policy on the mixes during this period. In other words, we can not identify the impact of monetary policy during the tight period which is vitally important for this study when we employ the *GMM* procedure for estimations. Therefore, instead we use the *IV-2SLS* procedure in order to capture the endogeneity in the model and to avoid loss of observations. We provide o discussion for the *GMM* procedure and employ it extensively in Chapter Six in order to analyse inventory investment and employment growth.

5.5. Results

In this section, we report the estimation results of the fixed effects model that use the cumulative base rate as the monetary policy stance. We report the findings of the fixed effect model that explains different measures of the mix, i.e. *MIX1*, *MIX2*, and *MIX3* in Tables 5.4-5.6, respectively. We use three interaction terms for these estimations to identify the impact of monetary policy across firm types and the tight policy regime period, conditional on the control variables. In addition, we report the fixed effect estimates for the model where interaction terms across firm types and the tight period dummy are used for all explanatory variables to test whether the impact of these variables differ with respect to firm characteristics. The findings are reported in Table 5.7. For a further test of robustness, we employ the *IV-2SLS* procedure by which it is intended to control for endogeneity in the empirical model. The fixed effects estimations of the *IV-2SLS* procedure, where interaction terms are used for the monetary stance variable, are reported in Tables 5.8-5.10. Moreover, the fixed effects estimations where the apparent interest rate is used as a monetary policy stance variable are reported in Tables A5.1-A5.3 in the Appendix.

The columns of each Table indicate the estimation results for each firm type dummy used as a component of the interaction terms in the regressions. In column one, we report the estimation results where we do not consider any interaction terms. For estimations where we use interaction terms, we separate out the responses of firms according to size – small and large firms in columns 2-3, credit rating – risky and secure

firms in columns 4-5, age – young and old firms in columns 6-7 and, gearing – highly and less indebted firms in columns 8-9. For example, in column 2, which is denoted as 'TYPE-Small', we provide estimation results with interaction terms that include the small firm dummy, while in column 3, which is denoted as 'TYPE-Large', we provide estimation results where the large firm dummy is used as a component of interaction terms.

5.5.1. Fixed Effects Model Results

5.5.1.1. Monetary Policy, Firm Characteristic and Financial Mix

We focus more on the findings for the *MIX1* and the *MIX2* in this section[14]. These mixes show the composition of short-term debt (basically the bank loans) and total debt versus current and total liabilities, respectively; therefore they have implications for the credit channel of monetary policy as explained earlier. Although the findings for the *MIX3* may not have a direct implication for the credit channel of monetary policy, nevertheless they may have implications about whether the monetary policy is important for the debt structure.

We estimate the empirical model including the interaction terms for the dummy variables for firm types and the tight period of 1990-92. We focus more on the estimation results where *BRATE* is used as the policy variable to explain the mixes even though it has some weaknesses as a candidate representing monetary policy stance in the sense that it is invariant across firms. Alternatively, *ARATE* can be used as a monetary stance variable that varies across time but its weakness is that it is not a policy variable controlled by the Bank of England and thus it may involve a potential endogeneity problem. In fact, the findings with these alternative measures of monetary policy stance variables are quite similar to those with *BRATE*[15]. In addition to the alternative monetary policy stance variables and their interaction terms with firm type and tight monetary policy dummies, we also include real tangible asset size, credit score, age, gearing ratio,

[14] *MIX1* is the closest mix by definition to the mixes which were used by Kashyap et al. (1993) and Oliner and Rudebush (1996) in their analyses.

[15] The coefficients for the *ARATE* in percentage terms are larger than *BRATE* because of the scales of the variables. The former is a ratio while the latter is a an index based on cumulative values.

the ratio of tangible asset to total and GDP growth rate in the regressions for all mixes to control for variables that reflect firm specific financial positions and demand conditions.

The coefficients for *BRATE* and *ARATE* for the regressions where interaction terms are not included as regressors are negative and significantly different from zero for *MIX1* and *MIX2* as shown in the first columns of Tables 5.4-5.5, and of Tables A.5.1-A.5.2, respectively. This result confirms that in general the *MIX1* and *MIX2* decline as interest rates increase. However, the coefficient for *BRATE* is negative but not significant while the coefficient for *ARATE* is positive and significant at the 10 percent level in the regression for the *MIX3* (Table A.5.3).

The magnitudes and signs of the estimated coefficients of the interaction terms for firm type and tight period dummies *(BRATE*TYPE*TP)* are particularly important for this study. They convey information about how the mixes are responsive to monetary policy shocks across various firm types in the recessionary period versus the recovery period. These coefficients tell us whether the credit channel of monetary transmission is operating through the bank lending channel, the balance sheet channel, or both. The coefficients of these interaction terms for firm groups that are more likely to be constrained are expected to be negative and large in absolute terms than those of less constrained firm groups. In fact, the coefficients of the interaction terms (the second variable in Table 5.4) for small, risky, young and highly indebted firms are -0.036, -0.016, -0.038, and -0.047, respectively and only insignificant for risky firms in the regressions for *MIX1*. The respective coefficients are positive and significant for large, secure, old and less indebted firms, and they are 0.035, 0.018, 0.040, and 0.049, respectively. We observe a similar pattern when *ARATE* is used as the monetary policy stance variable; the coefficients for interaction terms of constrained firms are generally negative and significant in all regressions for *MIX1*. These findings support the idea that tight monetary conditions have been destructive for small, risky, young and highly indebted firm groups in their access to short-term bank finance which is the most important source of finance for collaterally poor, small, and young firms.

In the regressions for *MIX2*, the results are slightly different but have similar implications. The coefficients of the interaction terms *(BRATE*TYPE*TP)* are negative

for small, risky, young, highly indebted firms but significant only for risky (at the 10 percent significant level) and highly indebted firms. The respective coefficients for large, secure, and, old, less indebted firms are positive and significant except the coefficient for old firms (Table 5.5). For *MIX3*, the coefficients for small, risky, secure young and less indebted firms are negative but insignificant for risky firms while those for large, old and highly indebted firms are positive and significant. Contrary to the regressions for *MIX1* and *MIX2*, the coefficients for secure and less indebted firms are negative and significant, while those for their counterparts are positive but significant only for highly indebted firms in the regression for *MIX3*. Although *MIX3* also declines with tight policy for secure, less indebted, small, young firms, it must have different implications for secure and less indebted firms compared to small and young firms. Firms in the first group might have flexibility to shift to long-term debt as short-term debt became relatively expensive during the recession while the firms in the second group might have difficulties to have access to short-term debt at the given long-term debt (Table 5.6).

The coefficients for the *BRATE*TYPE* are generally insignificant and are positive for constrained firms. This result confirms the findings in Table 5.1 to some extent; as the recovery set in after 1992, bank loans became more available to constrained firms thus their *MIX1* increased. The coefficients for the *BRATE*TP* are negative and significant for both *MIX1* and *MIX2* but they are larger in absolute terms for the latter. These coefficients are generally negative but only significant for large and old firms for *MIX3*. Negative coefficients of *BRATE*TP* for *MIX1* and *MIX2* regressions reflect the restrictive impact of the tight monetary policy for debt finance (mainly bank loans) versus non-debt finance.

We can simply measure the overall impact of monetary policy on the composition of firm liabilities during the tight policy by adding all the coefficients of the interaction terms and of *BRATE* together for each regression. The summations of coefficients are all negative and are larger in absolute term for small (-0.084), risky (-0.062), young (-0.086) and highly indebted (-0.063) firm groups compared to those for their counterpart groups, namely large (-0.044), secure (-0.060), old (-0.052), and less indebted (-0.049) firm groups in the regression for *MIX1*. A similar pattern is observed in the regressions for *MIX2* but we observe a different pattern for the regression for *MIX3* where the overall

summations of coefficients are not negative for large, old and highly indebted firm groups. Negative coefficients across all types can be considered as evidence for the bank lending channel as suggested by Kashyap *et al.* (1993) in the regressions for debt versus debt plus non-debt liabilities (*MIX1* and *MIX2).* These findings are supportive for the theoretical framework forwarded by Bernanke and Blinder (1988), where the tight monetary policy constrains the supply of loans. As Oliner and Rudebush (1996) highlight for the US economy, we may also expect that potentially unconstrained firms might shift to bank finance during the recession but the overall decline in the supply of loans seem to dominate such shift during the recession in the early 1990s.

These findings confirm that financially constrained firms have difficulties to get short-term debt (mainly bank overdrafts) during the tight period. As they are more dependent on bank sources they tend to reduce their real activities or access more expensive finance. The restrictive mechanism may work either by a decline in the overall supply of bank loans or by rationing bank loans for the firms that are more subject to moral hazard and adverse selection problems because of lack of collateral assets. Small, young, risky, and highly indebted firms are more likely to get bank loans with reasonable rates during loose periods, while those firms that are financially strong (large, secure, old, less indebted firms in our case) are more likely to have access to market finance in an environment where the demand and the supply for funds increase. They can extract low cost resources from the capital market directly by issuing bonds or equity rather than getting bank loans during the loose period, while they are more likely to have access to bank finance in tight periods. Lim (2003) splits the sample into periods based on the financial crisis in 1997 for Korean firms and he concludes that large firms, to some extent, shifted to capital market finance from intermediary finance after the crisis while small profitable firms used intermediary loans more often. He suggests that improving lending practices of banks, at least partially, contributed to this shift.

There is substantial heterogeneity in the impact of the monetary policy stance on the firms' choice of finance across firm types and monetary regime periods - small, young, risky and highly indebted firms are affected more severely than large, old, secure, and less indebted firms during the tight policy regime period. Variations in the coefficients of interaction terms for the monetary stance variable across firm groups are considered as

evidence of the balance sheet channel (the broad credit channel). The broad credit channel implies that financially constrained firms are more sensitive to a change in monetary stance, and are less likely to have access to already squeezed bank loans and therefore they are more likely to be subject to a 'credit crunch'. The findings are generally supportive for the broad credit channel as the summed coefficients for firm groups that are more likely to be financially constrained are larger in absolute terms than those for their financially unconstrained counterparts. Similarly, the coefficients for *BRATE*TYPE*TP* are negative for financially constrained firm groups while they are positive for the unconstrained firm groups in the regressions for *MIX1* and *MIX2*. In short, both coefficients of interaction terms alone, *BRATE*TYPE*TP*, and those for the summed coefficients confirm the broad credit channel hypothesis. The evidence is mixed in the regressions for *MIX3*. In fact, since the theoretical and empirical framework that we adopt in this chapter is to analyse the composition of bank-sourced finance versus non-debt liabilities rather than the composition of liabilities based on debt terms, the findings for *MIX3* regressions are not particularly important for our hypothesis. We document the regression results for *MIX3* in order to compare them with those for *MIX1*, and *MIX2*.

5.5.1.2. Response to Control Variables

In addition to the exogenous monetary stance variable, and interaction terms, we use real tangible asset size, rating score, age, collateral assets ratio, gearing ratio and the GDP growth rate as explanatory variables to control for the financial conditions of firms and for aggregate demand. In our original estimations, the interaction terms method assumes that the coefficients of the control variables other than *BRATE* do not vary significantly across regressions using various firm type dummies as components of interaction terms (Tables 5.4-5.6). For robustness, we carry out some additional regressions to test how the sensitivities of *MIX1* to all explanatory variables differ across firm types and when we use the tight regime dummy. We use interaction terms for all explanatory variables with the tight period dummy and report the regression results in the first column of Table 5.7. Estimations that consider these interaction terms with eight firm type dummies are

reported in the remaining columns of the same Table[16]. Therefore, *DUMMY* represents the tight dummy in the first column and the firm type dummies in the remaining columns.

Real tangible asset size captures firm-specific activity level, and this is found to be an important determinant of the mix. The coefficients of real assets are positively signed and significant in the regressions for *MIX1* and *MIX2* while they are negative in the regressions of the *MIX3* (Tables 5.4-5.6). We expect *MIX1* and *MIX2* to increase with real tangible assets because of improvements in bank credit conditions following a rise in the general activity level after 1992. The sensitivity of the mix to this variable is relatively high for the regressions of *MIX2*. Our findings support the theoretical model given in Chapter Three because we observe predominantly positive signs, implying a greater share of intermediary finance, in response to increasing real assets. Negative coefficients in the regression of *MIX3* may imply that positive macro and micro conditions lead firms to substitute long term debt as firm size increases. The coefficients of the interaction term for *RASSET* across firm types are significant except for secure firms and are positive only for interaction terms that include small, old and highly indebted group dummies (Table 5.7).

Rating scores, *SCORE*, may be interpreted as perceptions about the financial risk or the healthiness of firms. Estimation results imply that it is also an important explanatory variable for the different versions of the mix. The estimated coefficients are consistently negative and significant in all cases, lying around -0.46 for *MIX1*, -0.32 for *MIX2* and -0.35 for *MIX3*. These figures may imply that as the credit risk of firm declines firms may shift more easily from debt to non-debt finance and from short-term debt to long-term debt finance (Tables 5.4-5.6). The coefficients of the interaction terms with firm types are negative for financially unconstrained firms except the one for highly indebted firms. The coefficient for the interaction terms for less indebted firms is positive and larger than the coefficient of *SCORE* (Table 5.7). *SCORE* is highly correlated with financial variables that reflect the financial positions of firms[17]. This variable is likely to be endogenous, therefore, we carry out a robustness test that considers this problem in the next section.

[16] We only use the firm type dummies in the interaction terms across variables to have a more parsimonious model and to identify the sensitivity of *MIX1* to all regressors across firm groups.

[17] The correlations between *SCORE* and solvency ratio and between *SCORE* and gearing ratio are 0.80 and -0.45 on average across years, respectively.

The age of firms appears to be a significant explanatory variable for all versions of the mix and the coefficients are positive in all regressions but they are larger for the regressions of *MIX3* (Tables 5.4-5.6). Summations of the respective interaction terms with age indicate that small, risky, young and highly indebted firms are more sensitive to age than their counterpart firm groups, namely large, secure, old and less indebted firms. In other words, the estimated coefficients for the interaction terms are positive for the former firm groups, while they are negative for the latter groups in the *MIX1* regression (Table 5.7). When we consider the dummy for the monetary policy regime period in the interaction terms the coefficients of *AGE* are larger for the tight monetary regime than the loose one. That is, the age of the firms becomes a more important factor in for their ability to access short-term bank finance when monetary policy is relatively tight. These results provide a confirmation of the importance of a track record for certain types of firms and this is a direct test of the relationship-banking proposition of Sharpe (1990), Rajan (1992) and Boot (2000). Small and financially weak firms are less likely to be subject to financial constraints if they have a long track record that enables them to receive bank loans in tight periods

The gearing ratio also appears to be a significant factor in explaining the mix. Implication of the Hoshi *et al.* (1993) model is that a rise in firm debt relative to assets will lead to an increase in the demand for intermediary finance. Firms with high debt are more likely to have a close relation with banks and thus to raise bank finance relative to weak firms with low collateral and short track record. The positive and significant coefficients for *GEAR* in almost all regressions may confirm this prediction. Summed coefficients in the regressions with interaction terms in Table 5.7 are very large for less indebted firms but very close to zero for highly indebted firms and the same coefficients for other firm groups do not differ significantly. As we explained above, we classify firms based on their gearing ratios to measure the impact of monetary policy on the composition of external finance across low and highly indebted firms; the mix of firms in the high-debt group is more sensitive to a change in the monetary policy stance than that of the low-debt firms. High indebtedness is perceived as a weakness during tight periods when high interest rates reduce the cash flow of firms. This creates a debt-servicing burden on these firms.

The share of tangible assets, a measure of the collateral position of the firm, is likely to be important for accessing external finance. The model in Chapter Three implies that the response of the mix to more collateral assets is negative for firms in the upper tail of the distribution as they can easily access market finance when they have more collateral. We may assume that secure, large, old, less indebted firms are close to the upper tail of distribution, while small, risky, young and high indebted firms are more likely to be close the lower tail of distribution. The model does not have implications for the constrained firms that have difficulty getting bank finance (for the firms close to the lower tail of distribution). Regression results for *MIX1* indicate that the coefficients of *COL* are generally positive but only significant at the 10 percent level, while the coefficients for highly and less indebted firms are negative but significant only for the latter. These coefficients are very large, positive and significant in all regressions explaining *MIX2*. On the contrary, these coefficients are very large, negative and significant in all regressions explaining *MIX3*. They decline across the board as collateral increases, indicating that there is a shift in the composition of total debt towards longer maturity finance as collateral assets increase (Tables 5.4-5.6).

The findings for the regressions where we introduce the firm type interaction terms for all variables confirm our theoretical predictions up to some extent. Summation of the coefficients for *COL* and respective interaction terms are positive for small and risky firms but they are negative for the other groups, namely large, secure, old, less indebted, young and highly indebted firms. However, the coefficients for young and highly indebted groups are very small in absolute value compared to those for large, secure, old and less indebted ones. These findings imply that as collateral ratios increase small and risky firms tend to get more bank finance while large, secure, old and less indebted firms and up to some extent young and highly indebted firms tend to get cheap non-debt finance (Table 5.7). On the other hand, the coefficient of the interaction terms with the tight period dummy in the first column of Table 5.7 is negative and significant implying that during the recession high collateral level is more important for accessing alternative sources of finance.

We also use the *GDP* growth rate to control for cyclical effects in aggregate demand. The coefficients of this variable for the regressions explaining *MIX1* and *MIX2*

are negative and significant, while they are negative but insignificant in all regressions except the regression without interaction terms for *MIX3*. In general, an increase in the *GDP* growth rate leads firms to shift toward non-debt liabilities. This proposition seems reasonable since firms have more flexibility to access alternative financial sources during boom periods. In addition, during these times the extent of moral hazard and adverse selection is reduced and this leads financial markets to work more efficiently. On the other hand, the coefficients of the *GDP* growth rate differ across firm groups when we use the interaction terms suggesting that the effects are not uniform. Summed coefficients of the GDP growth rate for small, young and high indebted firms are larger than their counterparts. It seems that relatively fragile firms are more sensitive to a change in demand conditions.

The coefficients of *BRATE*DUMMY* where firm type dummies are interacted with all explanatory variables in Table 5.7, are significant except for the coefficients of risky and secure firms. More importantly, these coefficients for small and young firms are significantly negative while they are significantly positive for large, and old firms. These findings are different from what we find in Table 5.4 where both the tight regime dummy and firm type dummies are used as interaction terms in the regressions for *MIX1* in Table 5.4. We believe that this difference is because of the fact that we do not capture the impact of the tight period independently in the regressions reported in Table 5.7. In other words, the firm type dummies also capture the monetary regime period effects but the period effects might dominate the firm type effects. As a result the coefficients of *BRATE*DUMMY* are negative and significant for small, and young firms.

5.5.2. Robustness Tests: Estimations Considering Endogeneity Problem

We also carry out regressions by using instrumental variable two-stage least squares approach to consider possible endogenous explanatory variables. Estimations with the *IV-2SLS* are based on the fixed effects model as the Hausman specification test does not rejects the systematic difference between coefficients obtained from the random effects versus those from the fixed effects estimations, and therefore we report the estimation results for the consistent model which is the fixed effects model. We assume that all variables, except the firm invariant monetary policy stance variable (*BRATE*) and the

GDP growth rate, and firm-variant the age of firms, are endogenous. We had difficulty in finding valid instruments for the endogenous variables, namely *RASSET, GEAR, COL* and *SCORE,* and therefore we tend to use the first lags of these variables as instruments. Estimation results are reported only for the regressions where *BRATE* is used as the monetary policy variable. We follow the same methodology adopted in the previous section. Respective estimations for *MIX1*, *MIX2* and *MIX3* are given in Tables 5.8-5.10. Main findings from the *IV-2SLS* estimations are in the same line with those of the fixed effects model.

There are two important differences between estimations with the fixed effect and those with *IV-2SLS* in *MIX1* model. First, the coefficient of *BRATE* turns to be positive and insignificant in the model where we do not use interaction terms at all (the first column). Second, the coefficients for *COL* are negative and significant in all regressions. However, the findings for *MIX2* follow those of the fixed effects estimations.

We are mainly interested in the coefficients for the interaction terms rather than that for *BRATE* as we might better identify the restrictive impact of a tight policy on mixes across firm types. The findings from these interaction terms imply that as macro and micro conditions improved after 1992, the constraining impact of monetary policy weakened.

The coefficients of the interaction terms between the monetary stance variable, the firm type and tight monetary regime period dummies (*BRATE*TYPE*TP*) are again negative and significant for small, young and highly indebted firm groups, while they are positive and significant for large, old and less indebted firms for the regression of *MIX1*. Contrary to the fixed effects estimations in the previous section, the coefficient of the interaction term for secure firms is positive but not significant and that for risky firms is not negative. In spite of the change in some results when this estimation method is used, findings generally confirm the fact that, under the tight monetary regime, financially fragile firms like small, young and highly indebted have difficulties in accessing bank finance. However, these groups of firms are more likely to use bank loans during the loose monetary regime when large, secure, old and less indebted firms tend to prefer a variety of cheaper forms of market finance. In fact, during the tight period, financially

strong firms tend to use bank loans more intensively. When we add up the coefficients of interaction terms and that of *BRATE*, we find out that they are all negative across firm groups (Table 5.8).

Findings from the regressions for *MIX2* with the *IV-2SLS* procedure generally support those with the fixed effects regressions that do not use instruments. The coefficient of *BRATE* is negative and significant in the regression where we do not use interaction dummies. The coefficients for the interaction terms (*BRATE*TYPE*TP*) are negative for small, young and highly indebted firms but not significant for the small firm group. These coefficients are positive for large, risky, secure, old and less indebted firms groups but not significant for risky firms. The coefficients for large and old firms are significant at the 10 percent level (Table 5.9). For *MIX3*, the coefficients of the interaction terms are very much similar to those of the fixed effects regressions discussed in the previous section (Table 5.10).

We test the validity of the instruments by regressing each endogenous variable on instrumental variables, which are the first lags of the endogenous variables, namely $SCORE_{i,t-1}$, $RASSET_{i,t-1}$, $GEAR_{i,t-1}$, $COL_{i,t-1}$, $(BRATE*TYPE)_{i,t-1}$and $(BRATE*TYPE*TP)_{i,t-1}$ and all exogenous variables (*AGE, GDP, BRATE, BRATE*TP*). Following Nickell and Nicolitsas (1999), we estimate these regressions by using the random effects method and test whether the explanatory variables are jointly different from zero. The Wald statistics have a χ^2 distribution and are very large for all regressions. For example, the Wald statistics are $\chi^2(16)$= 230246.6 (p=0.00) for *SCORE*, $\chi^2(16)$ = 613899.2 (p=0.00) for *RASSET*, $\chi^2(16)$= 74500.8 (p=0.00) for *GEAR* and $\chi^2(16)$= 46150.4 (p=0.00) for *CAL*, in the regressions where we use the small firm dummy as part of the interaction terms. In fact, these statistics are also very large when we use other firm type dummies as a component of the interaction terms. The test results imply that the explanatory variables are jointly different from zero at less than one percent significant level, therefore, the instruments that we use in our regressions are valid.

5.6. Conclusion

This chapter has examined the influence of a tightening of monetary conditions on corporate credit in the United Kingdom by comparing the uptake of bank loans and other external credit during tight and benign periods of monetary policy. The study differentiates between firms according to their size, credit rating, indebtedness and age, and can therefore determine whether monetary policy tightening influences firms' finance choice according to their type.

Results show that smaller, more risky, highly indebted and younger firms are more influenced by monetary tightening than larger, secure, less-indebted or older firms. This confirms for the UK data the findings of major US studies - that there is a broad credit channel effect (as found by Oliner and Rudebusch, 1996), a bank lending channel (first discovered by Kashyap et al. 1993, Gertler and Gilchrist, 1994), accelerator effects (predicted by Kiyotaki and Moore, 1997), relationship banking when age proxies for the development of such bank-firm relationships (Rajan, 1992 and Boot, 2000), and influence from gearing (Hoshi *et al.*, 1993).

The effect of the tightening of monetary policy is felt more severely by small firms and by those that have adverse financial characteristics such as poor solvency, a short track record, high gearing and low real assets than by the financially healthy, large companies with good credit ratings. Relationship banking only favours larger, older and more secure firms rather than those that are affected most by the tightening of monetary conditions. Larger companies are less affected in their credit ratings by a changing monetary climate. It may be concluded that Oliner and Rudebusch (1996) were right to point out the importance of distinguishing between firm types, but for the UK, the effects of making this distinction do not undermine the findings of Kashyap *et al.* (1993) as they did for the US.

Potentially constrained firms such as small, risky, young and highly indebted firms in this empirical study tended to increase their share of intermediary finance as source of finance during the benign period while they have difficulties to access intermediary finance during the tight monetary regime period. This is understandable in the sense that

in the loose monetary policy environment the extent of moral hazard and adverse selection problem between lenders and borrowers tend to lessen. On the contrary, large, secure, old and less indebted firms have used relatively more intermediary finance during the tight monetary period while they tended to reduce their share of intermediary finance in the following period of 1993-1999 when monetary policy was loose. Financially less constrained firms are able to find cheaper financial sources relative to intermediary loans In short, we find plenty of evidence for the credit channel effects.

Table 5.4. Fixed Effects Estimation Results for the Short Term Debt-Current Liabilities Ratio (MIX1)

	No Inter. Terms (1)	*TYPE-Small (2)*	*TYPE - Large (3)*	*TYPE - Risky (4)*	*TYPE-Secure (5)*	*TYPE – Young (6)*	*TYPE-Old (7)*	*TYPE-High Indebted (8)*	*TYPE- Less Indebted (9)*
BRATE	-0.018***	-0.003	0.002	-0.002	0.008	-0.000	0.007	-0.009	0.008
	(5.79)	(0.50)	(0.35)	(0.32)	(1.12)	(0.08)	(1.26)	(1.56)	(1.38)
BRATE*TP*TYPE		-0.036***	0.035***	-0.016	0.018***	-0.038***	0.040***	-0.047***	0.049***
		(5.04)	(4.87)	(1.58)	(2.84)	(6.04)	(6.24)	(5.78)	(6.50)
BRATE*TYPE		0.010	-0.008	0.015	-0.017*	0.003	-0.028***	0.044***	-0.034***
		(1.00)	(0.75)	(1.01)	(1.82)	(0.36)	(3.41)	(3.83)	(3.15)
BRATE*TP		-0.055***	-0.073***	-0.059***	-0.069***	-0.051***	-0.071***	-0.051***	-0.072***
		(6.57)	(8.70)	(7.20)	(8.03)	(6.18)	(8.63)	(6.18)	(8.72)
TP		4.926***	4.839***	4.705***	4.708***	4.791***	4.774***	4.685***	4.692***
		(9.45)	(9.29)	(9.03)	(9.04)	(9.20)	(9.17)	(9.00)	(9.01)
AGE	0.812***	0.803***	0.803***	0.802***	0.803***	0.819***	0.816***	0.804***	0.804***
	(35.83)	(27.22)	(27.22)	(27.18)	(27.19)	(27.20)	(27.56)	(27.25)	(27.25)
GDP	-0.678***	-0.447***	-0.442***	-0.440***	-0.440***	-0.444***	-0.439***	-0.440***	-0.438***
	(15.44)	(7.67)	(7.59)	(7.56)	(7.55)	(7.62)	(7.54)	(7.54)	(7.52)
SCORE	-0.464***	-0.465***	-0.465***	-0.463***	-0.463***	-0.465***	-0.464***	-0.463***	-0.464***
	(118.62)	(118.90)	(118.91)	(118.48)	(118.35)	(118.99)	(118.76)	(118.52)	(118.64)
RASSET	2.974***	3.033***	3.023***	3.054***	3.043***	2.832***	2.926***	3.043***	3.030***
	(20.44)	(20.81)	(20.74)	(20.94)	(20.87)	(19.30)	(19.95)	(20.88)	(20.79)
GEAR	0.012***	0.012***	0.012***	0.012***	0.012***	0.012***	0.012***	0.012***	0.012***
	(46.34)	(46.20)	(46.29)	(46.19)	(46.30)	(46.63)	(46.40)	(46.37)	(46.38)
COL	1.111**	1.046*	0.991*	1.042*	1.019*	1.066*	1.080*	1.002*	1.005*
	(1.99)	(1.87)	(1.78)	(1.87)	(1.82)	(1.91)	(1.94)	(1.80)	(1.80)
CONS	6.274***	4.871***	4.941***	4.588***	4.656***	6.050***	5.281***	4.625***	4.762***
	(5.17)	(3.63)	(3.68)	(3.41)	(3.47)	(4.45)	(3.92)	(3.44)	(3.55)
Hausman Spec. Test	1,730***	1,256***	1,215***	1,201***	1,307***	1,189***	956***	1,291***	2,090***
R-squared	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19

Absolute value of t statistics in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

Numbers of firms and of observations are 15,491 and 123,422, respectively.

TYPE represents the respective firm type dummies that interact with the monetary stance variable and the tight period dummy.

The Hausman specification test has χ^2 distribution with *k-1* degrees of freedom where *k* denotes the number of estimated coefficients in the regressions. The Hausman test results confirm that there is a systematic difference between the coefficients obtained for the fixed effects and of random effects specifications. Therefore, the results for the consistent specification that is the fixed effects are reported in this study.

Table 5.5. Fixed Effects Estimation Results for the Total Debt-Total Liabilities Ratio (MIX2)

	No Inter. Terms (1)	*TYPE-Small (2)*	*TYPE - Large (3)*	*TYPE - Risky (4)*	*TYPE-Secure (5)*	*TYPE – Young (6)*	*TYPE-Old (7)*	*TYPE-High Indebted (8)*	*TYPE- Less Indebted (9)*
BRATE	-0.039***	-0.004	0.004	-0.004	0.003	-0.004	-0.000	-0.009	0.001
	(12.45)	(0.59)	(0.73)	(0.76)	(0.51)	(0.71)	(0.03)	(1.63)	(0.18)
BRATE*TP*TYPE		-0.012	0.027***	-0.020*	0.032***	-0.010	0.008	-0.062***	0.052***
		(1.60)	(3.70)	(1.92)	(4.94)	(1.53)	(1.22)	(7.69)	(6.85)
BRATED*TYPE		0.003	-0.025**	0.014	-0.014	0.005	-0.013*	0.033***	-0.015
		(0.30)	(2.46)	(0.92)	(1.47)	(0.63)	(1.81)	(2.88)	(1.43)
BRATE*TP		-0.104***	-0.114***	-0.104***	-0.121***	-0.103***	-0.107***	-0.093***	-0.118***
		(12.30)	(13.49)	(12.54)	(13.95)	(12.32)	(12.90)	(11.16)	(14.12)
TP		7.432***	7.398***	7.371***	7.407***	7.338***	7.328***	7.350***	7.356***
		(14.13)	(14.08)	(14.03)	(14.10)	(13.96)	(13.94)	(14.00)	(14.01)
AGE	0.580***	0.525***	0.526***	0.525***	0.525***	0.522***	0.515***	0.528***	0.527***
	(25.35)	(17.64)	(17.66)	(17.62)	(17.64)	(17.46)	(16.96)	(17.73)	(17.71)
GDP	-0.865***	-0.551***	-0.549***	-0.549***	-0.549***	-0.549***	-0.552***	-0.546***	-0.545***
	(19.53)	(9.37)	(9.34)	(9.33)	(9.33)	(9.34)	(9.39)	(9.30)	(9.28)
SCORE	-0.321***	-0.320***	-0.321***	-0.320***	-0.319***	-0.320***	-0.320***	-0.320***	-0.320***
	(81.23)	(81.19)	(81.24)	(81.07)	(80.79)	(81.01)	(81.12)	(81.14)	(81.29)
RASSET	4.410***	4.538***	4.526***	4.549***	4.529***	4.578***	4.531***	4.532***	4.519***
	(30.03)	(30.85)	(30.76)	(30.93)	(30.80)	(30.93)	(30.59)	(30.84)	(30.74)
GEAR	0.019***	0.019***	0.019***	0.019***	0.019***	0.019***	0.019***	0.019***	0.019***
	(71.83)	(71.71)	(71.76)	(71.63)	(71.84)	(71.70)	(71.71)	(71.88)	(71.93)
COL	15.636***	15.542***	15.516***	15.533***	15.470***	15.533***	15.550***	15.462***	15.487***
	(27.74)	(27.60)	(27.55)	(27.58)	(27.48)	(27.58)	(27.61)	(27.47)	(27.52)
CONS	-4.252***	-5.630***	-5.538***	-5.757***	-5.642***	-5.912***	-5.268***	-5.691***	-5.540***
	(3.47)	(4.15)	(4.08)	(4.25)	(4.16)	(4.35)	(3.84)	(4.20)	(4.09)
Hausman Spec. Test	1,465***	1,100***	866***	1,193***	1,226***	785***	1,537***	1,340***	3,211***
R-squared	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.18	0.18

Absolute value of t statistics in parentheses, * significant at 10%; ** significant at 5%; *** significant at 1%

Numbers of firms and of observations are 15,491 and 123,422, respectively.

TYPE represents the respective firm type dummies that interact with the monetary stance variable and the tight period dummy.

The Hausman specification test has χ^2 distribution with *k-1* degrees of freedom where *k* denotes the number of estimated coefficients in the regressions. The Hausman test results confirm that there is a systematic difference between the coefficients obtained for the fixed effects and of random effects specifications. Therefore, the results for the consistent specification that is the fixed effects are reported in this study.

Table 5.6. Fixed Effects Estimation Results for the Short Term Debt-Total Debt Ratio (MIX3)

	No Inter. Terms (1)	*TYPE-Small (2)*	*TYPE - Large (3)*	*TYPE - Risky (4)*	*TYPE-Secure (5)*	*TYPE – Young (6)*	*TYPE-Old (7)*	*TYPE-High Indebted (8)*	*TYPE- Less Indebted (9)*
BRATE	-0.001	0.004	-0.011	0.000	0.003	-0.004	0.025***	-0.004	0.008
	(0.15)	(0.45)	(1.12)	(0.03)	(0.24)	(0.40)	(2.66)	(0.44)	(0.87)
BRATE*TP*TYPE		-0.083***	0.063***	-0.005	-0.018*	-0.110***	0.145***	0.041***	-0.042***
		(6.85)	(5.18)	(0.29)	(1.67)	(10.34)	(13.68)	(3.14)	(3.10)
BRATED*TYPE		-0.016	0.042**	-0.002	-0.006	0.020*	-0.098***	0.020	-0.041**
		(0.93)	(2.40)	(0.06)	(0.37)	(1.73)	(7.04)	(1.07)	(2.14)
BRATE*TP		-0.008	-0.042***	-0.014	-0.006	0.014	-0.054***	-0.023	-0.005
		(0.59)	(3.00)	(1.02)	(0.39)	(1.01)	(3.91)	(1.64)	(0.40)
TP		2.487***	2.207**	1.656*	1.592*	1.888**	1.918**	1.633*	1.634*
		(2.86)	(2.54)	(1.91)	(1.83)	(2.18)	(2.21)	(1.88)	(1.88)
AGE	1.036***	1.057***	1.056***	1.059***	1.060***	1.108***	1.106***	1.057***	1.058***
	(27.34)	(21.48)	(21.46)	(21.47)	(21.50)	(22.07)	(22.40)	(21.45)	(21.47)
GDP	-0.129*	-0.035	-0.022	-0.009	-0.009	-0.012	-0.007	-0.011	-0.008
	(1.75)	(0.35)	(0.22)	(0.09)	(0.09)	(0.12)	(0.07)	(0.12)	(0.08)
SCORE	-0.350***	-0.355***	-0.355***	-0.350***	-0.351***	-0.355***	-0.353***	-0.350***	-0.350***
	(54.01)	(54.83)	(54.79)	(53.95)	(54.13)	(54.73)	(54.56)	(54.04)	(54.00)
RASSET	-2.485***	-2.500***	-2.524***	-2.462***	-2.457***	-3.016***	-2.918***	-2.455***	-2.441***
	(10.24)	(10.30)	(10.39)	(10.12)	(10.11)	(12.34)	(11.95)	(10.10)	(10.05)
GEAR	-0.008***	-0.008***	-0.008***	-0.008***	-0.008***	-0.008***	-0.008***	-0.008***	-0.008***
	(19.57)	(19.77)	(19.62)	(19.60)	(19.62)	(19.05)	(19.29)	(19.62)	(19.70)
COL	-40.018***	-40.09***	-40.21***	-40.05***	-39.98***	-40.01***	-39.96***	-39.94***	-39.98***
	(42.54)	(42.67)	(42.81)	(42.56)	(42.48)	(42.61)	(42.54)	(42.47)	(42.53)
CONS	92.079***	91.529***	91.714***	90.729***	90.711***	94.129***	93.273***	90.715***	90.584***
	(44.73)	(40.26)	(40.34)	(39.86)	(39.85)	(40.90)	(40.94)	(39.87)	(39.82)
Hausman Spec. Test	983***	876***	894***	866***	813***	926***	572***	839***	1,161***
R-squared	0.05	0.06	0.06	0.05	0.05	0.06	0.06	0.05	0.06

Absolute value of t statistics in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

Numbers of firms and of observations are 15,210 and 111,996, respectively.

TYPE represents the respective firm type dummies that interact with the monetary stance variable and the tight period dummy.

The Hausman specification test has χ^2 distribution with *k-1* degrees of freedom where *k* denotes the number of estimated coefficients in the regressions. The Hausman test results confirm that there is a systematic difference between the coefficients obtained for the fixed effects and of random effects specifications. Therefore, the results for the consistent specification that is the fixed effects are reported in this study.

Table 5.7. Fixed Effects Results for the MIX1-Introducing Interaction Terms for Firm Type and Policy Regime

	DUMMY-Tight (1)	*DUMMY-Small (2)*	*DUMMY-Large (3)*	*DUMMY-Risky (4)*	*DUMMY-Secure (5)*
BRATE	-0.001	-0.010***	-0.031***	-0.019***	-0.016***
	(0.27)	(2.87)	(8.32)	(5.83)	(3.75)
BRATE*DUMMY	-0.059***	-0.037***	0.039***	0.008	-0.005
	(8.20)	(5.19)	(5.72)	(0.83)	(0.86)
RASSET	2.729***	2.801***	3.848***	3.121***	2.913***
	(18.53)	(16.45)	(21.98)	(20.00)	(15.44)
RASSET*DUMMY	0.442***	0.409	-3.018***	-1.298***	0.008
	(7.93)	(1.25)	(9.61)	(3.00)	(0.03)
SCORE	-0.467***	-0.499***	-0.456***	-0.463***	-0.461***
	(111.89)	(109.25)	(98.78)	(113.54)	(83.44)
SCORE*DUMMY	0.002	0.120***	-0.038***	0.028*	-0.003
	(0.42)	(13.61)	(4.38)	(1.78)	(0.32)
AGE	0.820***	0.715***	0.836***	0.785***	0.893***
	(27.44)	(27.20)	(31.10)	(32.63)	(29.14)
AGE*DUMMY	0.027***	0.351***	-0.137***	0.238***	-0.179***
	(6.05)	(6.78)	(2.75)	(3.32)	(3.94)
GEAR	0.012***	0.010***	0.014***	0.013***	0.012***
	(41.58)	(32.60)	(44.60)	(40.16)	(40.23)
GEAR*DUMMY	-0.000	0.008***	-0.006***	-0.002***	0.004***
	(0.94)	(13.14)	(10.45)	(3.39)	(4.92)
COL	1.105*	-1.492**	5.295***	0.130	4.859***
	(1.91)	(2.27)	(8.09)	(0.22)	(6.31)
COL*DUMMY	-0.398	8.322***	-16.372***	9.309***	-8.164***
	(0.74)	(6.72)	(13.11)	(5.02)	(7.29)
GDP	-0.482***	-0.541***	-0.771***	-0.684***	-0.668***
	(6.95)	(10.66)	(14.85)	(14.73)	(11.17)
GDP*DUMMY	0.037	-0.587***	0.295***	0.062	-0.017
	(0.31)	(5.83)	(3.05)	(0.44)	(0.20)
Constant	7.122***	8.240***	8.419***	6.300***	7.028***
	(5.26)	(6.74)	(6.88)	(5.19)	(5.75)
Hausman Spec. Test	1,735***	1,814***	1,496***	1,532***	1,642***
R-squared	0.19	0.20	0.20	0.19	0.19

Absolute value of t statistics in parentheses, *significant at 10%; ** significant at 5%; *** significant at 1%
Numbers of firms and of observations are 15,491 and 123,422, respectively.
DUMMY represents dummy variables for tight period in column one and for firm types in the remaining columns. These dummies are interacted with explanatory variables.
The Hausman specification test has χ^2 distribution with $k-1$ degrees of freedom where k denotes the number of estimated coefficients in the regressions. The Hausman test results confirm that there is a systematic difference between the coefficients obtained for the fixed effects and of random effects specifications. Therefore, the results for the consistent specification that is the fixed effects are reported in this study.

Table 5.7. Fixed Effects Results for the MIX1-Introducing Interaction Terms for Firm Type and Policy Regime (Cont.)

	DUMMY-Young (6)	*DUMMY-Old (7)*	*DUMMY-High Indebted (8)*	*DUMMY-Less Indebted (9)*
BRATE	-0.008**	-0.027***	-0.023***	-0.018***
	(2.37)	(7.74)	(6.81)	(5.21)
BRATE*DUMMY	-0.041***	0.036***	-0.012*	0.014*
	(6.12)	(5.44)	(1.82)	(1.66)
RASSET	2.857***	2.803***	1.958***	3.043***
	(19.30)	(18.30)	(11.72)	(19.76)
RASSET*DUMMY	-0.376***	0.346*	1.057***	-4.082***
	(3.74)	(1.95)	(3.31)	(10.43)
SCORE	-0.473***	-0.454***	-0.323***	-0.499***
	(110.32)	(101.95)	(69.86)	(118.86)
SCORE*DUMMY	0.033***	-0.041***	-0.201***	0.517***
	(4.32)	(4.87)	(20.89)	(48.50)
AGE	0.759***	0.843***	0.757***	0.918***
	(30.20)	(33.39)	(30.57)	(36.45)
AGE*DUMMY	0.255***	-0.028	0.253***	-0.419***
	(4.94)	(0.79)	(4.57)	(8.08)
GEAR	0.012***	0.013***	0.069***	0.011***
	(39.61)	(43.71)	(83.49)	(41.85)
GEAR*DUMMY	-0.000	-0.003***	-0.063***	0.563***
	(0.66)	(5.38)	(72.18)	(78.70)
COL	1.602***	2.854***	-0.208	0.392
	(2.68)	(4.61)	(0.33)	(0.65)
COL*DUMMY	-1.886**	-7.301***	-1.313	-3.872***
	(2.18)	(6.53)	(1.02)	(2.82)
GDP	-0.663***	-0.719***	-0.638***	-0.664***
	(13.16)	(14.18)	(13.35)	(13.52)
GDP*DUMMY	-0.168*	0.142	0.150	0.248**
	(1.66)	(1.40)	(1.39)	(2.50)
Constant	9.224***	6.622***	4.719***	5.240***
	(7.30)	(5.32)	(3.96)	(4.37)
Hausman Spec. Test	1,592***	1,749***	2,477***	2,970***
R-squared	0.19	0.19	0.23	0.24

Absolute value of t statistics in parentheses, *significant at 10%; ** significant at 5%; *** significant at 1%
Numbers of firms and of observations are 15,491 and 123,422, respectively.
DUMMY represents dummy variables for tight period in column one and for firm types in the remaining columns.
These dummies are interacted with explanatory variables.
The Hausman specification test has χ^2 distribution with *k-1* degrees of freedom where *k* denotes the number of estimated coefficients in the regressions. The Hausman test results confirm that there is a systematic difference between the coefficients obtained for the fixed effects and of random effects specifications. Therefore, the results for the consistent specification that is the fixed effects are reported in this study.

Table 5.8. IV-2SLS Fixed Effects Etimation Results for the Short Term Debt-Current Liabilities Ratio (MIX1)

	No Inter. Terms (1)	*TYPE-Small (2)*	*TYPE - Large (3)*	*TYPE - Risky (4)*	*TYPE-Secure (5)*	*TYPE – Young (6)*	*TYPE-Old (7)*	*TYPE-High Indebted (8)*	*TYPE- Less Indebted (9)*
BRATE	0.002	-0.008	0.009	0.002	0.007	0.003	0.007	-0.004	0.009
	(0.44)	(1.41)	(1.55)	(0.31)	(1.11)	(0.53)	(1.18)	(0.77)	(1.56)
BRATE*TP*TYPE		-0.026***	0.022***	0.004	0.007	-0.023***	0.014**	-0.030***	0.036***
		(3.46)	(2.98)	(0.41)	(1.01)	(3.23)	(2.09)	(3.62)	(4.73)
BRATED*TYPE		0.036***	-0.028***	-0.001	-0.013	-0.006	-0.020**	0.030**	-0.031***
		(3.42)	(2.61)	(0.04)	(1.36)	(0.79)	(2.25)	(2.54)	(2.83)
BRATE*TP		-0.066***	-0.080***	-0.074***	-0.076***	-0.069***	-0.077***	-0.067***	-0.082***
		(4.39)	(5.27)	(4.91)	(4.99)	(4.59)	(5.10)	(4.47)	(5.42)
TP		5.244***	5.257***	5.244***	5.236***	5.372***	5.249***	5.229***	5.212***
		(6.04)	(6.07)	(6.06)	(6.05)	(6.20)	(6.06)	(6.04)	(6.02)
AGE	0.561***	0.574***	0.573***	0.572***	0.573***	0.577***	0.579***	0.573***	0.573***
	(21.10)	(17.64)	(17.62)	(17.60)	(17.61)	(17.43)	(17.70)	(17.62)	(17.62)
GDP	-0.523***	-0.516***	-0.515***	-0.515***	-0.515***	-0.515***	-0.513***	-0.515***	-0.515***
	(9.62)	(7.06)	(7.05)	(7.05)	(7.05)	(7.05)	(7.02)	(7.06)	(7.05)
SCORE	-0.598***	-0.599***	-0.598***	-0.598***	-0.598***	-0.598***	-0.598***	-0.597***	-0.597***
	(40.82)	(40.80)	(40.83)	(40.82)	(40.76)	(40.87)	(40.84)	(40.77)	(40.81)
RASSET	7.190***	7.282***	7.275***	7.286***	7.283***	7.127***	7.247***	7.283***	7.269***
	(26.45)	(26.72)	(26.68)	(26.72)	(26.72)	(25.96)	(26.36)	(26.72)	(26.67)
GEAR	0.019***	0.019***	0.019***	0.019***	0.019***	0.019***	0.019***	0.019***	0.019***
	(15.56)	(15.48)	(15.50)	(15.46)	(15.51)	(15.63)	(15.51)	(15.54)	(15.55)
COL	-5.995***	-6.205***	-6.198***	-6.182***	-6.180***	-6.156***	-6.168***	-6.250***	-6.218***
	(4.82)	(4.99)	(4.98)	(4.97)	(4.97)	(4.95)	(4.96)	(5.03)	(5.00)
CONS	-13.295***	-14.41***	-14.36***	-14.48***	-14.48***	-13.29***	-14.37***	-14.51***	-14.38***
	(7.04)	(7.25)	(7.22)	(7.28)	(7.28)	(6.61)	(7.20)	(7.30)	(7.23)
R-squared	0.16	0.17	0.16	0.16	0.15	0.16	0.16	0.16	0.17

Absolute value of t statistics in parentheses, * significant at 10%; ** significant at 5%; *** significant at 1%

Numbers of firms and of observations are 15,144 and 107,759, respectively.

TYPE represents the respective firm type dummies that interact with monetary stance variable and tight period dummy.

The first lags of endogenous variables (*RASSET, GEAR, SCORE, COL, BRATE*TYPE,* and *BRATE*TYPE*TP*) and the levels of exogenous variables (*AGE, GDP, TP,* and *BRATE*TP*) are used as instrumental variables.

Table 5.9. IV-2SLS Fixed Effects Estimation Results for the Total Debt-Total Liabilities Ratio (MIX2)

	No Inter. Terms (1)	*TYPE-Small (2)*	*TYPE - Large (3)*	*TYPE - Risky (4)*	*TYPE-Secure (5)*	*TYPE – Young (6)*	*TYPE-Old (7)*	*TYPE-High Indebted (8)*	*TYPE- Less Indebted (9)*
BRATE	-0.008*	-0.010	0.011*	-0.001	0.004	-0.002	0.001	-0.007	0.004
	(1.81)	(1.62)	(1.82)	(0.25)	(0.61)	(0.36)	(0.20)	(1.12)	(0.66)
BRATE*TP*TYPE		-0.000	0.014*	0.009	0.022***	-0.023***	0.012*	-0.044***	0.040***
		(0.02)	(1.92)	(0.84)	(3.32)	(3.35)	(1.69)	(5.14)	(5.17)
BRATE*TYPE		0.030***	-0.046***	-0.001	-0.013	0.002	-0.014*	0.025**	-0.023**
		(2.76)	(4.26)	(0.09)	(1.32)	(0.19)	(1.81)	(2.07)	(2.02)
BRATE*TP		-0.146***	-0.153***	-0.152***	-0.162***	-0.143***	-0.154***	-0.142***	-0.160***
		(9.49)	(9.91)	(9.91)	(10.39)	(9.31)	(10.02)	(9.27)	(10.42)
TP		9.405***	9.538***	9.647***	9.679***	9.548***	9.643***	9.633***	9.610***
		(10.64)	(10.81)	(10.93)	(10.98)	(10.82)	(10.93)	(10.92)	(10.90)
AGE	0.377***	0.349***	0.349***	0.348***	0.348***	0.341***	0.336***	0.349***	0.349***
	(13.92)	(10.53)	(10.55)	(10.51)	(10.49)	(10.22)	(9.95)	(10.53)	(10.52)
GDP	-0.563***	-0.678***	-0.678***	-0.677***	-0.678***	-0.679***	-0.682***	-0.678***	-0.678***
	(10.16)	(9.12)	(9.11)	(9.10)	(9.11)	(9.13)	(9.17)	(9.12)	(9.11)
SCORE	-0.408***	-0.407***	-0.407***	-0.408***	-0.406***	-0.407***	-0.408***	-0.407***	-0.407***
	(27.33)	(27.20)	(27.27)	(27.35)	(27.17)	(27.29)	(27.36)	(27.31)	(27.32)
RASSET	7.450***	7.636***	7.620***	7.643***	7.638***	7.758***	7.659***	7.645***	7.628***
	(26.88)	(27.51)	(27.44)	(27.51)	(27.51)	(27.71)	(27.37)	(27.54)	(27.48)
GEAR	0.035***	0.035***	0.035***	0.035***	0.035***	0.035***	0.035***	0.035***	0.035***
	(28.73)	(28.64)	(28.61)	(28.56)	(28.62)	(28.55)	(28.53)	(28.60)	(28.67)
COL	11.263***	10.971***	10.979***	10.963***	10.946***	10.898***	10.972***	10.855***	10.908***
	(8.89)	(8.66)	(8.67)	(8.66)	(8.65)	(8.61)	(8.66)	(8.57)	(8.61)
CONS	-21.030***	-21.55***	-21.41***	-21.51***	-21.58***	-22.28***	-21.22***	-21.56***	-21.43***
	(10.92)	(10.64)	(10.57)	(10.62)	(10.66)	(10.95)	(10.36)	(10.65)	(10.58)
R-squared	0.12	0.13	0.14	0.13	0.14	0.12	0.13	0.14	0.13

Absolute value of t statistics in parentheses, * significant at 10%; ** significant at 5%; *** significant at 1%

Numbers of firms and of observations are 15,144 and 107,759, respectively.

TYPE represents the respective firm type dummies that interact with monetary stance variable and tight period dummy.

The first lags of endogenous variables (*RASSET, GEAR, SCORE, COL, BRATE*TYPE,* and *BRATE*TYPE*TP*) and the levels of exogenous variables (*AGE, GDP, TP*, and *BRATE*TP*) are used as instrumental variables.

Table 5.10. IV-2SLS Fixed Effects Estimation Results for the Short Term Debt-Total Debt Ratio (MIX3)

	No Inter. Terms (1)	*TYPE-Small (2)*	*TYPE - Large (3)*	*TYPE - Risky (4)*	*TYPE-Secure (5)*	*TYPE – Young (6)*	*TYPE-Old (7)*	*TYPE-High Indebted (8)*	*TYPE- Less Indebted (9)*
BRATE	0.018**	-0.000	-0.002	0.005	0.001	0.002	0.021**	0.004	0.004
	(2.45)	(0.05)	(0.19)	(0.53)	(0.06)	(0.23)	(2.32)	(0.43)	(0.41)
BRATE*TP*TYPE		-0.075***	0.050***	-0.018	-0.031***	-0.091***	0.104***	0.033**	-0.042***
		(6.10)	(4.18)	(1.07)	(2.88)	(7.91)	(9.46)	(2.47)	(3.14)
BRATE*TYPE		0.016	0.021	-0.008	0.007	0.010	-0.068***	-0.001	-0.000
		(0.91)	(1.22)	(0.35)	(0.48)	(0.81)	(4.81)	(0.08)	(0.01)
BRATE*TP		0.088***	0.059**	0.083***	0.097***	0.101***	0.052**	0.075***	0.090***
		(3.59)	(2.43)	(3.41)	(3.93)	(4.14)	(2.13)	(3.10)	(3.72)
TP		-2.903**	-3.180**	-3.576**	-3.703***	-3.291**	-3.409**	-3.623***	-3.620***
		(2.08)	(2.28)	(2.57)	(2.66)	(2.37)	(2.45)	(2.60)	(2.60)
AGE	0.764***	0.856***	0.853***	0.854***	0.857***	0.891***	0.894***	0.855***	0.855***
	(17.85)	(16.32)	(16.25)	(16.26)	(16.32)	(16.69)	(16.95)	(16.29)	(16.30)
GDP	-0.019	0.235**	0.236**	0.234**	0.235**	0.243**	0.243**	0.234**	0.235**
	(0.21)	(1.97)	(1.98)	(1.96)	(1.97)	(2.04)	(2.04)	(1.97)	(1.97)
SCORE	-0.510***	-0.518***	-0.516***	-0.510***	-0.514***	-0.512***	-0.513***	-0.510***	-0.511***
	(21.10)	(21.38)	(21.35)	(21.10)	(21.24)	(21.20)	(21.24)	(21.12)	(21.16)
RASSET	1.417***	1.346***	1.348***	1.341***	1.331***	0.839*	0.924**	1.317***	1.337***
	(3.21)	(3.05)	(3.05)	(3.03)	(3.01)	(1.89)	(2.08)	(2.98)	(3.03)
GEAR	-0.030***	-0.030***	-0.029***	-0.030***	-0.029***	-0.029***	-0.029***	-0.029***	-0.030***
	(15.58)	(15.61)	(15.51)	(15.56)	(15.52)	(15.22)	(15.41)	(15.47)	(15.56)
COL	-52.477***	-52.53***	-52.54***	-52.44***	-52.40***	-52.42***	-52.27***	-52.33***	-52.36***
	(25.73)	(25.76)	(25.77)	(25.72)	(25.70)	(25.75)	(25.66)	(25.66)	(25.68)
CONS	82.651***	80.358***	80.318***	79.993***	80.193***	83.062***	82.307***	80.113***	80.014***
	(26.41)	(24.42)	(24.40)	(24.30)	(24.37)	(25.01)	(24.93)	(24.35)	(24.31)
R-squared	0.03	0.03	0.14	0.03	0.03	0.03	0.03	0.03	0.03

Absolute value of t statistics in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

Numbers of firms and of observations are 14,784 and 98,047, respectively.

TYPE represents the respective firm type dummies that interact with monetary stance variable and tight period dummy.

The first lags of endogenous variables (*RASSET, GEAR, SCORE, and COL*), and the level of exogenous variables (*AGE, GDP, TP*, and interaction terms) are used as instrumental variables.

CHAPTER SIX

Financial Constraints, Inventories, and Employment in the UK Manufacturing Industry

6.1. Introduction

Under perfect financial markets, the Modigliani and Miller theorem (the MM theorem) states that the market value of a firm is independent of its financial position[1]. However, a growing number of theoretical and empirical studies have shown that the financial positions of firms are important for their investment, and employment decisions under imperfect financial markets[2]. Theoretical and empirical evidence show that monetary or productivity shocks may affect investment, and the employment activities of firms or households, by changing their financial positions. The extent of the changes in investment and employment as a result of external shocks depends very much on how these activities are financed. In other words, the availability, cost and types (internal versus external, bank versus market finance) of financial sources are crucial in the formation of investment and employment decisions. This issue has been studied using the financial accelerator framework (Kiyotaki and Moore, 1997; Bernanke, Gertler and Gilchrist, 1996 and 1998)

Real or monetary shocks lead to changes in the balance sheets of firms, banks and households under imperfect financial markets. More specifically, the balance sheet channel of the transmission mechanism implies that a contractionary monetary policy shock reduces the asset prices and cash flow, and in turn, deteriorates firms' financial positions by changing the value of their collateral assets and thus weakening their borrowing ability. In this framework, a change in the monetary stance affects the net

[1] See Modigliani and Miller (1958)
[2] We use financial constraints and imperfect capital markets interchangeably.

worth of firms and their investment decisions. The literature largely focuses on models that explain fixed investment and inventories in this context.

In the neo-classical investment model, investment has often been assumed as a function of firms' investment opportunities (profitability) and not their financial position. However, models incorporating asymmetric information assert that a firm's investment is a function of its net worth in addition to investment opportunities. In this context, a shock to the financial position or net worth of firms may affect their investment decision. The empirical difficulty here is to identify and distinguish variables that reflect investment opportunities from those that are associated with a firm's financial position. For instance, cash flow may reflect both firm profitability and financial constraints, thus profitability needs to be controlled by other variables as in the Q model of investment.

The seminal paper by Fazzari, Hubbard and Peterson (1988) tests empirically the impact of financial constraints on the investment of firms by using cash flow as an explanatory variable. The empirical research following Fazzari *et al.* (1988) uses some financial variables in addition to traditional variables like sales, Tobin's q, the user cost of capital and lags of the dependent variable in the investment models. Estimations based on this type of models confirm a high sensitivity of investment of financially constrained firms to a change in their cash flow. This suggests that a contractionary monetary shock can affect investment through a worsening of the net worth positions of particular firms. However, Kaplan and Zingales (1997) comment on Fazzari *et al.* (1988) and conclude that high sensitivity of investment to cash flow should not necessarily be considered as an indicator of financing constraints. They claim that there is no strong theoretical reason to expect a monotonic relationship between cash flow sensitivity of investment and financial constraint. In this chapter, we will adopt a theoretical and empirical framework that was originated from the debate between Kaplan and Zingales (1997, 2000) and Fazzari *et al.* (1988, 2000).

Under informational problems, monetary policy shocks are supposed to affect firms' real activity by changing the composition of internal versus external finance, which are not perfectly substitutable. The external finance premium is expected to rise for firms with poor collateral as a result of an increase in the interest rates. Therefore, these firms are less likely to have access to external funds relative to well-capitalized firms. In addition, the

supply of bank loans may go down as money supply is squeezed. This leads to a shift especially in the composition bank finance versus market finance that reflects information about uniqueness of the bank loans.

Using aggregate data, Kashyap et al. (1993) use the mix (the ratio of short term bank debt to commercial papers plus short term bank debt) as an explanatory variable to explain investment and thus to test the bank lending channel. In this study, we use a proxy for the mix, the ratio of short-term debt to current liabilities, alongside other variables to explain inventory investment and employment growths by using firm level data. On the other hand, following Kaplan and Zingales (1997) and Fazzari et al. (1988), we also use cash flow as an explanatory variable in inventory investment and employment growth equations in order to capture the importance of the net worth of firms for various firm types.

In Chapter Five, we use a panel of over fifteen thousand UK manufacturing firm records for the period of 1990-1999. We find out that the reactions of firms (in terms of their mixes) with different risks, sizes, ages, and gearing level to monetary policy shocks differ significantly across time periods which refer to various monetary policy regimes. Based on this evidence, we estimate a variety of specifications for inventories and employment models that consider the mix as an explanatory variable in addition to other variables, which include the cumulative base rate (a proxy of the user cost of capital), sales, cash flow etc. across firm groups. This helps to some extent to resolve the identification problem originating from cash flow that contains information not only on the degree of financial constraints but also on investment opportunities. We use the *GMM* procedure of Arellano and Bond (1991) to test for the determinants of inventory investment and employment growths for the UK manufacturing industry.

The evidence shows that cyclical behaviour of output in the modern industrialized economies is influenced very much by fluctuations in inventories. It is generally argued that inventories (rather than fixed investment or employment) are more sensitive to changes in the monetary policy stance or other external shocks because they are expected to have a low adjustment cost. Therefore, they explain a large proportion of output fluctuations. Analysing the reaction of inventory investment to monetary policy shocks provides valuable

information to policy makers for managing aggregate demand.[3] We also estimate an empirical model of employment growth in the framework of capital market imperfections to test the impact of financial variables and to compare findings to those of inventory investment that has a lower adjustment cost. It is expected that employment growth is less sensitive to the monetary stance variable and other financial variables compared to inventory investment growth.

In section two, we summarize the theoretical and empirical literature related to the impact of monetary policy on investment under capital market imperfections. We concentrate more on the cash flow hypothesis, which recently has been discussed very often around the debate originated from Fazzari *et al.* (1988, 2000) and Kaplan and Zingales (1997, 2000). In section three, we briefly discuss the traditional theories on inventory investment. In addition, we summarize the empirical studies that use the financial position of firms to explain inventory investment and the employment behaviour of firms. Section four is devoted to the empirical model, methodology, and data. In section five, we provide the empirical results obtained by the *GMM* estimations for inventory investment and employment growth rates. Finally, in section six, we provide some concluding remarks.

6.2. Background Literature: Financial Constraints and Investment

6.2.1. Investment Models

Well-known models of investment are the accelerator, the neo-classical, the Q model[4] and those using the Euler equation[5]. Recent versions of investment models have introduced strictly convex adjustment cost into firms' optimisation problem to solve for the optimum levels of the capital stock and investment. This innovation in the profit function suggests the notion of a slow adjustment of investment. Most empirical studies in this field have introduced financial imperfections into the standard investment theories using the Q

[3] Using annual data in the empirical analysis may prevent us to fully observe the reaction of inventories to a change in the monetary policy because of the high volatility of inventory investment. High frequency data, for example quarterly data would be more useful for this purpose, however, they are not available in UK firm level data.

[4] Based on this model, investment is estimated econometrically by using a proxy of Tobin's q as an explanatory variable

[5] Clark (1979) provides a detailed comparison of investment models.

model and the Euler equation approach. The variables that reflect the financial positions of the firms (cash flow, debt-equity ratio, coverage ratio, liquid assets ratio, dividend payout ratio etc.) can be added to analyse the impact of financial imperfections.

The basic theoretical framework for the adjustment cost model of investment is given below by modifying the traditional neo-classical model. Consider a firm, whose objective is to maximise the expected present value of the discounted flow of future dividends, D_{t+i},

$$E\left[\sum_{i=0}^{\infty}\beta^{i}D_{t+i}\right] \qquad (6.1)$$

where β is the discount factor and is equal to $1/(1+r)$ where r denotes the market interest rate and

$$D_t=\pi(K_t,L_t,,I_t,\ v_t,\tau)=F(K_t,L_t)-C(K_t,I_t,\ \tau)-wL_t-p_t^{I}I_t+B_{t+1}-(1+r)B_t \qquad (6.2)$$

where profit, π, is a function of the capital stock, K_t, costlessly adjustable factors such as labour, L_t, investment, I_t, profitability shock, v_t and technology shock, τ. The adjustment cost, $C(.)$, is a function of the capital stock, investment and the technology shock. p_t denotes the price of output, $F(.)$ is the production function, w_t is the vector of prices for variable inputs, p_t^{I} is the price vector for capital goods, $(B_{t+1}-B_t)$ denotes net borrowing, and rB_t is the interest payment. The adjustment cost is assumed to be strictly convex in the level of investment. The capital stock is a quasi-fixed factor while labour is a variable factor. The profit is maximised subject to the adjustment cost function and a capital accumulation equation, $K_{t+1}=I_t+(1-\delta)K_t$, (where δ denotes the rate of capital depreciation).

Maximising (6.1) subject to the profit function, the capital accumulation constraint, and the adjustment cost function gives us the optimum levels of the capital stock and investment.[6] The constraining assumptions on dividends and borrowing enrich the

[6] For the derivation details, different presentations of the theoretical model and its solutions see Blundell, Bond, and Meghir (1996), Hubbard (1998) and Saltari (2001).

model's implications. We are not going into the derivation details of this model. Using the first order condition, the standard Q and the Euler equation can be derived. Tobin's q is derived as;

$$1+C_I(I_t, K_t, \tau) = q_t \qquad (6.3)$$

Fazzari *et al.* (1988) use this theoretical framework and assume a quadratic functional form for the adjustment cost

$$C_{It}(I_t, K_t, \tau) = \frac{\alpha}{2}\left(\frac{I_t}{K_t} - a - \tau\right)^2 K_t \qquad (6.4)$$

Substituting equation (6.4) into (6.3), we obtain the traditional Q model. That is:

$$\frac{I_t}{K_t} = a + \frac{1}{\alpha}(q_t - 1) + v_t \qquad (6.5)$$

where v_t is a combination of profitability and technology shocks and the error term.

Econometric estimation of the model given in equation (6.5) faces two obstacles. First, the marginal q_t, the increase in the value of the firm due to unit increase in investment, is not observable, thus testing this equation can only be possible by finding a proper proxy for the marginal q_t. Most studies in this area including Fazzari *et al.* (1988) use the average Tobin's q_t, that is defined as the market value of equity plus the book value of total debt minus inventories divided by the replacement value of capital stock. Second, the model given in equation (6.5) does not capture financial imperfections, which imply that internal finance is cheaper than external finance. Empirical studies like Fazzari *et al.* (1988) add variables that reflect the net worth of firms in order to account for market imperfections. Cash flow is a commonly used variable to capture the impact of financial imperfections across firm groups. Cash flow (or other liquid assets) acts not only as a proxy for net worth that reduces the premium on the external finance, but also gives information about the extent of investment that can be financed by internal funds. Since internal finance is less costly than external finance, an increase in internal funds or cash flow would lead to a higher investment.

$$\frac{I_t}{K_t} = \alpha + \beta_1 \frac{S_t}{K_t} + \beta_2 R + \beta_3 q_t + \delta \frac{CF_t}{K_t} + v_t \qquad (6.6)$$

where S denotes sales as the accelerator theory proposes, R is the user cost of capital consistent with neo-classical investment theory, CF_t denotes cash flow, often defined as the sum of net income plus capital stock depreciation. The coefficients β_1, β_3, and δ are positive. Firms with higher expected sales, higher market value relative to their replacement cost and high net worth are going to invest more. However, the coefficient for the user cost of capital that is a cost item, is expected to be negative.

The cash flow may also contain information about expected profitability. Unless variables, which reflect expected profitability like Tobin's q, are used alongside cash flow to explain investment, there will be an identification problem where cash flow conveys information both on expected profitability and the extent of financial imperfections. Therefore, empirical studies may fail to identify the impact of financial constraints on investment. In the Q model, it is the marginal Tobin's q (the ratio of market value of additional investment goods to their replacement cost) that reflects the expected profitability of investment for additional investment. Empirical studies in this research area generally use the average Tobin's q as a proxy for expected profitability because it is easily observable contrary to the marginal Tobin's q. However, the average Tobin's q can only replace the marginal Tobin's q if the market is perfectly competitive with a constant return to scale technology (Hayashi, 1982). Gilchrist and Himmelberg (1995) use an alternative proxy for expected marginal profits to solve this empirical problem in the Q model.

The Euler equation approach is formulated from the same maximisation problem from which the Q model is derived but it avoids relying on measures of profitability or investment opportunities that are based on firms' market value, namely Tobin's q. The Euler equation is superior to the Q model. The Euler equation is derived directly from the first order conditions of the model defined above and the investment opportunities are directly based on the estimation of future dividends. These studies generally employ the *GMM* panel data estimation procedure and the impact of monetary policy is tested in this context by looking at the elasticity of the user cost of capital, or liquidity indicators (Bond and Meghir, 1994; Guariglia and Schiantarelli, 1998).

The impact of monetary policy on investment is generally analysed by dividing samples into groups in terms of size, age, liquidity, rating, profitability, dividend etc. Asymmetrical effects of a change in the monetary stance on various firm groups can be interpreted as evidence for the credit channel. Heterogeneous reactions of firms to their respective cash flow can be observed by classifying them as more constrained or less constrained according to their internal sources, dividend pay out ratio, affiliation, indebtedness, bond ratings, access to bank or market finance, size, age etc. Recently, auto-regressive distributed lag models have been employed to explain investments based on the variables that reflect the user cost of capital, firm's liquidity or cash flow, lags of dependent variables and sales. (Chirinko, Fazzari and Myer, 1999; vonKalckreuth, 2001; Chatelain *et al.*, 2001; Gaiotti and Generale, 2001). The empirical model in this framework is generally specified in the following form:

$$\frac{I_{it}}{K_{i,t-1}} = \sum_{l=0}^{L} \alpha_l \frac{I_{i,t-l}}{K_{i,t-l-1}} + \sum_{m=0}^{M} \beta_m \Delta \log \frac{S_{i,t-m}}{K_{i,t-1}} + \sum_{n=0}^{N} \gamma_n \Delta \log UC_{i,t-n} + \sum_{q=0}^{Q} \phi_q \frac{CF_{i,t-q}}{K_{i,t-q-1}} + \lambda_i + \eta_t + \vartheta_{t,i} \qquad (6.7)$$

where $UC_{i,t}$ represent the user cost of capital, λ_i, η_t *and* $\vartheta_{t,i}$ denote time invariant individual effects, time effects and an error term, respectively.

6.2.2. The Cash Flow-Investment Sensitivity

The analysis so far in this thesis implies that the firm characteristics associated with the financial structures of firms determine their external finance premiums and thus their investment patterns. A monetary policy shock is supposed to affect the extent of informational problems associated with the financial transactions between lenders and borrowers. This affects the net worth or collateral level of borrowers and the composition of bank and market finance by changing the demand structure of borrowers as well as the supply behaviour of banks and other lenders. This theoretical framework has been tested empirically by using cash flow in the investment equation as a variable representing the financial position of firms.

Fazzari *et al.* (1988) investigate the impact of financial constraints on corporate investment. This study suggests that transaction costs, tax advantages, agency problems, and costs of financial distress and asymmetric information are the main reasons for differentiation between the cost of internal finance and external finance. Based on

theoretical studies, like Myers and Majluf (1984), it assumes that investment decisions are in accord with the hierarchy of finance where firms prefer the least costly finance, which implies that they prefer internal finance to external finance. Availability of internal finance allows firms to undertake investments without paying a premium on external finance. The extent of this premium is negatively related with the internal cash flow, or the net worth position.

Fazzari *et al.* (1988) classify firms according to their financial positions to investigate the impact of cash flow on investment. The investment equation is estimated by taking into account the role of internal finance when markets are imperfect and by following theoretical models of investment, namely the Q model, the neo-classical, and the sales accelerator model. Empirical estimations based on these theoretical models confirm a high sensitivity of investment to cash flow. In other words, the impact of cash flow on investments is strong, especially for financially constrained firms. This result suggests that contractionary monetary shocks may affect firms' investment through a worsening of their balance sheet positions, which are manifested in cash flow.

Kaplan and Zingales (1997) comment on Fazzari *et al.* (1988) and conclude that the sensitivity of investment to cash flow should not necessarily be considered as an indicator of financing constraints. They claim that there is no strong theoretical reason to expect a monotonic relationship between a cash flow sensitivity of investment and financing constraints. They found that the investment of less financially constrained firms exhibits significantly greater sensitivity to cash flow than the one of more financially constrained firms.

A simplified single period model is constructed by Kaplan and Zingales (1997) where the demand for investment *(I)* and capital are identical; by using this model they uncover a theoretical foundation of the investment cash-flow sensitivity. Firms choose the level of investment to maximize profit given the production function, $F(I)$, where the first derivative with respect to investment satisfies $F_I(I)>0$ and the second derivative satisfies $F_{II}<0$. Investment can be financed by internal funds (W) and external funds (E), $I = W+E$. The opportunity cost of internal fund is r. Since the capital depreciates in just one period, the user cost of capital is $1+r$, when investment is not higher than the amount of internal funds. The cost of external funds depend on the amount of external funds as well as the

wedge between internal and external funds that increases with the extent of informational, and agency cost problems. The cost function, $C(E, k)$ is assumed to be a convex function of external finance and an exogenously determined external finance premium, k. The first and the second derivatives of the cost function with respect to external finance are greater than zero, $C_E(E)>0$, and $C_{EE}>0$.

The firm maximizes the following profit function:

$$Max[F(I)-C(E,k)-(1+r)I)] \text{ where } I=W+E \qquad (6.7)$$

The f.o.c is given by,

$$F_I(I) = 1+r+ C_E(I-W, k) \qquad (6.8)$$

The external finance premium is zero if $I \leq W$ and it is positive if $I > W$ then the solution for the marginal product of investment is:

$$F_I(I) = 1+r, \text{ if } I \leq W \text{ and}$$

$$F_I(I) = 1+ r + C_E(E, k), \text{ if } I > W, \text{ where } C_E(E, k) > 0 \qquad (6.9)$$

The effect of internal finance on investment can be obtained by implicit differentiation of equation (6.8)

$$\frac{\partial I}{\partial W} = \frac{C_{EE}}{C_{EE} - F_{II}} > 0 \qquad (6.10)$$

where the assumption of imperfect capital market holds. This derivative is equal to zero if capital market is perfect since in that case $C_{EE} = 0$.

The sensitivity of investment to the exogenously determined external finance premium, is given by:

$$\frac{\partial I}{\partial k} = \frac{-C_{Ek}}{C_{EE} - F_{II}} < 0 \qquad (6.11)$$

where the marginal cost of external finance is increasing in k, $C_{Ek} > 0$. Therefore, investment in imperfect markets is positively correlated with the internal finance but

negatively correlated with the external finance premium that is assumed to be determined by the extent of informational and incentive problems that individual firms encounter. It is implicitly assumed that firms are financially constrained at various degrees depending on their net worth and informational problems. The empirical research in this area classifies firms according to the severity of their constraints in order to test their investment sensitivities to cash flow. Before going into this literature, in Figure 6.1, we show a graphical presentation of the model discussed above.[7]

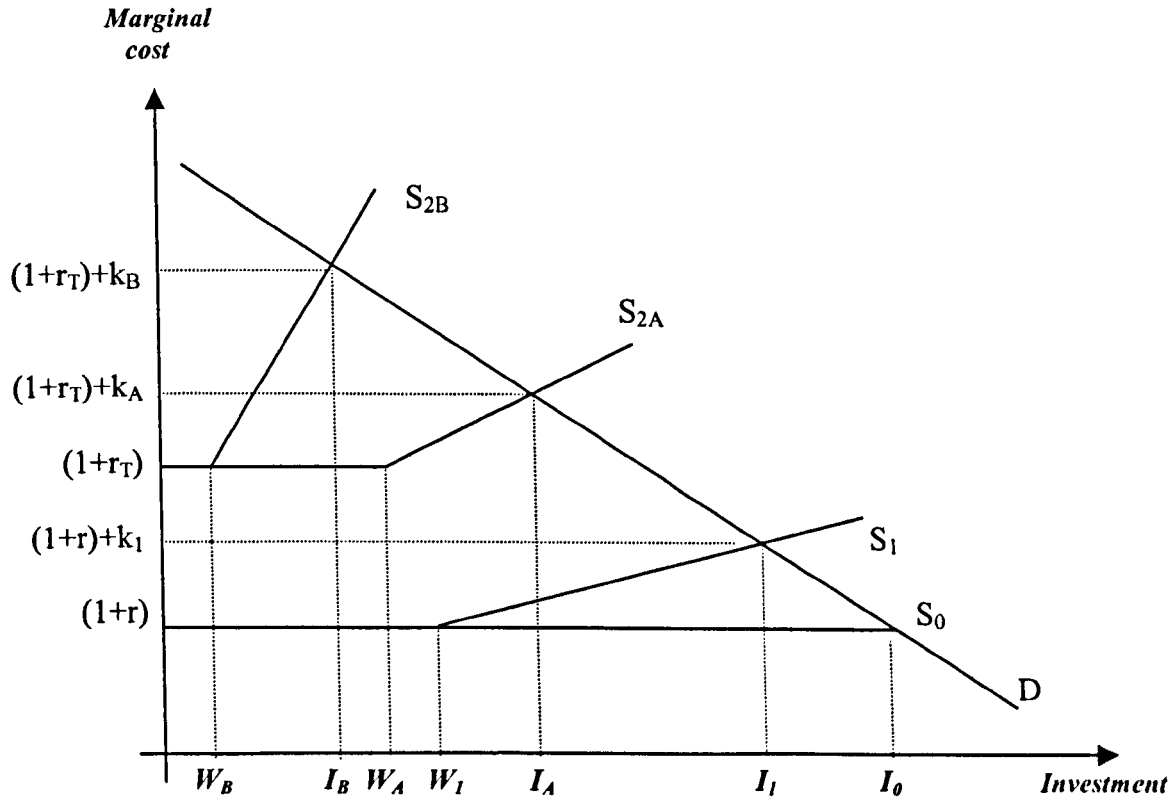


Figure 6.1: Investment, internal funds and asymmetric information

The figure shows supply and demand functions of investment. It is assumed that any change in investment opportunity will shift the demand curve, *D*. The MM theorem implies that the supply function, *S*, is horizontal at *(1+r)* that is, there is no difference between internal and external finance in terms of cost. The intersection of the demand curve and the horizontal supply function, S_0, determines Jorgenson's investment (desired capital stock) level, I_0. The amount of investment would still be the same when firms finance their investment projects entirely by using internal funds. However, since firms may own limited amount of internal funds, they need external funds for their investment

[7] Adopted from Hubbard (1998).

projects. Contrary to the MM theorem, under capital market imperfections the external finance is more costly. Lenders have less information than firms (borrowers) about the projects' default risk, thus they tend to ask a high return from lending to capture the default risk, i.e. the rate charged is higher than the risk free rate (the difference is external finance premium).

Initially, firms are assumed to have an amount of average internal funds, W_1 and the difference between investment and internal funds, I_1-W_1 is financed by external funds. If macroeconomic conditions and financial positions of firms are relatively supportive for investment, the risk-free interest rate, r, and the external finance premium, k_1, would be relatively low. A contractionary monetary policy would change the macroeconomic conditions, that is, the risk free interest rate increases. This also affects the financial positions of firms by deteriorating the extent of informational asymmetries between lenders and borrowers, and therefore the external finance premium increases and eventually the supply function shifts. We show the supply function of relatively less constrained firms by S_{2A} and more constrained firms by S_{2B}. Relatively more constrained firms are going to end up with relatively less internal resources, W_B and investment, I_B. There are two reasons for the low investment in this case: firstly, internal funds for more constrained firms decline more sharply than their internal funds for less constrained firms, and secondly, the extent of informational asymmetries is more serious for constrained firms.

This argument assumes that the steepness of the supply function depends on the availability and cost of external finance – either bank finance or other forms of finances. Evidence shows that firms with relatively good track records, large assets, high credit ratings have relatively flatter supply functions and lower external finance premiums. Similarly, firms that have close relationships with banks or other non-financial firms and get access to bank loans, have a relatively flatter supply function than the firms that cannot have access to bank finance because this lessens the extent of informational asymmetries, and as a result the potential external finance premiums for these firms. If a firm has access to market finance, however, it would pay a limited external finance premium that is close to zero. Apparently this is less than the external finance premium paid by a firm that does not have access to market finance but it has access to bank

finance. There are alternative sources of finance for firms that can not have access to bank finance, such as venture capital or trade credit but these funds are more costly.

The empirical literature considers both the cross-section and time series data and splits firms into less constrained and more constrained based on the availability and cost of external finance. Variables representing internal funds such as cash flow or the coverage ratio are often used among the explanatory variables to test the indirect impact of monetary policy on the investment behaviours of firms in this literature. The criteria for splitting firms are supposed to reflect the extent of the potential external finance premium.[8] This empirical literature predicts that the investment decisions of firms that are financially constrained are more sensitive to changes in internal funds. Monetary policy is one of the disturbances, which affects the level of internal funds of firms. Therefore, any change in monetary policy is going to be more effective on the activity of firms whose investment decisions are more responsive to internal funds.

In the theoretical model presented above, the slope of the supply function is given by C_{EE} and the slope of demand function by F_{II}. The larger the slope of the supply function (more constrained firms) and the lower the slope of the demand function in absolute terms the higher will be the investment sensitivity to a change in internal funds. According to Kaplan and Zingales (1997), the proposition that the investment of more constrained firms have high cash flow sensitivities relative to less constrained firms, may be valid only if dI/dW is monotonically decreasing in W (or increasing with respect to k). That is;

$$\frac{\partial^2 I}{\partial W^2} = \left(\frac{F_{III}}{F_{II}^{\ 2}} - \frac{C_{EEE}}{C_{EE}^{\ 2}} \right) \frac{C_{EE}^{\ 2} F_{II}^{\ 2}}{(C_{EE} - F_{II})^3} < 0 \qquad (6.12)$$

This condition depends on the curvatures of the cost and the production functions; the term in brackets is negative if the third derivative of the production function is negative, given a quadratic cost function. If this condition does not hold, the cash flow sensitivity of investment increases with firms' internal sources. By using the single period

[8] For example Fazzari *et al.* (1988) use the dividend pay out ratio to split firms as constrained or not, Gertler and Gilchrist (1994) use size for the same reason.

model given above, Kaplan and Zingales (1997) conclude that the investment-cash flow sensitivities do not necessarily increase with the degree of financial constraints. Figure 6.2 shows two different firm groups that have different levels of internal funds, W_L, W_H. In the first panel, the slope of the supply function is constant, $C_{EEE}=0$ and the demand function is convex, $F_{III}>0$. This implies that the investment of firms with lower internal funds is less sensitive to a change in internal finance, i.e. the derivative in equation (6.12) is positive. Similarly, in the second panel of the Figure 6.2, where the demand function has a constant slope, $F_{III}=0$ and the supply function is concave, $C_{EEE} < 0$, the investment of firms with high internal funds is also more sensitive to a change in internal funds. Therefore, the hypothesis that the investment of financially constrained firms is more sensitive to internal funds is not necessarily valid.

Fazzari *et al.* (2000) comment on Kaplan and Zingales (1997, 2000) and claim that since the split criterion is not cash flow, there is no need to check the second derivative of investment with respect to internal finance given in equation (6.12). A larger slope for the supply function of more constrained firms (C_{EE}^{B}) compared to that of unconstrained firms (C_{EE}^{A}) is a sufficient condition for the financially constrained firms' investment to be more sensitive to cash flow than that of financially unconstrained firms. Figure 6.3 shows that the investment of financially constrained firms is more sensitive to a change in internal funds than those of unconstrained in those cases where both firm groups have the same level of internal funds.

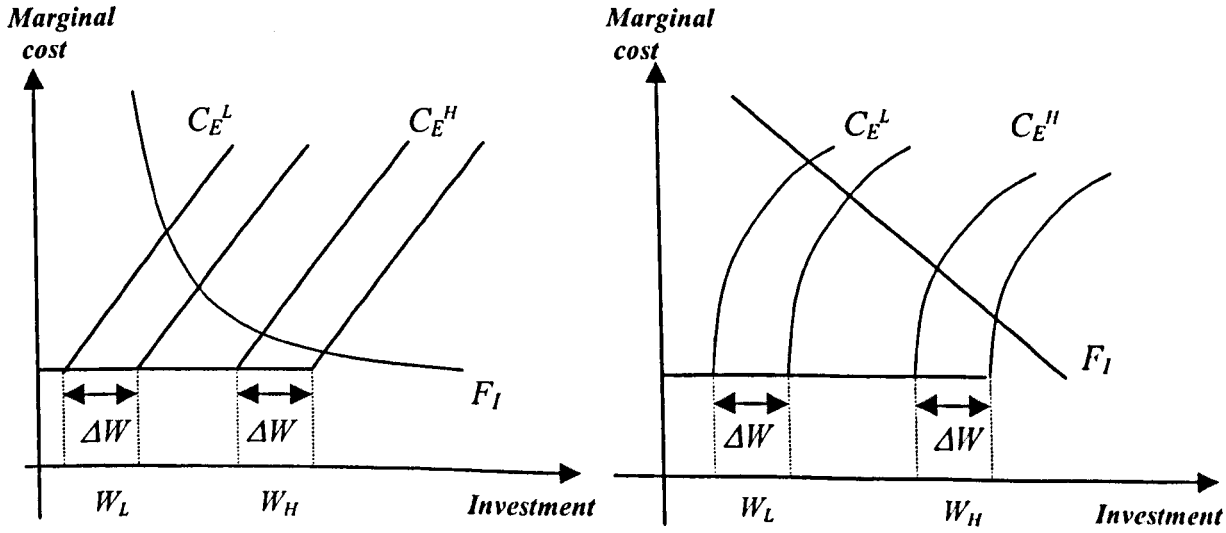


Figure 6.2: Investment-cash flow sensitivity and the shape of production and cost functions

Kaplan and Zingales (2000), however, argue that the condition forwarded by Fazzari *et al.* (2000) is not sufficient for reaching the conclusion that the investment of financially constrained firms is more sensitive to a change in internal funds. That is, the sensitivity of investment to internal finance with respect to an increase in the external finance premium, k, may increase or decrease depending on the curvature of the cost and production functions of the firms. The monotonicity condition proposed by Fazzari *et al.* (1988, 2000) is valid only if the derivative in (6.13) is positive. That is, firms with higher k have a higher slope of the external finance curve, $C_{EEk} > 0$, and F_{II} is the same across firms otherwise the derivatives would be negative depending on the form of production and cost functions.

$$\frac{\partial^2 I}{\partial k \partial W} = \frac{C_{EEk}{}^2 F_{II}{}^2 - C_{EEk} C_{EE} F_{II} + C_{Ek} C_{EEE} F_{II} - C_{Ek} C_{EE} F_{III}}{(C_{EE} - F_{II})^3} \begin{matrix} \leq \\ \geq \end{matrix} 0 \qquad (6.13)$$

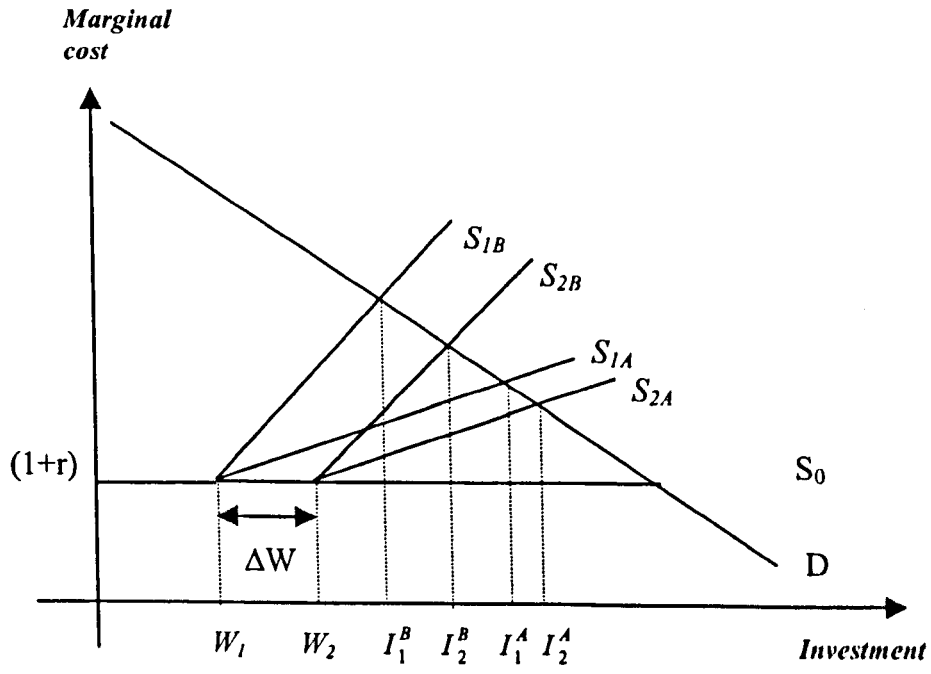


Figure 6.3: Investment-cash flow sensitivity and the degree of financial imperfections

Cleary (1999) finds evidence supporting Kaplan and Zingales (1997) by splitting US firms according to their creditworthiness that reflects financial constraints. His study uses a larger sample and verifies the results reached by Kaplan and Zingales (1997). It is found that the investment decisions of firms are very sensitive to the availability of internal funds in general but less creditworthy firms are relatively less sensitive to internal

funds. Similarly, Gomes (2001) claims that testing the extent of the financial imperfection may be misleading when using cash flow. According to Gomes (2001), the studies that find evidence supporting the hypothesis of investment monotonicity are subject to a measurement error in Tobin's q and an identification problem concerning it. Gomes (2001) finds that in case of liquidity constraints, investment is sensitive to cash flow if one ignores Tobin's q. This paper also finds evidence that cash flow explains investment significantly even in the absence of financial frictions. Kadapakkam, Kumar and Riddick (1998) use a sample of six OECD countries and support the results forwarded by Kaplan and Zingales (1997) and others by splitting firms in terms of size. They find evidence that the investment of small firms, which are known to have less access to external finance are generally less sensitive to cash flow than the investment of large firms. They conclude that the degree of sensitivity of a firm's investment to its cash flow cannot be considered as measure of the extent of the firm's financial constraint.

Allayannis and Mozumdar (2004) provide evidence on the debate between Kaplan and Zingales (1997) and Fazzari *et al.* (1988) and support the conclusions of Kaplan and Zingales (1997) and Cleary (1999) by using a sample of overwhelmingly fragile firms. It is found that the investment of those firms having negative cash flow is not sensitive to cash flow. However, excluding such firms from the sample increases the investment sensitivity of more constrained firms to cash flow. This result confirms Fazzari *et al.* (1988) and the theoretical evidence forwarded by Povel and Raith (2002). Allayannis and Mozumdar (2004) also claim that the investment sensitivity of firms to cash flow declines in periods 1987-1996 relative to the period 1977-1986 for the US corporate sector because of the decline in the extent of informational problems in recent years.

Povel and Raith (2002) construct a model in which the relationship between investment and internal funds can be negative, positive, or undetermined depending on the level of internal funds at given degrees of asymmetric information. Povel and Raith (2002) point out that the degree of a firm's financial constraints depends both on the extent of capital market imperfections (where external finance premium is determined endogenously by the model), and the level of the firm's internal funds. They show that these two measures of financial constraints have different implications for the firm's investment. With more asymmetric information, a high k, investment becomes more sensitive to changes in the internal finance. In their microeconomic model, they show that

the optimal scalable investment is a U-shaped function of the firm's level of internal funds: an increase in internal funds leads to an increase in investment if the level of internal funds is sufficiently high but it leads to a decline in investment if its level is very low. Financial indebtedness may lead to negative internal funds but the firm may still have positive net worth that includes also the firm's marketable collateral. Therefore, a rise in the level of internal funds is used for the repayment of debt rather than new investment projects and a further decline in internal finance may encourage firms to invest more with the expectation that the revenue from this investment will exceed the cost.

The solid line in Figure 6.4 summarizes the basic findings of the model where the financial contract used is debt.[9] It is assumed that a higher investment incurs a larger cost effect (borrowing cost) relative to the revenue from investment when the internal funds are high. At sufficiently high level of internal funds, $W > \tilde{W}$, a decline in the internal funds is going to lead to a rise in the cost of initial level investment thus the firm avoids this cost by reducing its investment level $dI/dW>0$. However, at a sufficiently negative internal funds level, $W < \tilde{W}$ where financial fixed costs and debt payments are higher than income, as internal funds decline, the revenue effect of an additional unit of investment dominates the cost effect (lower marginal cost of investment relative to the marginal revenue) thus investment is going to increase, $dI/dW<0$. The sensitivity of investment to internal funds will be less important if internal funds are close to $\tilde{W}$, that is, if the investment function is nearly flat, $dI / dW \cong 0$. In the Kaplan-Zingales's model, a firm's cash flow-investment sensitivity depends on the shape of production and cost functions while in this model, the sensitivity is independent from the shape of the production function but it is associated with the nature of the debt relationship between firms and investors that gives rise to the U-shaped investment function.

The model has also implications for the investment under various degree of asymmetric information problem when introducing an uncertainty factor about the firm's

[9] A firm that wishes to invest in a project may require funds from an outside investor if its internal funds are insufficient. The return from the investment is stochastic, thus unobservable to the borrower and the lender. To enforce repayment, the investor can be threatened to liquidate the firm's assets. Therefore, the optimal financial arrangement is the debt contract in which the firm promises to repay a certain amount and the default is followed by liquidation.

future profit. The dotted line in Figure 6.4 shows the investment function of the firm with a high degree of informational problems. As the informational problems becomes more severe, the curve becomes steeper almost everywhere, i.e. investment become more sensitive to a change in internal funds. Therefore, an increase in market imperfections tends to strengthen the investment cash flow sensitivity, except at the level of internal funds where the curve is nearly flat and thus the sensitivity is limited.

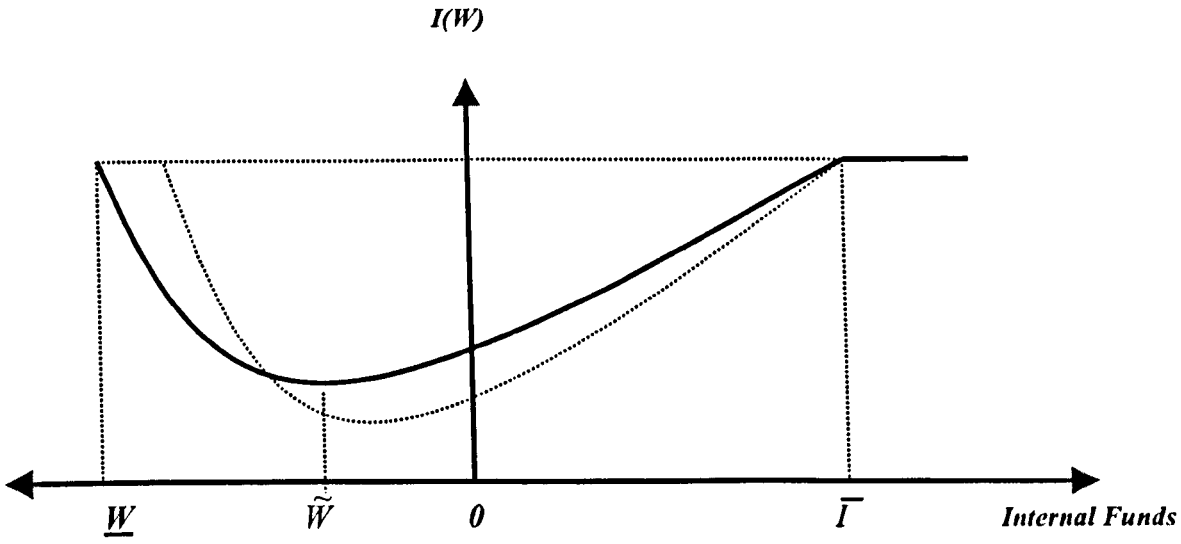


Figure 6.4: Investment and cash flow: allowing for negative internal funds

This study contributes to the debate on the cash flow hypothesis where it is argued that firms with relatively limited internal funds invest less in order to avoid the high cost incurred by borrowing external funds. The levels of internal funds and external finance premium determines the degree of financial constraints. Therefore, it is argued that more financially constrained firms are going to be more sensitive to variations in the available internal funds. Investment of unconstrained or less constrained firms should depend on their expected profits or investment opportunities. The criteria of splitting the sample are central to this hypothesis. If samples are split into groups by using measures that reflect the degree of asymmetric information, the firms with positive and moderate internal funds level are going to have a high investment-cash flow sensitivity compared to the group of firms that are subject to severe informational problems. On the contrary, if splitting measures are based on the internal funds or net worth, since the investment curve is U-shaped it is difficult to derive implications about the investment-cash flow sensitivity across groups. The investment of a group of firms whose internal funds are in the range

$(\tilde{W},0)$ is going to be less sensitive to a change in the internal funds than the other group whose internal funds are positive, and the slope of their investment function therefore is steeper.

The studies discussed above implicitly assume that there are no quantity restrictions on external finance; external finance is available with varying external finance premiums across firms and time. In real life, however, firms often face credit rationing: quantity restrictions may be as important as the external finance premium for the corporate sector activity. In fact, Greenwald, Siglitz and Weiss (1984) claim that the availability of external finance rather than its cost is what really limits corporate investment. Almeida and Campello (2002) develop a model in which the relationship between investment demand and cash flow is considered when firms face credit rationing. This study predicts that the investment-cash flow sensitivity decreases with the financial constraints so long as firms are not entirely unconstrained and when investment and external finance are endogenously related. As we have shown in Chapter Five, during a tight period of monetary policy the reduction in the mix, especially for more financially constrained firms, is more substantial. It is suspected that this variable conveys some information about potential credit rationing.

6.3. Inventory Investment, Employment and Cash Flow

6.3.1. Inventory Investment and Cash Flow: Theory

The traditional theories on inventory investment hardly support the observed empirical evidence and therefore new models of inventory investment have been adopted accordingly to explain the observed facts. During the last decade, it has been noticed that inventory investment has played a central role for business cycle fluctuations, especially in recessions (Blinder and Maccini, 1991). Recent empirical literature incorporates financial imperfections into inventory investment parallel to the case for fixed investment (See Gertler and Gilchrist, 1994; Kashyap, Lamont and Stein, 1994; Carpenter, Fazzari, and Petersen, 1994 and 1998 for the US corporate sector and Guariglia and Schiantarelli, 1998; Guariglia, 1999 and 2000; Small, 2000 for the UK corporate sector). This area of research on inventories goes beyond the standard theoretical model of inventory behaviour in order to uncover a consistent relation between theory and data. We will

summarize the theories on inventory investment and discuss recent theoretical work and empirical evidence on the role of monetary policy within the framework of the financial accelerator theory.

Macroeconomic and microeconomic views on inventories have conflicting implications. The former sees inventories as a destabilizing factor that causes cycles while the latter considers inventories as stabilizing for productive activity. One of the well-known theories on inventory investment is based on the production-smoothing model. This model has provided the microeconomic foundations for further research on the behaviour of inventories over the business cycle. The intuition behind this model is that firms adjust inventories to minimize their costs as demand conditions change. This model adopts the convex cost function as in the case of fixed investment models. Firms in this model tend to reduce the fluctuations in their production to minimize costs. Therefore, this model predicts lower volatility in production than in sales.

A firm is going to maximize the following long-term discounted values of profit.

$$\text{Max } E_0 \sum_{t=0}^{\infty} \beta^t (p_t S_t - C_t)$$

subject to

$$C_t = \gamma_1 Y_t + \gamma_2 Y_t^2 + \gamma_3 N_t^2$$

$$\Delta N = Y_t - S_t \text{ and } N \geq 0 \qquad (6.14)$$

where E_0, β_t, p_t S_t, C_t, Y_t, and N_t denote the expectation conditional on information at time zero, discount factor, commodity prices, sales, cost function, output and inventory stock at time period t, respectively. The cost function satisfies the following conditions $\gamma_1, \gamma_2 > 0$ and $\gamma_3 \geq 0$. The discount factor is equal to $(1/1+r)$ and it is between zero and one where r is the constant interest rate. In this model, prices and sales are determined exogenously. Therefore, the profit maximization problem defined above can be reformulated as a cost minimization problem subject to the same constraints.

$$Min\ E_0 \sum_{t=0}^{\infty} \beta^t C_t \qquad (6.15)$$

The model allows for a smaller variance for output relative to sales if the cost function is sufficiently convex and the discount factor is not too small. As demand conditions change, firms tend to adjust inventories to minimize costs and therefore they exhibit *production-smoothing* behaviour. In other words, firms will have an incentive to produce a surplus when sales are low and use this surplus to keep their output fluctuations at a moderate level when sales are high. On the other hand, if sales are stochastic, the response of firms to an unexpected increase in sales will be to reduce inventories and increase production. If the firm must make its production decision before observing sales shocks, then the increase in the sales is met completely by a decline in inventories. This inventory behaviour of firms is generally referred to the *buffer-stock* motive.

The production-smoothing model makes two predictions: the variance of sales exceeds the variance of output and inventory investment and output move in opposite directions. However, empirical findings for US industry level data do not confirm this theory: output is found to be more variable than sales and output and inventory investment move in the same direction (Blinder and Maccini, 1991; Blanchard, 1983). Although some other research suggests that these findings result from measurement errors and data aggregations, new theoretical approaches appear to resolve this discrepancy between theory and observed facts, as we shall explain.

Fitzgerald (1997) classifies the modified production-smoothing models that were developed in response to the empirical findings into three groups: adding cost shocks, adding target inventory level and adding non-convexities in technology. Adding time varying cost shocks to the cost function given above, explains theoretically why production could be more volatile than sales. Specifically, the new version of the cost function after adding the cost shock parameter, ψ_t, can be written as:

$$C_t = (\gamma_1 + \psi_t)Y_t + \gamma_2 Y_t^2 + \gamma_3 N_t^2 \qquad (6.16)$$

Monetary policy shocks are included in this framework because they affect the cost function of firms. In addition, since firms with different financial structure react differently to these shocks, analysis with a disaggregated sample would be more informative in this respect.

Adding a target inventory level to the cost function leads to the following cost function:

$$C_t = \gamma_1 Y_t + \gamma_2 Y_t^2 + \gamma_3 (N_t - \alpha S_t)^2, \text{ where } \alpha > 0 \qquad (6.17)$$

The target level of inventory investment that minimizes the cost function is assumed to be proportional to sales, αS_t. Additional inventory investment increases holding costs but it reduces the cost of stocking out or backlogging orders. An unexpected increase in the sales for a given level of production can be met by a reduction in inventories. In the next period, the firm can respond by increasing production to meet higher expected sales as well as to restore inventories to the targeted level. In this case, output and inventories are positively correlated and the volatility of production exceeds that of sales. These theoretical implications are derived within a framework of a *stockout avoidance* motive of inventory accumulation (Lovell, 1961; Kahn, 1987; Maccini and Zabel, 1996).

Most of empirical research in this field uses the inventory stock adjustment equation derived by Lovell (1961). Following Lovell (1961), it is assumed that the actual stock of inventories depends on the planned stock of inventories (N^P) and unanticipated changes in sales.

$$N_{it} = N_{it}^P + [E_{t-1} S_{it} - S_{it}] \qquad (6.18)$$

$E_{t-1}S_{it}$ is the expected value of sales at the beginning of period t. The targeted stock of inventories is modelled by using a standard stock adjustment equation.

$$N_{it}^P = \lambda N_{it}^* + (1-\lambda)[N_{i,t-1}] \qquad (6.19)$$

N_{it}^* represents the target stock for firm i at time t. $N_{i,t-1}$ is the actual stock of inventories at the beginning of period t. λ is the adjustment speed parameter of inventories. By combining equation (6.18) and equation (6.19), the inventory investment for firm i at period t can be formulated as follows,

$$\Delta N_{it} = \lambda (N_{it}^* - N_{i,t-1}) + [S_{it} - E_{t-1} S_{it}] \qquad (6.20)$$

Inventory investment depends on the difference between the targeted inventory stock and the actual stock of inventories at the beginning of period and the unexpected change in sales. The target level of inventories is modelled as a linear function of expected sales

$$N_{it}^{*} = \alpha + \beta E_{t-1} S_{it} \qquad (6.21)$$

where α is constant and β is the accelerator effect. Firms' targeted level of inventory increases with expected sales. Therefore, production adjusts to accumulate inventories and to meet increased sales so that the firm avoids stockout. On the other hand, the expected sales are modelled in the following form:

$$E_{t-1} S_{it} = \eta S_{i,t-1} + (1-\eta) S_{it} \qquad (6.22)$$

where η gives information about the expectation of firms. If it is negative, firms over-estimate sales when sales increase over time, and they underestimate sales when sales decrease. Therefore, in that case the business cycles will be amplified by firm expectations. Combining these equations into an inventory investment equation, we get inventory investment in terms of observed variables:

$$\Delta N_{it} = \lambda\alpha - \lambda N_{i,t-1} + [\lambda\beta(1-\eta) + \eta] S_{it} + (\lambda\beta + 1)\eta S_{i,t-1} \qquad (6.23)$$

This model has an empirically testable form and it can be extended by adding financial variables, firm specific fixed effects, time effects and others. Later in this section, we will extend our discussion by focusing on the empirical research that studies the inventory investment within the framework of financial imperfections.

The third modification in the production smoothing model is to adopt non-convexities in technology. This approach implies that as output increases the cost of production declines, i.e. decreasing marginal cost. The parameter, γ_2, would be negative in the cost function given in (6.14). Under this assumption, in some periods, firms tend to increase output to lower their costs, while in some other periods, low output leads to a

high marginal cost. Therefore, firms would minimize their costs by bunching production rather than smoothing it. The evidence on decreasing marginal costs is mixed.

An alternative approach to the production smoothing models family is the (*S,s*) model which focuses on the timing of deliveries rather than the timing of production. If inventories fall to the level of *s*, the firm reacts by increasing them to the optimal level, *S*. In the range of *(S,s),* the firm does not intend to change inventories. The model assumes that the cost of acquiring goods is made up of a fixed cost and a constant marginal cost. The marginal cost represents shipment costs, which are assumed to be a constant function of ordering and ordering also requires a fixed cost. High fixed costs imply a large optimal lot size, *S-s*, thus less frequent shipments. Even when sales are constant, the shipments will change between zero and optimal lot size, thus the volatility of production will be higher than that of sales. Even in the case of variable sales this result may hold.

Early studies including Blinder (1981) and Caplin (1985) provide evidence that (*S,s*) models explain the fact that the production is more volatile compared to sales. Caballero and Engel (1991) study the aggregate dynamics of (*S,s*) inventory behaviour in details. Recently, Fisher and Hornstein (1997) provide a general-equilibrium framework in which the aggregate implications of the (*S,s*) model. By using this framework, they find evidence supporting the empirical observations over the business cycles. More specifically, they claim that polices have little impact on the propagation and amplification of productivity shocks but they contribute substantially to the amplification of demand shocks.

6.3.2. Inventory Investment and Cash Flow: Empirical Research

Many empirical studies tend to combine the traditional inventory models and the asymmetric information framework that is consistent with the investment cash flow hypothesis. These studies have investigated the role of financial frictions for the inventory decisions of firms. They emphasize that inventory decisions play an important role in business cycle fluctuations. Firms respond to the variations in financial or macroeconomic conditions by changing inventory investment to overcome the difficulties in their cash management. Negative inventory investment provides the source of liquidity in case of difficulties faced in borrowing from external credit markets because the

adjustment cost of inventory investment (more specifically for work-in-process and raw material inventories) is lower than that of the other investment and spending items. The literature in this field supports that inventory investment of more constrained firms in the credit market is more sensitive to adverse monetary shocks.

Since public information is less available on small, young and financially weak firms, they are more likely to encounter greater informational asymmetries that lead to severe adverse selection and moral hazard problems. Such firms rely heavily on bank debt and rarely issue corporate bonds or commercial paper. Bank debt may be the only way of recovering the losses in liquidity and internal finance as a result of adverse external shocks. Evidence shows that the volume of short-term credits and of internal funds decline during the recessions. Short-term external funds are not generally sufficient to offset the reduction of internal funds and therefore the economic activities of firms including inventory investment are expected to fall during these periods. We summarize a number of empirical studies that incorporate financial constraints into inventory decisions of firms.

Kashyap, Lamont and Stein (1994) have been influential in establishing a link between monetary policy and inventory investment and first to provide micro-level evidence to support the bank-lending channel of monetary transmission. Their study uses the Federal Funds rate, the prime rate-commercial paper rate spread and real M2 as indicators of the monetary policy stance and gives a brief history of US monetary policy during the recessions 1974-1975 and 1981-1982. Inventory investment is explained by using the inventory-sales ratio, sales growth, the ratio of cash plus marketable securities to total asset as an indicator of liquidity, a dummy variable that indicates the access of firms to the bond market and industry dummies corresponding to two-digit SIC codes to control for the non-financial determinants of inventories. An interaction term controls how liquidity affects inventory investment differently for firms with bond rating and firms without it.[10] The evidence shows that the inventory investment of firms without access to the bond market is more liquidity constrained during tight monetary periods.

[10] We use a similar specification in our estimations in this study.

Gertler and Gilchrist (1994) analyse the response of small versus large manufacturing firms to monetary policy. The aim is to find evidence on the importance of the financial propagation mechanism for aggregate activity as a result of monetary shocks. Monetary policy affects firms directly and indirectly. In the first stage, a rise in interest rates weakens balance sheets by increasing short-term interest payment (reducing cash flow) and lowering the value of collateral assets. This constrains the borrowers' spending including inventory investment. The balance sheet of the firm will further deteriorate after an initial drop of firms' spending. In other words, financial factors will affect the real activities with a lag after a policy shift. Empirical evidence for the US economy shows that the decline in the credit volume and economic activity occurs within 6-9 months following a tight monetary policy.

Carpenter, Fazzari and Petersen (1994) investigate the impact of changes in internal finance or net worth on the firm's inventory investment behaviour given imperfections in capital markets. Their study employs quarterly panel data and the estimations include both fixed firm effects and industry time dummies, to control for non-financial shocks to technology or costs. The evidence shows that the variations in inventory investment can explain a significant proportion of the change in output during recessions. In fact, the fluctuation in internal finance is one of the main reasons for changes in inventory investment. Capital market imperfections may limit firms' access to external finance and lead to fluctuations in all type of investments including inventories. Inventories are considered as a buffer stock to smooth production. Firms can rearrange their inventories easily because of their lower adjustment cost relative to other investment forms, such as fixed investment or research and development. Financial firms will seek to equate the marginal returns on different investment.

The inventory investment literature has also different implications for disaggregated inventory investment, namely finished goods inventories, raw material inventories and work in progress. Carpenter *et al.* (1994) observe that raw materials and work-in-process inventories are much more volatile relative to finished goods inventories. A firm can readily disinvest a portion of its raw materials stock by consuming the inventory without making new orders, to mitigate the impact of financial constraints.

Carpenter, Fazzari and Petersen (1998) find new evidence supporting the importance of financing constraints for inventory investment. Financial variables like coverage ratio, cash stock and cash flow as measures of financing constraints, were extensively used in previous research. This study uses these variables and compares the statistical results for inventory investment equation by means of an identical high-frequency (quarterly) firm panel sample. The main finding of this study is that the results with cash flow are more successful in explaining inventories compared to those with cash stock, and coverage ratio across firm size, inventory cycles and manufacturing sectors in the US.

Small (2000) uses a panel of UK manufacturing firms to test whether the effect of cash flow on inventory investment reflect the presence of financially constrained firms. A number of criteria are employed to determine the financial condition of firms including the dividend payout ratio used by Bond and Meghir (1994). A panel of 527 firms for the period of 1977-1994 is used to carry out the estimation based on the *GMM* procedure proposed by Arellano and Bond (1991). The main finding is that there is no unique criterion for identifying financially constrained firms using financial information from company accounts. This study emphasizes that cash flow also affects the inventory investments of unconstrained firms based on different criteria such as firm size or coverage ratio. Small (2000) concludes that cash flow affects inventory investments of both constrained and unconstrained firms. This may be due to the exclusion of the key variables that reflect expectation about future demand. However, this does not explain why cash flow has a larger impact on the inventory investments of financially constrained firms than on unconstrained firms. Different criteria did not reduce the impact of cash flow on the inventory investments of financially unconstrained firms.

Guariglia and Schiantarelli (1998) use a linear quadratic model to test the role of firm heterogeneity and financial constraints on inventory investment in the UK manufacturing industries by using panel data techniques for the period 1980-1991. By adding new components into the cost function defined above, the Euler equation is derived to explain the inventory investment empirically. The evidence does not support the production-smoothing theory even when firms are partitioned into groups reflecting the degree of financial constraints.

Guariglia (2000) extends the linear quadratic model to create a direct theoretical link between inventory investment and capital market imperfections and to allow the testing of the effects of financial constraints on inventory investment. This study also estimates the Euler equation derived from the model and provides empirical evidence that financial factors have strong effects on the inventory investment of financially constrained firms by using a panel of UK manufacturing firm for the period 1980-91. Inventories are more sensitive to monetary shocks while they are less sensitive to real interest rates. This contradiction can be explained by the fact that in a world of imperfect capital markets, interest rates generally affect inventory investments indirectly through the credit channel. Tight monetary policy causes the financial performance of firms to deteriorate by decreasing cash flow (by increasing interest expense and reducing consumer expenditures), and collateralisable net worth (Bernanke and Gertler, 1995). In the case of imperfect capital markets, the premium on external funds increases as a result of a worsening of the internal fund stock and the increasing demand for external funds. A contractionary monetary policy affects the borrowing performance of firms, which have relatively weak balance sheet positions (more constrained) due to an increase in the interest rates in the credit market. Therefore, they reduce investments and general economic activities following an immediate reduction in the raw material inventory investments (Carpenter *et al.* 1994).

Guariglia (1999) uses Lovell's target adjustment model to test the inventories behaviour in UK manufacturing firms for the period 1968-1991. This paper employs different categories of inventories (total, raw material and work-in-process) and different criteria of splitting firms into more and less constrained by using coverage ratio, leverage ratio and the ratio of short-term debt to sales in order to test the impact of coverage ratio and cash flow on different categories of inventories. Cycle dummies are also used to capture the impact of tight monetary periods. The evidence supports the proposition that inventory investment of financially weak firms is more sensitive to financial variables, and the degree of sensitivity increases during recession or tight monetary policy periods.

6.3.3. Employment and Financial Constraints

The empirical literature that studies the role of financial constraints for economic activity is mainly concentrated on the area of fixed investment and inventory accumulation. A

limited number of studies pay attention to the impact of financial constraints on the employment behaviour of corporate firms. It is generally believed that the cost of adjustment for employment is higher than that of inventory or fixed investment over the business cycles. Hiring, training and firing employees involves substantial cost for firms and the existence of such costs especially for skilled employees make firms dampen fluctuations in the employment compared to cyclical fluctuations in their output or investment. This behaviour pattern is commonly referred to as *labour hoarding.* However, during the recessionary periods, financially more constrained, small or highly indebted firms are more likely to engage in less labour hoarding behaviour, that is, they are more likely to adjust the employment in response to temporary shocks in order to conserve their working capital. Credit restrictions or an increase in borrowing costs reduce employment and all kinds of investment. Firms in financial difficulties reduce the number of employees in order to avoid bankruptcy.

One of the earlier empirical studies, which tests the impact of financial constraints on employment, is Cantor (1990) that employs US data. It is shown that highly indebted firms experience greater volatility in their investment and employment. Nickell and Wadhwani (1991) test the determinants of employment using UK industry firm level data. Among other variables, it is found that financial variables like the debt-equity ratio, and market capitalization explain a significant part of employment fluctuations. Sharp (1994) finds evidence that the employment growth of highly indebted and small firms, *ceteris paribus,* is more sensitive to demand and financial conditions over the business cycles. Recently, Nickell and Nicolitas (1999) use UK firm level data and find that the inverse coverage rate, i.e. the ratio of interest payments to cash flow, has a large negative impact on employment after controlling for wages and supply and demand conditions.

We adopt the empirical framework provided by Nickell and Nicolitas (1999) to test the determinants of employment growth by considering firms with various financial characteristics. Nickell and Nicolitas (1999) suggest an empirical framework that controls for financial variables reflecting net worth of firms in addition to demand and labour cost factors in order to explain employment. We present this framework below.

Consider a firm, i, with a production function;

$$Y_i=A_iF(N_i,K_i) \qquad (6.24)$$

where Y, N, K and A show output, employment, capital, and efficiency, respectively. Profit maximization in an imperfect competitive environment implies the following first order condition for employment (ignoring financial variables);

$$A_iF_N(N_i,K_i)=W_i(1+t)/P_i\kappa_i \qquad (6.25)$$

where F_N, W_i, t, P_i and κ_i indicate the derivative of the production function with respect to employment, wages that are determined prior to employment, payroll tax rate, output price and one minus the inverse demand elasticity that is expected to be influenced by current and future expected demand and the competitive position of the firm. The following expression is obtained if one takes the logarithm of the expression in *(6.25)*;

$$n_{it}=\alpha_i+\lambda_t+ \alpha_1k_{it}+ \alpha_2w_{it}+ \alpha_3d_{it} \qquad (6.26)$$

where α_i and λ_t reflects firm specific, and time effects, respectively. These terms capture efficiency, productivity shocks and other unobservable effects. n, k, and w are logarithms of employment, capital and real wages, and d captures demand-competition effects associated with κ. One may incorporate the lags of employment through the standard quadratic adjustment cost model[11]. The following specification is obtained after adding financial variables controlling for financing constraints in the employment equation.

$$n_{it}= \beta n_{i,t-1}+ \alpha_i+\lambda_t+ \alpha_1k_{it}+ \alpha_2w_{it}+ \alpha_3d_{it}+ \alpha_4f_{it} + \varepsilon_{it} \qquad (6.27)$$

where $n_{i,t-1}$, f_{it} and ε_{it} represent lag employment, variables that reflects firms' financial positions and an idiosyncratic disturbance term. We use a version of this empirical framework for our econometric estimations in this chapter.

[11] For details of derivations, see Nickell and Nicolitas (1999).

6.4. Methodology, Empirical Model, and Data

6.4.1. Financial Constraints and Criteria for Splitting Data

The empirical literature that investigates the link between real activity of firms and their financial positions categorises firms as more constrained or less constrained. This taxonomy, also employed in Chapter Five, allows us to observe the reactions of firm groups in the tails of the distribution to external shocks. This eases the identification of the credit channel as we focus on more diversified groups. In fact, firms between the lower and the upper tails are expected to exhibit mixed characteristics therefore it may be difficult to identify the credit channel using them. As explained above, by splitting firms into groups it is intended to create relatively homogeneous firm categories that are subject to more or less the same degree of informational and incentive problems and have similar financial structure in terms of net worth. By this method, we capture the impact of asymmetric information and agency problems and avoid the problems associated with aggregation. We already provide information on widely used grouping criteria in the literature in Chapter Five, thus in the subsequent paragraphs we only discuss some additional grouping criteria that we employ in this chapter. The criteria used in this study are based on size, credit rating, age, indebtedness and dividend payout ratio.

It is likely that some firms switch between the more constrained and the less constrained status over time depending upon shifts in investment opportunities and availability of internal and external financing[12]. Therefore, as in Chapter Five, firms are allowed to switch across firm type over time. This procedure may potentially lead to an endogeneity problem originated from correlation between grouping criteria and variables used in the regressions. This endogeneity problem is likely to be controlled by using firm type interaction terms as instrumental variables in the econometric estimations. Alternatively, we classify firms based on the information of in the beginning of the period; we take the average value of the variables that are used as splitting criteria for the year 1991. In fact, estimation results obtained from both classification methods do not differ significantly but we report only results for the former classification.

[12] Fazzari *et.al* (1988) adopt a priory groupings while Kasplan and Zingales (1997) examine firms in greater details in terms of categorising them as constrained or unconstrained and they reach opposite results about the cash flow investment sensitivity.

Size is more often employed as a criterion for splitting firms into the less constrained and the more constrained groups. The rational behind this criterion is that small firms are generally poor in terms of collateral, younger, less known, thus are to be subject to capital market imperfections induced by information asymmetries (Gertler and Gilchrist, 1994, Carpenter *et al.*, 1994 and 1995). The size may be related with age, that is, smaller firms are less likely to have good track records that help lenders to distinguish between good from bad ones. In addition, lack of collateral assets increases the risk of bankruptcy among smaller firms because they hardly have access to external finance during the tight periods. Therefore, their activities including inventory, fixed investment, and employment are expected to be more sensitive to the availability of external finance especially during tight periods. On the other hand, smaller firms are more concentrated in terms of share ownership, and this mitigates the agency problem between managers and outside investors

The dividend is a widely used criterion by the investment-cash flow literature to differentiate between constrained and unconstrained firms (Fazzari, Hubbard, Petersen, 1988; Whited, 1992; Bond and Meghir, 1994, and others). It is generally believed that matured firms have higher dividend payout ratios payout ratio (the ratio of dividend payment to total assets in our case), while financially constrained firms tend to have lower dividend payout ratios because they are highly dependent on internal sources for additional investment and for repaying their debt. However, some firms may pay high dividend and possibly borrow at the same time for signalling purposes. In this chapter, firms are categorised according to their dividend payout ratios. Those firms that are in the upper quartile of the dividend payout ratios distribution are named the *high dividend* firm group, while those in the lowest quartile of the distribution are grouped under the *low* dividend firm group.

Firms may be split also according to their association with business groups and banks. Firms that have a close link with large financial institutions, or large mature firms having access to external finance, are less likely to be subject to financial constraints. The link between firms and financial institutions may be manifested in terms of ownership as tested by Hoshi, Kashyap and Scharfstein (1991) for the Japanese industries, or in terms of a long track record that is related to the banking relationship or trade credit. Our data allow us to split firms according to whether they have a large number of subsidiaries or

not and whether they are a part of holding companies or not. If the firm has large number of subsidiaries and connected holdings, it is expected that such firms are less financially constrained because they can receive and extend trade credit to other subsidiaries of the group. We do not provide estimation results based on this taxonomy here as we have enough splitting criteria.

Contrary to the static panel data framework employed in the previous chapter in which we identified tight and loose regime periods in our sample, the dynamic panel model that we use in this chapter leads to loss of all observations for the tight period. Therefore, we are not able to test our hypothesis for the two polar monetary policy regimes, namely the tight period, 1990-1992 and the loose period, 1993-1999. In fact, we are going to analyse mainly the loose period as we effectively use the data for the 1994-1999 period in our dynamic model estimations. We capture the impact of monetary policy shocks by including the cumulative base rate among explanatory variables. The impact of the monetary policy stance on financial and real activity is expected to be muted in the loose period compared to the tight period and therefore empirical findings may potentially be less supportive for the credit channel that works more often when firms are subject to serious financial constraints.

6.4.2. Estimations Techniques

6.4.2.1. Introductory Remarks

Selecting an appropriate econometric methodology to estimate an empirical model depends very much upon the nature of the sample as well as the theory behind the hypothesis to be tested. Our sample is an unbalanced panels, it contains missing observations over time. The unbalanced panel data consist of a set of individuals (firms in this study) with various number of time periods. Constructing a balanced sample from the existing unbalanced sample would lead to a substantial loss of information, therefore we tend to use an unbalanced sample in our econometric estimations. In fact, it is generally claimed that the use of the unbalanced panel may abbreviate the potential biases stemmed from self-selection. The econometric estimation methods of unbalanced samples are similar to those of balanced samples provided that there is sufficient number of continuing time periods. An essential assumption here is that the observations in the

initial cross-section are distributed independently and that subsequent additions and deletions of new panels are random (see Hsiao, 1986).

For long time periods, and a small number of individuals, it would be possible to use simultaneous equations modelling while for short time periods, with a large number of firms, and unbalanced panels, the panel data methods are the most suitable estimation procedures. The panel data methods allow us to analyze dynamic relationships (in autoregressive form) in a single equation by using the cross-section and the time dimensions of the data. In other words, these methods are especially useful in the sense that the importance of firm heterogeneity over the business cycles can be combined into the analysis and the aggregation biases can be removed by using micro data (Nickell, 1981).

Most economic behaviours exhibit a dynamic pattern as in the case of investment. Decisions about current investment are more likely to affect investment in the future periods. This type of behaviour can easily be estimated in the framework of dynamic panel models. The static panel data models produce biased and inconsistent estimates for short time periods because of dynamic factors (lagged dependent variables) and the existence of endogenous or predetermined explanatory variables. In other words, the correlation between the lagged dependent variables and the disturbance terms leads to inconsistent estimates in the fixed effects or random effects models (Nickell, 1981). On the contrary, the dynamic panel framework considers endogenous or predetermined regressors in addition to strictly exogenous explanatory variables in the estimation. The diagnostic complications originated from endogenous or predetermined regressors are considered in this framework and therefore more efficient and consistent estimates are obtained. The dynamic panel method captures the feedback from current or past shocks to current values of variables by using suitable instruments for the endogenous variables.

A dynamic panel data model can be presented in the following form:

$$y_{it} = \sum_{k=1}^{p} \alpha_k y_{i,t-k} + x_{it}\beta_1 + w_{it}\beta_2 + \lambda_t + \eta_i + v_{it}; \quad t=q+1,...,T_i; \quad i=1,...,N, \qquad (6.28)$$

where η_i, λ_t and v_{it} are individual specific effects, time specific effects, and disturbance terms, respectively. y_{it} is the dependent variable and the first term in the right hand side

shows p lags of the dependent variables. x_{it} are strictly exogenous explanatory variables while w_{it} are endogenous or predetermined explanatory variables other than the lags of the dependent variable. These variables can be in the form of levels and lags. q is the maximum lag length in the model. The number of time periods available for the i^{th} individual (T_i) is assumed to be small relative to the number of individuals (N).

The model is identified according to restrictions on the serial correlation properties of the disturbance terms and on the properties of explanatory variables. If some explanatory variables are endogenous or predetermined, shocks to the serially correlated autoregressive disturbance terms impose some restrictions on the regression coefficients, α, β. To avoid this problem only serially uncorrelated or moving average disturbances are allowed. The disturbance terms are assumed to be distributed independently across individuals with zero mean but some forms of heteroscedasticity across individuals and time are allowed. The explanatory variables which are made up of strictly exogenous, endogenous, or predetermined variables do not have to be correlated with the individual effects but the lagged dependent variables are expected to be correlated with them. *The Arellano-Bond Generalized Method of Moments (GMM)* procedure, which is a widely used estimation method, produces consistent and more efficient estimates for the dynamic panels and is described below.

6.4.2.2. The Arellano-Bond GMM Procedure

The ordinary least square *(OLS)* procedure considers the individual effects as omitted variables that are part of the disturbance term and therefore the *OLS* estimates of the model in (*6.28*) are not consistent as the lags of dependent variable are correlated with the disturbance term ($\eta_i + v_{it}$). This correlation does not disappear as the number of observations increases across time and individuals. The Within Groups estimates remove this inconsistency by eliminating the individual specific effects through a transformation that use deviations of the variables from their individual means over time in the regressions. The *OLS* estimation of the transformed model (the model with mean deviated variables) then produces asymptotically consistent coefficients if the number of time period is large enough. However, if the time period is short, the transformed lagged dependent variable (lagged dependent variable minus its individual mean over time) is

likely to be correlated with the transformed disturbance terms as the means in the transformed variables capture the feedback[13].

By using the first difference transformation, Anderson and Hsiao (1981) suggest using two or more lags of the dependent variable as instruments that are both correlated with the differenced lag dependent variable, $\Delta y_{i,t-1}$, and orthogonal to the difference disturbance term, Δv_{it}, to eliminate this endogoneity. A two-step least square procedure produces consistent estimates for this model but it does not produce asymptotically efficient estimates as this procedure does not consider all possible instruments for the endogenous explanatory variables. On the contrary, the *GMM* developed by Hansen (1982) provides consistent and asymptotically efficient estimates. We can rewrite (*6.28*) for each individual *i* across time.

$$y_i = X_i\delta + \iota_i\eta_i + \varepsilon_i \qquad (6.29)$$

where X_i shows all explanatory variables including lags of the dependent variable and time effects, δ represents the coefficients of the explanatory variables, and ι_i is unit vector. y_i, X_i, and ε_i are T_i-p vectors of respective variables. This implies that there are T_i-q equations for each individual. The first difference transformation of this model is shown below[14].

$$y_i^* = X_i^*\delta + \varepsilon_i^* \qquad (6.30)$$

where $y_i^*, X_i^* and\ \varepsilon_i^*$ are the vectors of first differences of the respective variables[15].

The most crucial stage in the *GMM* procedure is to construct the instrumental variable matrix, Z_i, which is made up of suitable lags of the dependent variable, endogenous (or predetermined) variables and the first difference of exogenous

[13] Bond (2002) highlights that the *OLS* estimate of the lagged dependent is upward biased while the within group estimation is downward biased. The consistent and the most efficient estimate is therefore likely to fall between these two estimates.

[14] Arellano and Bover (1995) suggest a number of methods for removing individual effects. The most common methods are first differencing and orthogonal deviations that express each observation as the deviation from the average of future observations in the sample for the same individual, and weighting each deviation to standardise the variance.

[15] $y_{it}^*=y_{it}-y_{i,t-1}$, $X_{it}^*=X_{it}-X_{i,t-1}$ and , $\varepsilon_{it}^*=\varepsilon_{it}-\varepsilon_{i,t-1}$

variables[16]. The following *moment conditions* are exploited for selecting suitable instruments[17].

$$E[Z_i'\varepsilon_i^*] = 0 \quad \text{for i= 1,2,...,N} \tag{6.31}$$

Instruments are independent from ε_i^* by which the endogeneity problem is handled. Assume that we use two lags of the dependent variable, in addition to other endogenous (or predetermined) and exogenous variables as explanatory variables in the model *(6.28)* for the balanced sample case. The instrumental variable matrix is shown as follows;

$$Z_i = \begin{bmatrix} y_{i1} & y_{i2} & w_{i1} & w_{i2} & 0 & 0 & 0 & 0 & 0 & 0 & . & 0 & . & 0 & 0 & . & 0 & \Delta x_{i4} \\ 0 & 0 & 0 & 0 & y_{i1} & y_{i2} & y_{i3} & w_{i1} & w_{i2} & w_{i3} & . & 0 & . & 0 & 0 & . & 0 & \Delta x_{i5} \\ . & . & . & . & . & . & . & . & . & . & . & . & . & . & . & . & & \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & . & y_{i1} & . & y_{iT-2} & w_{i1} & . & w_{iT-2} & \Delta x_{iT} \end{bmatrix}$$

The Z matrix has T_i-3 rows implying that the number of time periods for each individual should be higher than the corresponding maximum lag in the model; the number of time periods should be at least four in this particular case. The variables in the first row are the instruments for the equation explaining y_{i4}^* while those in the last raw are the instruments for y_{iT}^*. The number of columns depends on the number of explanatory variables, the characteristics of these variables, for example, whether they are endogenous or exogenous and the number of lagged dependent variable used as explanatory variables[18]. The matrix for this particular case may include two and earlier lags of the dependent variables, two and earlier lags of endogenous explanatory variables, the first difference of all exogenous variables as instruments under the assumption that the moment conditions in *(6.31)* are satisfied[19].

The difference *GMM* procedure provides efficient estimates for a well specified model by using suitably lagged dependent variable and endogenous variables as

[16] A variable, x, is predetermined if $E(x_{it}v_{is})=0$ for $s \geq t$ and $E(x_{it}v_{it}) \neq 0$ otherwise, and $E(x_{it}\eta_t) \neq 0$.

[17] Instrument selection process is not only a statistical process but also requires some economic intuition.

[18] If the sample is unbalanced then the missing observations are handled by dropping the rows for which there are no data and by replacing the column with zero where the missing observation would be required.

[19] Bond (2002) suggests that too many instruments may result in over-fitting biases especially in small samples. A restricted set of instruments that is obtained by deleting columns for the least informative instruments, generally very early lags of instruments, produce more coherent estimates for long time series. For the models that include endogenous variables, over-fitting problem leads to biased estimates.

instruments. The asymptotically efficient *GMM* estimates minimize the following term, namely the Sargan statistic;

$$J_N = \left(\frac{1}{N}\sum_{i=1}^{N} \varepsilon_i^{*'} Z_i\right) W_N \left(\frac{1}{N}\sum_{i=1}^{N} Z_i' \varepsilon_i^{*}\right) \qquad (6.32)$$

where W_N is the weight matrix. Various linear *GMM* estimators are calculated based on how the weight matrix is constructed, i.e. the one-step and the two-step estimates. A general form of estimated coefficients is

$$\hat{\delta} = \left[\left(\sum_i^N X_i^{*'} Z_i\right) W_N \left(\sum_i^N Z_i' X_i^{*}\right)\right]^{-1} \left(\sum_i^N X_i^{*'} Z_i\right) W_N \left(\sum_i^N Z_i' y_i^{*}\right) \qquad (6.33)$$

where $\hat{W}_N = \left[\left(\sum_i^N Z_i' H_i Z_i\right)\right]^{-1}$ and $H_i = E\left[\varepsilon_i^{*} \varepsilon_i^{*'}\right]$

If the number of columns of Z equals that of X^* the weight matrix becomes irrelevant thus,

$$\hat{\delta} = \left[\left(\sum_i^N Z_i' X_i^{*}\right)\right]^{-1} \left(\sum_i^N Z_i' y_i^{*}\right)$$

The Within Groups estimation results are obtained when the number of columns in Z equals that of X^* and the variables are transformed by using deviations from individual means. The one-step *GMM* procedure estimates the coefficients by using some known matrix for H_{1i}[20], while the two-step *GMM* procedure uses estimates of the transformed error term, e_i^*, to construct the weight matrix, H_{2i}. H_{1i} and H_{2i} can be expressed as follow;

$$H_{1i} = \begin{bmatrix} 2 & -1 & 0 & . & . & 0 & 0 \\ -1 & 2 & -1 & . & . & 0 & 0 \\ . & . & . & . & . & . & . \\ 0 & 0 & 0 & . & . & -1 & 2 \end{bmatrix} \text{ and } H_{2i} = E(e_i^{*} e_i^{*'}) \qquad (6.34)$$

If the disturbance terms are heteroscedastic, a two-step estimator is more efficient however as Arellano Bond (1991) suggest the standard errors for the two-step estimators can be poor guide for hypothesis testing for typical sample sizes as the standard errors are downward biased. In this case, inferences based on the one-step estimates is more useful

[20] H_{1i} becomes an identity matrix if the transformation is based on the orthogonal deviations.

while heteroscedasticity-consistent two-step estimates are potentially more suitable for deciding on the specification of the model.

As we explained above the first-difference transformation suggested by Anderson and Hsiao (1981) produces consistent estimators with instrumental variable estimations while the methodology suggested by Arellano and Bond (1991) produces consistent as well as more efficient estimators by using all available moment conditions in the first difference transformation. Arellano and Bover (1995) employ additional instrumental variables for the level equations to provide further efficiency gains for the estimates. The levels of the explanatory variables may be correlated with individual effects while their suitably lagged first differences are not correlated with them. In this case, lagged first differences of explanatory variables and the dependent variable that are uncorrelated with the individual effects can be used as instruments for the level equations.

Blundell and Bond (1998) combine moment conditions relating to the equations in the first difference with moment conditions relating to the equations in levels to obtain more efficient *GMM* estimators. This extended *GMM* approach is called the *system GMM*. In this model, earlier lags of first difference of variables are not used as instruments in the level equations as they are correlated with the lagged level instruments in the difference equation. More specifically, if the simple *AR(1)* model is mean-stationary, then first differences, Δy_{it}, will be uncorrelated with η_i , and this implies that $\Delta y_{i,t-1}$ can be used as instruments in the level equations. Again, in the system of equations, the one-step estimators are more useful for inferences compared to the two-step estimators but for the model specification the latter is preferred[21].

The specification of econometric model can be verified mainly on the basis of two tests, i.e. the test of serial autocorrelation and the Sargan tests of overidentifying restrictions. The assumption of no serial correlation in error term, e_i^* is essential for the consistency of estimates in the model using the lags of the dependent variable as instruments. Two statistics can be computed to test for the first and second order correlation and are denoted by m_1 and m_2, respectively. We may expect a negative first

[21] *STATA 7.0* performs only the difference *GMM* while DPD for Ox under PCGive performs both the system and difference procedures. We use PCGive in estimating our models.

order serial correlation (m_1) and no evidence of second order serial correlation (m_2) in the first difference error terms for serially uncorrelated error terms. That is, Δe_i^* is negatively correlated with $\Delta e_{i,t-1}^*$ and it is uncorrelated with $\Delta e_{i,t-2}^*$. Therefore, in case of sufficiently small value of the m_2 statistic, the hypothesis of having serial correlation is rejected.

The *GMM* model uses a larger number of instrumental variables than the *IV-2SLS* procedure does. The Sargan statistic given in *(6.32)* is widely used to test for the validity of overidentifing restrictions in the *GMM* procedure. It is asymptotically distributed as chi-square with as many degrees of freedom as overidentifying restrictions, under the null hypothesis of the validity of the instruments. The statistic takes different values based on the weights assigned in the one-step or the two-step estimates. The Sargan statistic calculated from the two-step procedure, using H_{2i} in constructing weight matrix, is suggested for selecting instruments and specifying the model (Arallano and Bond, 1991) as it is heteroscedasticity-consistent under the two-step *GMM* procedure.

The *system GMM* provides additional instrumental variables thus it leads to more efficient estimates. The instruments for the difference equations are likely to be weak when the variables in the regression have near unit root properties. Weak instruments may be subject to biases in the finite samples. If the variables are more likely to be non-stationary, the system *GMM* procedure produces the most efficient estimates. Bond (2002) shows that the system *GMM* gives smaller finite sample bias and greater precision than the difference *GMM* when persistent series are modelled in an autoregressive form. Therefore, time series properties of individual series should be considered in dynamic panel data models[22].

6.4.3. The Empirical Models

In this section, we study empirical models for both inventory investment and employment growth. The empirical models used here are based on the theoretical framework derived above according to which firm activities depend very much on the financial position of firms under the assumption of imperfect capital markets. We use two different categories

[22] We also test our models by using the system GMM procedure. Findings from this procedure are similar to those with the difference *GMM*, therefore we only report the results of the latter procedure.

of variables that represent financial conditions of the firms. In the first place, we potentially use variables aimed at capturing the net worth of firms such as cash flow (net income plus capital stock depreciation). This variable is expected to capture information on both the degree of firms' financial constraint and their profitability. In addition, we use the financial mix as an explanatory variable, as suggested by Kashyap *et al.* (1993), alongside cash flow as well as other variables representing demand and supply conditions to identify the model. Having access to bank finance is particularly important for those firms that have limited internal funds and limited access to cheap market funds because of their poor collateral structure. By using US aggregate data, Kashyap *et al.* (1993) find that the mix explains inventories well, as firms get access to bank finance they will be less constrained and thus, *ceteris paribus*, they will be able to continue investing.

6.4.3.1. Inventory Investment Model

We adopt the linear quadratic framework discussed above for specifying the inventory investment model. The stock avoidance motive has been often introduced in this setup by the empirical literature in the framework of the target adjustment model proposed by Lovell (1961). More specifically, firms decide about the amount of inventories that minimizes their holding costs and the risk of stocking out or backlogging orders. This implies that firms tend to associate the amount of inventories with sales to obtain optimum inventory target. A deviation from the targeted inventory-sales ratio affects the cost and thus the inventory behaviour of firms. The stock avoidance motive is captured by using this ratio as an explanatory variable in the inventory model. We use sales growth instead of sales level in the regressions to reflect the expected sales as in Kashyap *et al.* (1994). We also use a lag of the inventory-sales ratio to capture long run dynamics in the target adjustment model.

We also introduce variables that reflect the cost and the financial positions of firms to obtain a testable version of inventory the investment model given in (6.23). This empirical literature considers cost shocks stemmed from changes in monetary policy or in the costs of labour, raw materials and capital (Carpenter *et al.*, 1994). It is expected that firm specific and time effects capture these unobservable factors to some extent. We also use the cumulative base rate to capture the monetary policy shocks that have direct and indirect impact on inventory investment through its impact on the cash positions of firms.

The variables that represent the cash positions of firms are often used to explain inventory investment in the empirical literature discussed above. For example, Kashyap *et al.* (1994) uses a liquidity indicator by dividing cash and marketable securities to total assets while Guariglia (1999) and Gertler and Gilchrist (1994) use the interest coverage ratio. Following Kashyap *et al.* (1993), we use the mix as a financial variable to capture the uniqueness of bank finance. We use binary variables for size, dividend, risk, age, indebtedness criteria interacted with these financial variables as explanatory variables. Using interaction terms allows us to identify the reaction of inventories to the different firms groups' financial conditions, and to use a larger sample size. In short, we adopt a specification that considers cost shocks, and the financial positions of firms across firm types in the framework of the target adjustment model described above[23],

$$GINV_{it} = \sum_{k=1}^{2} \alpha_k GINV_{i,t-k} + \sum_{j=1}^{2} \beta_j GS_{i,t-j} + \beta_3 MIX_{it} + \beta_4 (MIX_{it} * TYPE_{it}^j) + \beta_5 CF_{i,t-1} + \beta_6 (CF_{i,t-1} * TYPE_{it}^j) + \beta_7 TYPE_{it}^j + \beta_8 BRATE_t + \beta_9 RINVS_{i,t-1} + \lambda_t + \eta_i + \nu_{it} \quad (6.35)$$

where j denotes various firm groups, that is $TYPE^j$ consists of twelve different binary variables ($j = 1 \ldots 12$) reflecting twelve different firm characteristics i.e. small/large, risky/secure, young/old, highly indebted/low indebted, low dividend/high dividend, respectively[24].

$$TYPE^j = 1 \quad j = 1 \ldots 12 \quad \text{and} \quad TYPE^j = 0 \ \text{otherwise}$$

We use two lags of the dependent variables to consider the dynamic nature of inventories. Sales growth, the mix, cash flow, the ratio of inventory investment to sales and interaction terms are treated as endogenous (or predetermined) variables, while only the cumulative base rate is treated as an exogenous variable. The mix is assumed to be predetermined in the sense that an innovation to the disturbance terms and thus inventories is expected to affect the mix. Inventories and short-term debt are determined simultaneously as it is likely that inventories are financed by short-term debt.

[23] We obtain this specification from a general distributed lag model, dropping insignificant regressors to obtain a parsimonious econometric model.

[24] We intend to use the firm type dummy among the explanatory variables but the estimated coefficients are not generally significant therefore we do not report the estimation results where *TYPE* is used as an explanatory variable

$GINV_{it}$ denotes the change in the logarithm of real inventory investment. Fixed investment clearly has a dynamic nature because it may take more than one period to complete the project thus investment in the previous period affects the investment in the present or future periods. This fact is valid also for inventory investment over the business cycle but the change in inventory investment is considered to be more volatile and frequent because of low adjustment costs. Therefore, it is more likely that we loose some information by using less frequent data, namely annual data.

$RINVS_{it-1}$ is the ratio of inventory investment to sales. As the target adjustment model proposed by Lovell (1961) implies, firms may have an implicit target for the inventory-sales ratio in their mind[25]. If the inventory-sales ratio increases in the present period (if inventories divert from the targeted level) firms would adjust their inventories to attain the targeted level in the next period. Therefore, the expected sign for *RINVS* is negative; an increase in this ratio is a diversion from the inventory target thus inventories come down to keep this ratio at the targeted level in the next period.

We use the change in the logarithm of real sales and its lag, GS_{it}, among the explanatory variables for inventory investment growth. This variable represents the expected sales and captures demand conditions according to the accelerator model framework. Therefore, inventories increase with expected sales that is consistent with the target adjustment model.

We use the cumulative base rate, $BRATE_t$, to capture the impact of the monetary policy stance on inventory investment. This variable is considered as a cost shock that affects inventory decisions. At the high level of interest rates, firms tend to reduce their inventory investment to minimize their cost therefore we expect a negative coefficient for this variable.

The logarithm of real cash flow, $CF_{i,t-1}$, and the ratio of short-term debt to current liabilities, MIX_{it}, are the variables that capture the financial conditions that affect the inventory investment through imperfect capital markets. Cash flow is used in the

[25] The same ratio is also used by Kashyap *et al.* (1994) to explain inventory investment for the US manufacturing industry.

estimations to represent the net worth of firms. The mix is not only a complementary variable to cash flow that captures the financial position of firms, but also it provides information on the uniqueness of bank finance. The findings here should be evaluated together with the evidence found in the previous chapter according to which financially constrained firms are less likely to get bank loans during the tight period. That is, the inventory investment of financially constrained firms is expected to be more sensitive to the mix in the period of the tight policy. However, during the loose period of 1993-1999, firms that are treated as financially constrained are more likely to have access to bank loans compared to the tight period, therefore the sensitivity of inventories to the mix is hardly identified across firm types whether they are constrained or not.

We follow a similar methodology to that we applied in the previous chapter where we use the interaction terms to measure the reaction of various firm groups to the monetary policy stance across monetary policy regime periods. We estimate the model for each firm type reflecting polar tails of firm distributions according to various criteria explained above. Contrary to the model employed in the previous chapter; we are not able to identify the reaction of inventory investment across monetary policy regime periods because the estimation method leads to missing observations belonging to the tight monetary policy period, 1990-1992. However, we can still identify the reaction of inventory investment across firm groups. This time the interaction terms enable us to test only the reaction of inventories to a change in the financial position and net worth of firms across firm characteristics. Therefore, the interaction terms, $FPV*TYPE^{j}$, have two components: variables that reflect the financial positions of firms, FPV (MIX_{it} and $CF_{i,t-1}$) and firm characteristics dummies.

6.4.3.2. Employment Model

We also follow the same empirical methodology for modelling employment, i.e. using financial variables and their interaction terms with firm type dummies among explanatory variables to estimate employment growth. We adopt a similar empirical framework as in Nickell and Nicolitas (1999) for employment shown in (6.27). The main differences between our econometric specification and that of Nickell and Nicolitas (1999) are that we use the change in the logarithms of basic variables instead of their levels and various lags of some of the explanatory variables in the econometric

estimations. This specification allows us to compare the econometric findings from the employment model with those from the inventory investment model as the dependent variables in both models are in the form of change in log levels (growth rates). We estimate the following employment model across various firm types by using interaction terms for the mix and cash flow as in the case of the inventory model.

$$GEMP_{it}=\sum_{k=1}^{2}\alpha_k GEMP_{i,t-k}+\sum_{j=1}^{2}\beta_j GS_{i,t-j}+\beta_3 MIX_{it}+\beta_4(MIX_{it}*TYPE_{it}^{F})+\beta_5 CF_{i,t-1}+$$
$$\beta_6(CF_{i,t-1}*TYPE_{it}^{F})+\beta_7 TYPE_{it}^{F}+\beta_8 BRATE_t+\beta_9 GRTA_{it}+\sum_{m=10}^{11}\beta_j GW_{i,t-j}+\lambda_t+\eta_i+\nu_{it} \qquad (6.36)$$

where $GEMP_{it}$, $GRTA_{it}$ and GW_{it} show the change in the logarithm of employment, real tangible assets and real wages, respectively.

Again, GS_{it} captures the expected demand for the firm's product and its coefficient is expected to be positive. MIX_{it} and $CF_{i,t-1}$, and their interaction terms capture the importance of bank finance and net worth position of firms for various firm types. The coefficients for MIX_{it} and $CF_{i,t-1}$ are expected to be positive while those for the interaction terms vary across firm types. $BRATE_t$ captures the exogenous monetary shocks. Employment growth is expected to decline with $BRATE_t$ as restrictive monetary policy increases the cost of external borrowing substantially through the interest rate and the credit channels. We also expect that employment declines with real wage growth (GW_{it}) but increases with capital growth ($GRTA_{it}$). As in the case of the inventory investment model, we treat all explanatory variables except $BRATE_t$ as endogenous or predetermined variables[26].

6.4.4. Data and Descriptive Analysis

In this study, we use the FAME data set that covers detailed information about the UK manufacturing companies for the period of 1990-1999. The sample used in this analysis is already discussed in detail in the previous two chapters. We are not going to repeat the information given in these chapters, instead a basic descriptive analysis is carried out in this section. We cannot differentiate between types of inventories such as raw material,

[26] As in the case of the inventory investment model, we use *TYPE* as a separate explanatory variable for each firm type in the econometric estimations. Since its estimated coefficients are not significant we do not use this variable among explanatory variables.

work-in-progress and final goods; therefore, we use overall inventories in our analysis. In this section, some details of data are reported in three tables. In Table 6.1, we provide the output-sales variance ratios for firms groups *over time* for a preliminary analysis of the production smoothing theory. In addition, we compare the output and sale variances *across firms* and we calculate average figures for firm groups for the two monetary policy regimes in Table 6.2. The variance ratios in Table 6.1 are calculated based on the time periods while those reported in Table 6.2 are based on the cross-section units. Lastly, we provide summary information for variables used in the regression across firm groups in Table 6.3.

As we discussed in the literature section, the production smoothing theory entails lower variance for output, because firms adjust inventories to minimize the cost of production. Lower output variance relative to sales variance is a direct implication of cost minimization behaviour. However, preliminary evidence does not verify this theoretical prediction. We report two output-sale variance ratios based on the number of years used in the calculations in Table 6.1. Firstly, the output and sales variances for each firm are calculated separately by using a balanced sample of 1991-1999 (nine years observations) and firm group variances are obtained from averaging these variances. We also calculate variances for individual firms that have at least five years observations by using the same method. The output-sales variance ratios for risky, young and highly indebted firms are upward biased in the balanced sample. The output-sales variance ratios for all groups except for low indebted firms are larger than one. This finding clearly does not support the production smoothing theory. Specifically, the output-sales variance ratios for large, high dividend, risky, young and highly indebted firms are larger than their counterparts, namely small, low dividend, secure, old, low indebted[27]. These findings are against the production smoothing theory and suggest that firm characteristics reflecting the extent of informational problems and financial variables may be important in modelling inventory investment. We consider these characteristics in our econometric estimations in the next section.

On the other hand, we calculate the variance ratios across firms and find out that these ratios are significantly bigger than the one for all firm groups. In addition, these

[27] We have relatively short time periods for the calculation of the variances but we think that this information still can be useful.

ratios are much higher for financially more constrained firms, namely small, low dividend, risky, young, highly indebted than those for less constrained firms, namely large, high dividend, secure, old, and low indebted. Moreover, these ratios are higher during the tight period compared to the loose period for all firm groups. These findings imply that relatively more constrained firms have much more variability in their output than their sales, that is, they react less uniformly to cost shocks, and this is more significant during the recessionary period (Table 6.2).

Table 6.1: Output-Sales Variance Ratios across Firm Groups

	Balanced Data (1991-1999)		*More than Five Years*	
	No. of Firms	*Ratio*	*No. of Firms*	*Ratio*
Whole	6,180	1.07	10,700	1.07
Small	1,322	1.05	3,043	1.08
Large	2,546	1.07	3,645	1.07
Risky	594	1.44	1,438	1.33
Secure	2,652	1.03	4,397	1.04
Young	661	1.14	1,608	1.09
Old	1,987	1.03	2,908	1.04
Highly Indebted	1,180	1.29	2,444	1.26
Low Indebted	1,022	0.90	1,999	0.76
Low Dividend	1,145	1.16	2,009	1.18
High Dividend	2,111	1.23	3,972	1.22

Table 6.2: Output-Sales Variance Ratios across Firm Groups and Monetary Policy Regime

	Whole Period (1990-1999)	*Tight Period (1990-1992)*	*Loose Period (1993-1999)*	*Tight/Loose*
Whole Sample	1.232	1.260	1.221	1.032
Small	1.275	1.392	1.225	1.136
Large	1.232	1.259	1.220	1.032
Risky	1.363	1.455	1.334	1.091
Secure	1.208	1.239	1.200	1.033
Young	1.379	1.448	1.349	1.074
Old	1.221	1.244	1.211	1.028
Highly Indebted	1.256	1.258	1.256	1.001
Low Indebted	1.169	1.201	1.166	1.030
Low Dividend	1.232	1.272	1.213	1.048
High Dividend	1.232	1.234	1.231	1.003

Basic statistics for the variables used in the empirical tests for both the inventory and the employment growth equations are summarized in Table 6.3 across firm type groups. We removed outliers for variables that have a large gap between their maximum and minimum values to obtain a representative sample for the population. The statistics that are provided in Table 6.3 are based on trimmed results. We provide more detailed explanations on the trimming for each variable used in our empirical estimations in the Appendix.

Table 6.3: Basic Statistics for Variables Used in the Regressions across Firm Groups

	GINV	*GEMP*	*GS*	*CF*	*MIX*	*GW*	*GRTA*	*RINVS*
Whole Sample								
Obs	76,920	76,920	76,920	67,760	76,920	76,720	76,920	76,920
Mean	0.016	0.011	0.031	6.538	32.88	0.059	0.048	0.130
Std.Dev.	0.326	0.160	0.208	1.790	25.11	0.206	0.200	0.096
Min	-1.539	-0.736	-0.870	-3.219	0.00	-0.559	-0.743	0.000
Max	1.584	0.806	1.071	15.246	100.00	1.367	1.028	1.714
Small Firms								
Obs	13,936	13,936	13,936	12,110	13,936	13,852	13,936	13,936
Mean	0.027	0.015	0.031	4.739	32.47	0.059	0.061	0.119
Std.Dev.	0.364	0.174	0.224	1.057	25.59	0.227	0.215	0.106
Min	-1.522	-0.736	-0.866	-2.634	0.00	-0.559	-0.736	0.000
Max	1.582	0.799	1.065	8.970	100.00	1.367	1.023	1.480
Large Firms								
Obs	33,242	33,242	33,242	29,509	33,242	33,202	33,242	33,242
Mean	0.010	0.007	0.033	7.904	33.65	0.058	0.044	0.134
Std.Dev.	0.300	0.157	0.195	1.535	25.37	0.194	0.193	0.089
Min	-1.539	-0.736	-0.867	-0.048	0.00	-0.559	-0.742	0.000
Max	1.584	0.806	1.069	15.246	100.00	1.367	1.027	1.032
Risky Firms								
Obs	13,090	13,090	13,090	9,302	13,090	13,045	13,090	13,090
Mean	0.012	0.007	0.033	5.704	46.75	0.057	0.041	0.136
Std.Dev.	0.370	0.184	0.241	1.720	26.75	0.229	0.238	0.106
Min	-1.527	-0.728	-0.870	-2.634	0.00	-0.557	-0.743	0.000
Max	1.570	0.803	1.069	13.475	100.00	1.360	1.027	1.480
Secure Firms								
Obs	31,751	31,751	31,751	30,149	31,751	31,670	31,751	31,751
Mean	0.014	0.008	0.026	6.916	24.31	0.054	0.048	0.131
Std.Dev.	0.299	0.145	0.189	1.784	22.60	0.191	0.174	0.095
Min	-1.539	-0.736	-0.862	-0.867	0.00	-0.559	-0.738	0.000
Max	1.582	0.806	1.071	15.246	100.00	1.367	1.023	1.714

Table 6.3: Basic Statistics for Variables Used in the Regressions across Firm Groups (Continued)

	GINV	*GEMP*	*GS*	*MIX*	*CF*	*GW*	*GRTA*	*RINVS*
Young Firms								
Obs	16,505	16,505	16,505	14,281	16,505	16,444	16,505	16,505
Mean	0.043	0.035	0.059	6.237	34.28	0.089	0.071	0.123
Std.Dev.	0.367	0.182	0.229	1.681	25.87	0.232	0.223	0.095
Min	-1.527	-0.727	-0.867	-1.487	0.00	-0.559	-0.743	0.000
Max	1.570	0.806	1.067	14.561	100.00	1.367	1.027	1.714
Old Firms								
Obs	21,630	21,630	21,630	19,231	21,630	21,583	21,630	21,630
Mean	-0.006	-0.012	0.010	7.113	30.58	0.034	0.026	0.140
Std.Dev.	0.285	0.144	0.183	1.954	24.81	0.179	0.179	0.097
Min	-1.519	-0.736	-0.866	-2.634	0.00	-0.559	-0.739	0.000
Max	1.584	0.795	1.069	15.246	100.00	1.367	1.027	1.019
Highly Indebted Firms								
Obs	21,445	21,445	21,445	17,124	21,445	21,373	21,445	21,445
Mean	0.013	0.009	0.035	6.412	45.75	0.059	0.048	0.131
Std.Dev.	0.357	0.177	0.228	1.853	26.62	0.219	0.231	0.102
Min	-1.537	-0.727	-0.870	-1.974	0.00	-0.559	-0.743	0.000
Max	1.584	0.802	1.071	14.705	100.00	1.363	1.027	1.480
Low Indebted Firms								
Obs	15,391	15,391	15,391	14,504	15,391	15,343	15,391	15,391
Mean	0.010	0.005	0.021	6.453	14.58	0.051	0.045	0.130
Std.Dev.	0.300	0.138	0.185	1.578	17.41	0.188	0.161	0.096
Min	-1.488	-0.736	-0.862	-3.219	0.00	-0.554	-0.738	0.000
Max	1.569	0.806	1.056	14.482	100.00	1.354	1.009	1.413
Low Dividend Firms								
Obs	13,305	13,305	13,305	11,357	13,305	13,280	13,305	13,305
Mean	0.022	0.011	0.029	5.700	33.58	0.055	0.048	0.139
Std.Dev.	0.321	0.158	0.206	1.346	24.37	0.201	0.192	0.108
Min	-1.529	-0.727	-0.866	-2.634	0.00	-0.556	-0.742	0.000
Max	1.578	0.799	1.067	12.862	100.00	1.367	1.022	1.714
High Dividend Ratio Firms								
Obs	30,806	30,806	30,806	26,450	30,806	30,697	30,806	30,806
Mean	0.012	0.008	0.034	6.663	37.47	0.058	0.047	0.125
Std.Dev.	0.345	0.167	0.220	1.818	26.82	0.211	0.219	0.096
Min	-1.539	-0.736	-0.870	-1.974	0.00	-0.559	-0.743	0.000
Max	1.584	0.806	1.071	15.246	100.00	1.360	1.027	1.413

6.5. Estimation Results

In this section, we report the difference *GMM* estimates for the inventory investment and the employment growth models discussed above. We use the binary variables representing firm characteristics interacted with the financial variables like the mix and cash flow to capture the reaction of firm groups to the changes in financial conditions. Table 6.4 summarises the estimation results for the inventory investment growth equation while Table 6.5 shows the same estimations for the employment growth equation. The estimation results for firm groups are shown horizontally in each table. As in Chapter Five, we differentiate the responses of inventory investment and employment growth of various types of firms by using firm type dummies as part of interaction terms. The findings for the inventory investment and employment models that do not use the interaction terms are reported in the first column of each table while those for the models that consider interaction terms for size, credit rating, age, indebtedness and the dividend-payout ratio are reported in the remaining columns. As we did in Chapter Five, we estimate the model for firm groups that represent polar tails of firm distribution. For example, since medium sized firms are not considered in small and large firms dummies, we estimate the model for small and large firms separately instead of using either small or large firm dummies in a single estimation.

6.5.1. Inventory Investment Growth Estimation Results[28]

We employ the difference *GMM* procedure for estimating our model. We use two lags of the inventory investment growth to capture the dynamics of inventory behaviour and to avoid serial correlation in the econometric specification. We treat the lags of dependent variables, the mix, cash flow, sales growth, the inventory-sales ratio and interactions terms as endogenous (or predetermined) variables[29]. This means that these are not strictly exogenous i.e. any shock that affects the error terms or inventory investment today may change the future values of these variables. Therefore, we tend to use two and three lags

[28] We use DPD for Ox to estimate the models with the difference *GMM* (see Doornik, Arellano, and Bond; 2001 for the program and estimation details).

[29] Treating variables as endogenous or predetermined increases the size of the instrument matrix. According to Kiviet (1995), large number of endogenous or predetermined variables leads the *GMM* estimators to be less efficient especially in small samples.

of these variables and the lagged dependent variable as instruments to obtain consistent estimates[30]. That is, we use following linear moment restrictions

$$E[(\varepsilon_{it} - \varepsilon_{i,t-1})Z_{i,t-j}] \quad \text{for } j= 2,3,\ t=1991,\ .....,\ 1999 \qquad (6.37)$$

where $Z_{i,t-j}$ is an instrumental variables matrix that consists of two and three lags of endogenous (or predetermined) variables; namely $GINV_{i,t-2}$, $GINV_{i,t-3}$, $GS_{i,t-2}$, $GS_{i,t-3}$, $MIX_{i,t-2}$, $MIX_{i,t-3}$, $(MIX*TYPE)_{i,t-2}$, $(MIX*TYPE)_{i,t-3}$, $CF_{i,t-2}$, $CF_{i,t-3}$, $(CF*TYPE)_{i,t-2}$, $(CF*TYPE)_{i,t-3}$, $RINVS_{i,t-2}$ and $RINVS_{i,t-3}$. The instrument set also includes the first differences of $BRATE_t$, GDP_t, AGE_{it}, and year dummies. The first differences of exogenous variables are used as instruments to capture some macro and micro aspects that affect the inventory behaviours of firms. That is, the GDP_t growth rate and $BRATE_t$ reflect the macroeconomic environment. The validity of the instruments depends on the lack of serial correlation in the error terms[31].

The estimated coefficients from both the one-step and two-step *GMM* procedures are consistent. However, standard errors from the two-step procedure are generally biased downward for small samples. Therefore Arellano and Bond (1991) recommend using the one-step estimates for the inferences (hypothesis testing) but using the two-step procedure for the specification of the model. We report the estimated coefficients, t-statistics and serial correlation statistics, m_1, and m_2 obtained from the one-step procedure while we report the Sargan statistic obtained from the two-step procedure as only the Sargan test based on the two-step GMM estimator is heteroscedasticity-consistent. We do not reject the hypothesis of no second order autocorrelation of error terms for all regressions, i.e. m_2 is close to zero, and therefore the model is well specified and produces consistent estimates. However, the Sargan test from the two-step procedure rejects the null hypothesis that over-identifying restrictions are valid in all regressions. Following Nickell

[30] We estimate the model using alternative lags for instruments including three and four lags; two and earlier lags; three and earlier lags. The estimations results and test statistics do not differ significantly across lag selection. The Sargan test statistics are significant for all estimations with different lag selections.

[31] The disturbance terms are serially uncorrelated if their differences, $\varepsilon_{it} - \varepsilon_{it-1}$, display first order serial negative correlation but no the second order serial correlation, i.e. $E(\varepsilon_{it} - \varepsilon_{i,t-1})(\varepsilon_{i,t-1} - \varepsilon_{i,t-2})<0$ and $E(\varepsilon_{it} - \varepsilon_{i,t-1})(\varepsilon_{i,t-2} - \varepsilon_{i,t-3})=0$.

and Nicolitsas (1999) and Benito (2002) who report significant Sargan test statistics in their papers, we also report these statistics in our analysis[32].

Following Nickell and Nicolitsas (1999), we check the effectiveness of our instruments whether they are good predictors of the endogenous variables in the inventory investment model. We regress, in turn, the first difference of endogenous (or predetermined) variables on all instrumental variables including the first differences of exogenous variables; using the *GLS* random effects method. Wald statistics testing the joint significance of the instrumental variables for each endogenous or predetermined variable imply that our instruments significantly explain the first differences of all endogenous or predetermined variables[33]. The findings are reported in Table A.6.1 in the Appendix.

The coefficients of the lags of inventory investment growth are generally significant and negatively signed in all regressions[34]. $GINV_{i,t-1}$ has a larger coefficients than that of $GINV_{i,t-2}$ in absolute terms. This suggests that like many other economic variables, inventory investment exhibits a dynamic pattern and the link between past values of $GINV_{it}$ and its current level is less important for the earlier lags.

We include the cumulative base rate, $BRATE_t$, among the exploratory variables to capture the user cost of capital, which is the basis of the neoclassical investment theory.[35] This variable also measures the direct impact of monetary policy (the money or interest rate channel). An increase in the interest rate by the Bank of England is going to increase the cost of investment and thus firms will tend to postpone their investment projects. In the framework of the inventory investment model derived above, the increase in the base rate may be considered as a change in the stochastic component of the cost function; it is going to be costly to increase inventories at high interest rates. This theoretical implication is verified by the estimation results where $BRATE_t$ has a negative and significant coefficient for the estimation that does not use interaction terms even though it is not large

[32] Blundell *et al.* (2000) question the usefulness of this Sargan test in the context of model specification and conclude that the Sargan test tends to over-reject the hypothesis in the case of heteroscedasticity.
[33] The Wald test has χ^2 distribution with 14 degrees of freedom for the model that does not have interaction term and 18 for the models that use interaction terms.
[34] We mean significant at the five prevent level otherwise we are going to provide the significance level.
[35] The Jorgenson's neo-classical model of investment is a linear function of output and the user cost of capital under the assumption of perfect competition and a Cobb-Douglas production function.

in absolute value, -0.003. Contrary to our result, previous studies that estimated inventory investment do not find empirical evidence supporting this theoretical prediction (Blinder and Maccini, 1991).

When we add the interaction terms for the mix and cash flow as explanatory variables, the coefficient for $BRATE_t$ becomes smaller in absolute term and insignificant in some regressions. The coefficient for $BRATE_t$ is significant for the regressions that use dummies for small and low dividend ratio firms as components of interaction terms but significant only at the 10 percent level for large, young, and high dividend ratio firms. This result implies that firm specific characteristics capture some of the impact of the cumulative base rate therefore this may prove the existence of some other channels other than the interest rate channel by which monetary policy affects the real activity of firms.

Kashyap *et al.* (1993) suggest using the mix as an explanatory variable to explain investment alongside the interest rate. This study claims that if the interest rate is not included among the explanatory variables of investment, the lending channel of monetary transmission would not be verified independently (p 89). By using time series techniques for aggregate data, Kashyap *et al.* (1993) estimate that the mix explains inventory investment significantly; a higher share of bank loans leads firms to invest more in inventories. Our estimations show that the coefficients of the mix are positive in all regressions except for the one that uses a large firm dummy as a component of the interaction terms. However, these coefficients are not significant only for large, highly indebted, and high dividend ratio firms. The coefficients of the interaction terms for the mix are significantly different from zero for large, risky, secure, young, highly indebted, less indebted and high dividend ratio firms. The sums of the coefficients of the mix and those of its interaction terms measure the overall impact of the mix on the inventory investment growth conditioning on firm characteristics. These sums are larger for small, secure, highly indebted, old and high dividend firms compared to those of the counterpart groups but negative only for large firms. Negative coefficient for large firms and positive coefficient for small firms clearly support the hypothesis that financially constrained firms including small firms are bank dependent. However, larger coefficients for secure, highly indebted, old and high dividend firms, which are categorized as less financially constrained, compared to financially constrained counterparts do not support this hypothesis.

These results still imply that having access to bank finance is special: it reduces the extent of informational problems and thus the negative impact of external shocks on firms' activity. In other words, as explained in the previous chapter, bank finance can overcome the adverse selection and moral hazard problems because of the monitoring technology of banks. Banks can match their liabilities structure to the term to maturity of loans and gather information on the financial background of companies. In this context, a contractionary monetary policy, which reduces the bank loan supply, affects the level of economic activity by changing the cost and availability of bank finance and thus the mix. In fact, our estimations show that even during benign period the mix appears an important explanatory variable for inventory investment growth.

We also use one lag of cash flow, $CF_{i,t-1}$, to capture the impact of net worth on inventory activity. The coefficients of $CF_{i,t-1}$ are positive and all significant across firm groups except for the estimation that uses low dividend firms as component of interaction terms. The sums of coefficients of $CF_{i,t-1}$ and $CF_{i,t-1}*TYPE_{it}$ are larger for small, young, secure, less indebted, and high dividend firms compared to those of their counterparts, namely large, old, risky, highly indebted and low dividend firms. These results support the cash flow hypothesis forwarded by Fazzari *et al.* (1988), i.e. investment activity of financially constrained firms is more sensitive to internal funds or net worth, when we categorize firms according to size and age but they do not support this hypothesis for other splitting criteria[36]. Apparently, these findings do not capture the restrictive impact of the tight policy on inventory investment because of the estimation period used where micro and macro conditions have been supportive for getting external finance.

We use the level and one lag of sales growth rate, GS_{it}, to capture the impact of the change in expected sales. The coefficients of sales growth and its lag are positive and significant for all regressions but those of the lag are smaller in absolute values. The coefficients of sales growth for small, risky, young, highly indebted, low dividend firms are higher than their counterparts; inventory growth of more constrained firm groups are more sensitive to sales growth expectations. We also use one lag of the ratio of inventory to sales, $RINVS_{t-1}$ following Kashyap *et al.* (1994) to capture the adjustment of inventories

[36] We should be aware that the cash flow sensitivity of investments is expected to be higher especially for financially constrained firms during the tight periods as tested by Guariglia (1999).

to their long term target. Negative and significant coefficients are generally found for this variable. An increase of inventory-sales ratio in the previous period leads to a reduction in current inventory investment, which is consistent with the inventory target approach.

6.5.2. Employment Growth Estimation Results

As we explained above in our employment growth equation, we add two new variables to capture employment dynamics, namely the change in the real wage (and its lag) and of the real tangible assets that represent the capital stock of firms but we drop the RINVSit which is directly related to the inventory target adjustment dynamics. We treat the lags of employment growth, the mix, cash flow, sales growth, real tangible assets growth, real wage growth, and the interactions terms as endogenous (or predetermined) variables. We use three and four lags of level endogenous variables as instrumental variables in the difference GMM procedure to obtain consistent estimations. If we use two and three lags instead of three and four lags as in the case of the inventory investment equation, the Sargan test rejects the hypothesis of the validity of instruments therefore we tend to use three and four lags by which the Sargan test does not reject this hypothesis for all regressions. We also use the first differences of the cumulative base rate, age, the GDP growth rate and rating score as instrumental variables. Formally, our instrumental variables for the employment growth equation are $GEMP_{i,t-3}$, $GEMP_{i,t-4}$, $GS_{i,t-3}$, $GS_{i,t-3}$, $MIX_{i,t-3}$, $MIX_{i,t-3}$, $(MIX*TYPE)_{i,t-3}$, $(MIX*TYPE)_{i,t-4}$, $CF_{i,t-3}$, $CF_{i,t-4}$, $(CF*TYPE)_{i,t-3}$, $(CF*TYPE)_{i,t-4}$, $GRTA_{i,t-3}$, $GRTA_{i,t-4}$, $GW_{i,t-3}$, $GW_{i,t-4}$, the first differences of $BRATE_t$, GDP_t, AGE_{it}, and $SCORE_{it}$, and year dummies. In the employment growth model, both the hypotheses of no second order autocorrelation and of the validity of instrumental variable based on the Sargan statistic were not rejected. Therefore, our employment growth model is specified with the valid instruments. The estimation results with the one-step *GMM* across firm characteristics are reported in Table 6.5[37].

Although the coefficients of the monetary stance variable, $BRATE_t$, are all negative for all estimations, they are smaller in absolute terms in the employment model compared to those in the inventory investment model and do not differ across estimations significantly. These coefficients are significant at the 10 percent level only for estimations

[37] As in the case of inventory growth model, the Sargan statistics are from the two-step *GMM* procedure.

where risky, young, and old firm dummies are used as component of interaction terms and for the estimation without interaction terms. These results imply that inventory investment growth is more sensitive to interest rates than employment growth. Contrary to the inventory investment growth model, adding interaction terms that capture financial variables and firm characteristics to the model does not change the value of the coefficients of $BRATE_t$ significantly.

The estimated coefficients for the mix are positive and generally significant but smaller in the employment growth model. We sum up the coefficients of the mix and its interaction terms across firm characteristics; we find out that the summed coefficient for large firms is negative while that for small firms is positive and very large. This result confirms our findings from the inventory investment growth model discussed above implying that having access to bank finance is more important for small firms than large firms for their inventory and employment behaviours. The coefficients of the interaction terms for other firm groups are generally insignificant therefore we analyse only the coefficients of the mix across various regressions. The coefficients of the mix for young, risky, less indebted firms and low dividend ratio firms are larger than those of their counterparts. Overall, the findings for the mix and the cumulative base rate imply that the employment growth is less sensitive to monetary policy stance and the composition of external finance compared to inventory growth. This is not totally surprising since after all inventories are held to shelter firms from costly adjustment to production and employment.

One lag of the cash flow, $CF_{i,t-1}$, explains the employment growth significantly as in the case of inventory growth. The coefficients for this variable are positive and significant in all estimations and they are larger for constrained firm groups, namely small, low dividend, risky and young firms compared to their counterparts with the exception of high indebted firms when we do not consider the coefficients of interaction terms. Persistently positive coefficients for $CF_{i,t-1}$ across various regressions imply that the net worth position of firms is important for employment decisions; this result supports the findings of Nickell and Nicolitas (1999) where the ratio of interest payments to cash flow has negative impact on employment after controlling for current and expected wages and demand.

We sum up the coefficients of significant interaction terms and $CF_{i,t-1}$ and find out that the coefficients for small, secure, and young firm group are larger than those for their counterparts. When we consider the interaction terms for the cash flow across firm types we do not find strong evidence supporting the cash flow hypothesis. In other words, the interaction terms for financially constrained firms are not generally larger than those of unconstrained firms. One possible reason for this is the period of our analysis, that is, firms are less likely to be subject to financial constraints during the 1993-1999 period. Another possible reason may be related to our taxonomy that may not reflect the degree of financing constraints properly.

Nickell and Nicolitas (1999) use capital and wage among the explanatory variables in their employment model. We also use the change in the log of real tangible assets to reflect the change in the capital stock, $GRTA_{it}$ and the change in the log of real wage, GW_{it}, and its lag, $GW_{i,t-1}$, in our estimations. The coefficients for $GRTA_{it}$ are positive across estimations as expected but not significant. The coefficient for GW_{it} are positive and significant while those for $GW_{i,t-1}$ are negative and significant in all estimations. The sum of coefficients for GW_{it} and $GW_{i,t-1}$ are negative for all estimations; we may conclude that employment growth declines with the overall real wage growth.

The coefficients for the first lag of employment growth are negative and generally significant across regressions but those for the second lag are rarely significant. These coefficients for the lags of employment growth are generally smaller in absolute term than those for the lags of inventory investment growth. The coefficients for sales growth, GS_{it}, are positive and significant but those for its lag are negative but insignificant. These variables are considered to reflect industrial demand conditions. Although we do not report the coefficients for the year dummies here, they are generally significant.

6.6. Conclusion

Recently the literature has emphasized the fact that monetary policy shocks transmit asymmetrically to the financial and real activity of the corporate sector. In this context, studies employing micro data are very helpful for understanding this transmission in depth. Such efforts produce valuable information for the policy makers. In this study, we use a very large sample that enables us to split firms according to their size, rating, age,

dividend payout ratio and indebtedness. This sort of analysis reduces the potential problems encountered with aggregation. In addition, the channels of credit, namely the bank lending and the balance sheet channels are well identified by this methodology.

Incorporating the role of financial variables following the development of the literature on asymmetric information, incentive and agency problems has extended the traditional theories of investment. The financial structure of firms and thus the shocks that affect this structure may play an important role on their real activity. Many studies use the cash flows that reflect the financial position of firms to explain inventory and fixed investment. In this context, there is no agreement on the impact of cash flow on the investment activity of firms across firm groups having different degrees of informational problems. Apparently, firms with various default risks react differently to external shocks including monetary policy shocks. Including cash flow among the explanatory variables for investment may not be sufficient to capture the financial structure of firms because it may also reflect investment opportunities. We add the financial mix as an explanatory variable in order to obtain a well-identified model as proposed by Kashyap *et al.* (1993).

We use the interaction term approach in our econometric model to explain inventory investment and employment growth. Econometric evidence shows that both the financial mix and cash flow explain inventory investment and employment quite well after controlling for firm characteristics, cost and demand conditions. The mix captures the importance of bank finance and the bank-lending channel, while cash flow captures information for the net worth position of firms and the balance sheet channel. Estimation results show that the coefficients of the interaction terms for the mix and cash flow differ across firm types. More specifically, we find out that bank finance is less important for large firms among other firm groups both for investment and employment growth equations. However, we do not find strong evidence that supports the argument that inventory and employment activity of firms that are classified in groups representing financially constrained firms, namely small, risky, young, highly indebted and low dividend ratio groups are more sensitive to the mix and cash flow compared to their counterpart groups. In fact, we think that since our sample period coincides with positive macro and micro conditions for firms with financial difficulties, the financial constraining hypothesis is not supported strongly by the empirical findings.

The empirical evidence also shows that the cumulative base rate reflecting the monetary policy stance has a restrictive impact on both inventory investment and employment but this impact is stronger for inventory investment. In addition, the sensitivity of inventory investment to the cumulative base rate changes significantly after using the interaction terms that control for firm characteristics and financial variables. In short, we may claim that the financial positions of firms are important for both inventory investment and employment growth. It seems that the interest rate channel is stronger for inventories while we observe some evidence of the credit channel for both inventories and employment.

Table 6.4: Inventory Investment Growth: Controlling for Firm Types and Financial Variables

	Without Inter.Terms (1)	*TYPE=Small* (2)	*TYPE=Large* (3)	*TYPE=Risky* (4)	*TYPE=Secure* (5)
$GINV_{i,t-1}$	-0.204***	-0.200***	-0.209***	-0.192***	-0.186***
	-(12.90)	-(11.90)	-(12.00)	-(11.70)	-(11.30)
$GINV_{i,t-2}$	-0.031***	-0.024**	-0.031***	-0.022**	-0.024**
	-(3.03)	-(2.19)	-(2.73)	-(2.02)	-(2.21)
GS_{it}	1.112***	1.125***	0.999***	0.994***	0.867***
	(14.70)	(14.60)	(11.80)	(13.20)	(10.60)
$GS_{i,t-1}$	0.092***	0.070***	0.062***	0.078***	0.076***
	(5.24)	(3.61)	(3.13)	(4.18)	(4.05)
MIX_{it}	0.357***	0.345***	-0.067	0.082***	0.282***
	(7.27)	(6.66)	-(0.63)	(1.33)	(5.73)
$MIX_{it}*TYPE_{it}$		0.000	0.009***	0.004***	-0.004***
		-(0.10)	(4.31)	(6.59)	-(6.35)
$CF_{i,t-1}$	0.027***	0.036***	0.061***	0.028***	0.033***
	(3.07)	(3.96)	(5.05)	(3.02)	(3.56)
$CF_{i,t-1}*TYPE_{it}$		-0.007	-0.054***	-0.003*	0.005***
		-(0.96)	-(3.39)	-(1.67)	(3.50)
$BRATE_t$	-0.003***	-0.002**	-0.002*	0.000	0.000
	-(3.06)	-(2.02)	-(1.94)	-(0.40)	-(0.35)
$RINVS_{i,t-1}$	-2.791***	-2.625***	-2.388***	-2.220***	-2.023***
	-(12.20)	-(11.00)	-(9.39)	-(9.45)	-(8.38)
CONS	0.014	0.016	0.017*	0.026***	0.030***
	(1.47)	(1.55)	(1.67)	(2.57)	(3.05)
Sargan Test	208.70 [0.00]	187.80 [0.00]	150.90 [0.00]	151.30 [0.00]	166.50 [0.00]
m1	-33.52 [0.00]	-28.89 [0.00]	-24.94 [0.00]	-29.33 [0.00]	-29.94 [0.00]
m2	-0.76 [0.45]	0.06 [0.95]	0.52 [0.60]	-0.14 [0.89]	0.28 [0.78]

* significant at 10%; ** significant at 5%; *** significant at 1%, Heteroscedasticity consistent robust t-statistics in parenthesis. All equations include time dummies. There are 8,609 firms and 33,264 observations.

Difference GMM Results: *Dependent variable*: inventory growth, $GINV_{it}$. *Explanatory variables*: two lags of the dependent variable; $GINV_{i,t-1}$, $GINV_{i,t-2}$, sales growth and its lag; GS_{it}, $GS_{i,t-1}$, ratio of bank loans to total current liabilities; $MIX_{i,t}$, lag of real cash flow, $CF_{i,t-1}$, interaction terms for the mix and cash flow across firm types; $MIX_{it}*TYPE_{it}$, $CF_{i,t-1}*TYPE_{it}$, cumulative base rate; $BRATE_t$, the ratio of inventories to sales; $RINVS_{i,t-1}$; constant term and year dummies.

All variables except $BRATE_t$ are treated as endogenous or predetermined variables. We use two and three lags of these variables, namely $GINV_{i,t-2}$, $GINV_{i,t-3}$, $GS_{i,t-2}$, $GS_{i,t-3}$, $MIX_{i,t-2}$, $MIX_{i,t-3}$, $(MIX*TYPE)_{i,t-2}$, $(MIX*TYPE)_{i,t-3}$, $CF_{i,t-2}$, $CF_{i,t-3}$, $(CF*TYPE)_{i,t-2}$, $(CF*TYPE)_{i,t-3}$, $RINVS_{i,t-2}$ and $RINVS_{i,t-3}$, and the first differences of $BRATE_t$, GDP_t, and AGE_{it} as instrumental variables. In the first column we do not use interaction terms as explanatory variables therefore we do not include their lags the in instrument set.

Estimations are based on the firm type dummies that are employed as component of the interaction terms for $MIX_{i,t}$, and $CF_{i,t-1}$. For example, in the second column, we use the interaction terms for the financial variables that are based on the small firm dummy as explanatory variables. The corresponding estimations for various firm types are reported in the following columns.

Estimations results are from the one-step GMM procedure except the Sargan test which is obtained from the two-step procedure. Second order autocorrelation tests, m_2, do not reject the hypothesis of no serial correlation in the error terms for all regressions, while the Sargan tests reject the hypothesis of the validity of over-identifying restrictions.

Table 6.4: Inventory Investment Growth: Controlling for Firm Types and Financial Variables (Continued)

	TYPE= Young (6)	*TYPE= Old* (7)	*TYPE=High Indebted* (8)	*TYPE=Less Indebted* (9)	*TYPE=Low Dividend* (10)	*TYPE=High Dividend* (11)
$GINV_{i,t-1}$	-0.196***	-0.194***	-0.190***	-0.183***	-0.184***	-0.199***
	-(11.7)	-(11.5)	-(11.5)	-(10.7)	-(10.3)	-(11.8)
$GINV_{i,t-2}$	-0.024**	-0.022**	-0.025**	-0.022**	-0.012	-0.024**
	-(2.16)	-(2.00)	-(2.28)	-(1.98)	-(1.09)	-(2.17)
GS_{it}	1.090***	1.083***	0.953***	0.898***	1.250***	1.077***
	(14.20)	(14.00)	(11.50)	(9.84)	(13.60)	(13.40)
$GS_{i,t-1}$	0.070***	0.071***	0.071***	0.068***	0.055***	0.067***
	(3.64)	(3.70)	(3.80)	(3.63)	(2.75)	(3.50)
MIX_{it}	0.418***	0.383***	0.110	0.241***	0.207***	0.131
	(8.03)	(4.41)	(1.40)	(4.25)	(3.10)	(1.53)
MIX_{it}*$TYPE_{it}$	-0.251***	-0.087	0.003***	-0.010***	0.040	0.274***
	-(2.84)	-(0.31)	(3.89)	-(4.04)	(0.26)	(2.82)
$CF_{i,t-1}$	0.032***	0.038***	0.033***	0.035***	0.012	0.037***
	(3.40)	(4.05)	(3.72)	(3.82)	(1.32)	(4.06)
$CF_{i,t-1}$*$TYPE_{it}$	0.007	-0.033*	-0.008***	0.005**	-0.030**	-0.002
	(1.36)	-(1.67)	-(4.03)	(2.54)	-(2.21)	-(1.22)
$BRATE_t$	-0.002*	-0.002	-0.001	-0.001	-0.003***	-0.002*
	-(1.88)	-(1.61)	-(1.17)	-(1.09)	-(2.97)	-(1.84)
$RINVS_{i,t-1}$	-2.558***	-2.608***	-2.235***	-2.264***	-2.946***	-2.500***
	-(10.8)	-(10.5)	-(9.3)	-(9.3)	-(11.2)	-(10.4)
CONS	0.017*	0.022**	0.023**	0.024**	0.001	0.015
	(1.69)	(2.15)	(2.33)	(2.40)	(0.08)	(1.51)
Sargan Test	178.10 [0.00]	182.40 [0.00]	174.50 [0.00]	164.40 [0.00]	163.40 [0.00]	168.30 [0.00]
m1	-28.39 [0.00]	-29.30 [0.00]	-29.36 [0.00]	-31.15 [0.00]	-25.27 [0.00]	-28.77 [0.00]
m2	0.18 [0.86]	0.08 [0.94]	0.21 [0.83]	0.35 [0.72]	-0.28 [0.78]	0.14 [0.89]

* significant at 10%; ** significant at 5%; *** significant at 1%, Heteroscedasticity consistent robust t-statistics in parenthesis. All equations include time dummies. There are 8,609 firms and 33,264 observations.

Difference GMM Results: *Dependent variable*: inventory growth, $GINV_{it}$. *Explanatory variables*: two lags of the dependent variable; $GINV_{i,t-1}$, $GINV_{i,t-2}$, sales growth and its lag; GS_{it}, $GS_{i,t-1}$, ratio of bank loans to total current liabilities; $MIX_{i,t}$, lag of real cash flow, $CF_{i,t-1}$, interaction terms for the mix and cash flow across firm types; MIX_{it}*$TYPE_{it\,ib}$, $CF_{i\,t-1}$*$TYPE_{it}$, cumulative base rate; $BRATE_t$, the ratio of inventories to sales; $RINVS_{i,t-1}$; constant term and year dummies.

All variables except $BRATE_t$ are treated as endogenous or predetermined variables. We use two and three lags of these variables, namely $GINV_{i,t-2}$, $GINV_{i,t-3}$, $GS_{i,t-2}$, $GS_{i,t-3}$, $MIX_{i,t-2}$, $MIX_{i,t-3}$, $(MIX*TYPE)_{i,t-2}$, $(MIX*TYPE)_{i,t-3}$, $CF_{i,t-2}$, $CF_{i,t-3}$, $(CF*TYPE)_{i,t-2}$, $(CF*TYPE)_{i,t-3}$, $RINVS_{i,t-2}$ and $RINVS_{i,t-3}$, and the first differences of $BRATE_t$, GDP_t, and AGE_{it} as instrumental variables. In the first column we do not use interaction terms as explanatory variables therefore we do not include their lags in the instrument set.

Estimations are based on the firm type dummies that are employed as component of the interaction terms for $MIX_{i,t}$, and $CF_{i,t-1}$. For example, in the second column, we use the interaction terms for the financial variables that are based on the small firm dummy as explanatory variables. The corresponding estimations for various firm types are reported in the following columns.

Estimations results are from the one-step GMM procedure except the Sargan test which is obtained from the two-step procedure. Second order autocorrelation tests, m_2, do not reject the hypothesis of no serial correlation in the error terms for all regressions, while the Sargan tests reject the hypothesis of the validity of over-identifying restrictions.

Table 6.5: Employment Growth: Controlling for Firm Types and Financial Variables

	Without Inter.Terms (1)	*TYPE=Small* (2)	*TYPE=Large* (3)	*TYPE=Risky* (4)	*TYPE=Secure* (5)
$GEMP_{i,t-1}$	-0.060 **	-0.118 **	-0.100 **	-0.047	-0.077 *
	-(2.31)	-(2.41)	-(2.13)	-(1.04)	-(1.71)
$GEMP_{i,t-2}$	0.003	0.006	0.004	0.000	0.001
	(0.26)	(0.61)	(0.36)	(0.02)	(0.11)
GS_{it}	0.296 ***	0.204 ***	0.232 ***	0.293 ***	0.254 ***
	(4.74)	(3.14)	(3.96)	(4.65)	(3.97)
$GS_{i,t-1}$	-0.020	-0.077	-0.036	-0.005	-0.004
	-(0.41)	-(1.46)	-(0.69)	-(0.11)	-(0.09)
MIX_{it}	0.092 ***	0.041	0.158 ***	0.085 ***	0.088 *
	(3.47)	(1.17)	(2.98)	(2.79)	(1.86)
$MIX_{it}*TYPE_{it}$		0.467 ***	-0.166 *	0.107	0.025
		(2.56)	-(1.83)	(0.63)	(0.30)
$CF_{i,t-1}$	0.040 ***	0.067 **	0.056 *	0.043 ***	0.030 **
	(2.58)	(2.42)	(1.78)	(2.81)	(2.03)
$CF_{i,t-1}*TYPE_{it}$		0.059 **	-0.037 *	-0.035	0.043 ***
		(2.04)	-(1.77)	-(1.22)	(2.57)
$BRATE_t$	-0.001 *	-0.001	-0.001	-0.001 *	-0.001
	-(1.78)	-(1.31)	-(1.40)	-(1.79)	-(1.52)
$GRTA_{it}$	0.050	0.095	0.084	0.037	0.046
	(0.93)	(1.62)	(1.59)	(0.72)	(0.88)
GW_{it}	0.175 **	0.270 ***	0.221 ***	0.198 ***	0.238 ***
	(2.43)	(3.59)	(3.61)	(2.74)	(2.84)
$GW_{i,t-1}$	-0.305 ***	-0.444 ***	-0.400 ***	-0.308 ***	-0.346 ***
	-(4.68)	-(6.88)	-(7.32)	-(4.68)	-(4.64)
Constant	0.017 ***	0.011	0.018 *	0.015 **	0.013 *
	(2.59)	(1.45)	(2.73)	(2.28)	(1.91)
Sargan Test	69.59 [0.24]	66.45 [0.63]	72.86 [0.16]	89.92 [0.26]	96.10 [0.14]
m1	-9.18 [0.00]	-10.23 [0.00]	-9.45 [0.00]	-9.62 [0.00]	-10.31 [0.00]
m2	0.25 [0.80]	-0.08 [0.94]	-0.05 [0.96]	0.34 [0.74]	0.11 [0.91]

* significant at 10%; ** significant at 5%; *** significant at 1%, Heteroscedasticity consistent robust t-statistics in parenthesis. All equations include time dummies. There are 8,594 firms and 32,987 observations.

Difference GMM Results: *Dependent variable*: employment growth, $GEMP_{it}$. *Explanatory variables*: two lags of dependent variable; $GEMP_{i,t-1}$, $GEMP_{i,t-2}$, sales growth and its lag; GS_{it}, $GS_{i,t-1}$, ratio of bank loans to total current liabilities; $MIX_{i,t}$, the lag of real cash flow, $CF_{i,t-1}$; interaction terms for the mix and cash flow across firm types; $MIX_{it}*TYPE_{it}$, $CF_{i,t-1}*TYPE_{it}$, cumulative base rate; $BRATE_t$, the tangible asset growth; $GRTA_{it}$; wage growth and its lag, GW_{it}, $GW_{i,t-1}$, constant term and year dummies.

All variables except $BRATE_t$ are treated as endogenous or predetermined variables. We use three and four lags of these variables, namely $GEMP_{i,t-3}$, $GEMP_{i,t-4}$, $GS_{i,t-3}$, $GS_{i,t-4}$, $MIX_{i,t-3}$, $MIX_{i,t-4}$, $(MIX*TYPE)_{i,t-3}$, $(MIX*TYPE)_{i,t-4}$, $CF_{i,t-3}$, $CF_{i,t-4}$, $(CF*TYPE)_{i,t-3}$, $(CF*TYPE)_{i,t-4}$, $GRTA_{i,t-3}$, $GRTA_{i,t-4}$, $GW_{i,t-3}$, $GW_{i,t-4}$, and the first differences of $BRATE_t$, GDP_t and AGE_{it} as instrumental variables. In the first column we do not use interaction terms as explanatory variables therefore we do not include their lags in the instrument set.

Estimations are based on the firm type dummies that are employed as component of the interaction terms for $MIX_{i,t}$, and $CF_{i,t-1}$. For example, in the second column, we use the interaction terms for the financial variables that are based on the small firm dummy as explanatory variables. The corresponding estimations for various firm types are reported in the following columns.

Estimations results are from the one-step *GMM* procedure except the Sargan test which is obtained from the two-step procedure. Second order autocorrelation tests, m_2, do not reject the hypothesis of no serial correlation in the error terms for all regressions. Contrary to the inventory investment model, the Sargan tests do not reject the hypothesis of the validity of over-identifying restrictions in the employment model.

Table 6.5: Employment Growth: Controlling for Firm Types and Financial Variables (Cont.)

	TYPE= Young (6)	*TYPE= Old* (7)	*TYPE=High Indebted* (8)	*TYPE=Less Indebted* (9)	*TYPE=Low Dividend* (10)	*TYPE=High Dividend* (11)
$GEMP_{i,t-1}$	-0.061*	-0.067**	-0.063	-0.078*	-0.055	-0.074*
	-(1.84)	-(2.19)	-(1.39)	-(1.65)	-(1.22)	-(1.68)
$GEMP_{i,t-2}$	0.001	0.002	0.001	0.005	0.001	0.003
	(0.07)	(0.16)	(0.05)	(0.46)	(0.14)	(0.26)
GS_{it}	0.281***	0.279***	0.276***	0.267***	0.253***	0.254***
	(4.47)	(4.68)	(4.48)	(4.33)	(3.84)	(3.98)
$GS_{i,t-1}$	-0.013	-0.008	0.005	-0.019	-0.020	-0.009
	-(0.25)	-(0.16)	(0.11)	-(0.40)	-(0.40)	-(0.19)
MIX_{it}	0.159***	0.069**	0.098***	0.139***	0.164***	0.068**
	(2.59)	(2.26)	(3.45)	(3.12)	(3.26)	(2.44)
MIX_{it}*$TYPE_{it}$	-0.138	0.136	-0.022	-0.157	-0.232	0.197
	-(1.27)	(1.00)	-(0.41)	-(1.33)	-(0.77)	(1.05)
$CF_{i,t-1}$	0.072***	0.040***	0.037**	0.046***	0.062***	0.034***
	(3.59)	(2.72)	(2.53)	(2.64)	(2.96)	(2.57)
$CF_{i,t-1}$*$TYPE_{it}$	-0.063***	-0.044*	0.002	-0.010	-0.054**	0.017
	-(3.30)	-(1.70)	(0.67)	-(0.81)	-(2.48)	(0.51)
$BRATE_t$	-0.001*	-0.001*	-0.001	-0.001	-0.001	-0.001
	-(1.66)	-(1.76)	-(1.57)	-(1.29)	-(1.42)	-(1.49)
$GRTA_{it}$	0.052	0.046	0.046	0.049	0.049	0.063
	(1.00)	(0.88)	(0.87)	(0.93)	(0.99)	(1.19)
GW_{it}	0.200**	0.199***	0.204***	0.214***	0.206**	0.181**
	(2.53)	(2.89)	(2.86)	(2.98)	(2.53)	(2.37)
$GW_{i,t-1}$	-0.327***	-0.324***	-0.322***	-0.343***	-0.329***	-0.320***
	-(4.67)	-(5.28)	-(5.09)	-(5.61)	-(4.67)	-(4.87)
CONS	0.014**	0.016***	0.016**	0.018***	0.016**	0.018***
	(2.11)	(2.58)	(2.46)	(2.72)	(2.28)	(2.69)
Sargan Test	83.64 [0.43]	86.16 [0.36]	83.85 [0.42]	93.86 [0.18]	83.09 [0.45]	95.86 [0.14]
m1	-9.99 [0.00]	-9.50 [0.00]	-9.75 [0.00]	-9.53 [0.00]	-9.82 [0.00]	-9.54 [0.00]
m2	0.65 [0.52]	0.34 [0.74]	0.35 [0.72]	0.02 [0.98]	0.11 [0.91]	-0.23 [0.82]

* significant at 10%; ** significant at 5%; *** significant at 1%, Heteroscedasticity consistent robust t-statistics in parenthesis. All equations include time dummies. There are 8,594 firms and 32,987 observations.

Difference GMM Results: *Dependent variable*: employment growth, $GEMP_{it}$. *Explanatory variables*: two lags of dependent variable; $GEMP_{i,t-1}$, $GEMP_{i,t-2}$, sales growth and its lag; GS_{it}, $GS_{i,t-1}$, ratio of bank loans to total current liabilities; $MIX_{i,t}$, the lag of real cash flow, $CF_{i,t-1}$; interaction terms for the mix and cash flow across firm types; MIX_{it}*$TYPE_{it}$, $CF_{i,t-1}$*$TYPE_{it}$, cumulative base rate; $BRATE_t$, the tangible asset growth; $GRTA_{it}$; wage growth and its lag, GW_{it}, $GW_{i,t-1}$, constant term and year dummies.

All variables except $BRATE_t$ are treated as endogenous or predetermined variables. We use three and four lags of these variables, namely $GEMP_{i,t-3}$, $GEMP_{i,t-4}$, $GS_{i,t-3}$, $GS_{i,t-4}$, $MIX_{i,t-3}$, $MIX_{i,t-4}$, $(MIX*TYPE)_{i,t-3}$, $(MIX*TYPE)_{i,t-4}$, $CF_{i,t-3}$, $CF_{i,t-4}$, $(CF*TYPE)_{i,t-3}$, $(CF*TYPE)_{i,t-4}$, $GRTA_{i,t-3}$, $GRTA_{i,t-4}$, $GW_{i,t-3}$, $GW_{i,t-4}$, and the first differences of $BRATE_t$, GDP_t and AGE_{it} as instrumental variables. In the first column we do not use interaction terms as explanatory variables therefore we do not include their lags in the instrument set.

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Estimations results are from the one-step *GMM* procedure except the Sargan test which is obtained from the two-step procedure. Second order autocorrelation tests, m_2, do not reject the hypothesis of no serial correlation in the error terms for all regressions. Contrary to the inventory investment model, the Sargan tests do not reject the hypothesis of the validity of over-identifying restrictions in the employment model.

CHAPTER SEVEN

Selectivity Bias and the FAME Sample

7.1. Introduction

When undertaking empirical analysis, standard estimation methods generally employ a random sample assumption concerning samples. Parameters, which are estimated by using such samples, are expected to be unbiased, efficient, consistent, and sufficient after removing some diagnostic problems. For example, in a regression analysis, the estimated parameters are expected to be good representatives of population parameters where the standard regression assumptions hold. However, because of sample behaviour and the way some economic data sets are collected, available panel data samples are less likely to be balanced and complete.

Many economic surveys are carried out based on 'selection rules' that lead to non-random samples. Such sampling is generally called truncated, censored, or incomplete. One classical example of incomplete sampling is related with the female labour supply, where hours worked are observed only for women who decide to participate in the labour force (Gronau, 1974 and Heckman, 1976). Powell (1994) gives a further review of literature for the cross-sectional data. For panel data, in addition to unobserved heterogeneity, the sample selectivity problem should be considered in order to produce consistent and efficient estimators. Since the seminal contributions of Heckman (1976, 1979), it is known that inferences based on either balanced sub-panels or unbalanced panels without correcting for selectivity bias may be subject to bias if the non-response is endogenously determined.

Another typical example of incomplete samples relates to measuring the impact of worker eligibility on family wealth. Wealth is assumed to be dependent on income, education, age and a binary variable that indicates whether people belong to a pension

plan or not. The sample covers people whose net wealth is under a threshold. In this example, the sample is truncated based on a response variable i.e. wealth.

It is generally claimed that sampling based on a response variable is much more serious in terms of inferences made from the sample than sampling based on an exogenous explanatory variable (Wooldridge, 2002). Alternatively, however, suppose that we want to estimate a model of desired labour supply. One can only observe working hours for those employed, with zero working hours assumed for non-working people. In this case desired working hours for non-working people are censored from below at zero. In short, for a typical truncated sample we observe only a restricted part of the population, thus in a regression analysis with a truncated sample, we do not observe both dependent and explanatory variables for part of the population. However, in a censored sample we may observe explanatory variables, but we can observe the dependent variable only partially.

Truncated or censored samples lead to incorrect inferences about the population if standard methods of random samples are employed to estimate the parameters of interest. Many existing panels suffer from missing observations, not only due to selectivity bias, which can lead to truncated or censored samples, but also due to the non-response of agents or attrition (Verbeek and Nijman, 1996). Non-response occurs, for example, when the individuals refuse to participate in surveys or answer particular questions. Therefore, incomplete samples whether censored, truncated, or affected by non-response or attrition require sophisticated methods that consider selectivity bias and other problems in the data collection process. Before adopting alternative techniques for non-random samples it is crucial to understand the selection rules and make decisions on whether these rules are ignorable (in terms of the properties of estimators concerned). There are also cases where the estimated parameters are not affected by the estimation method even though the samples concerned are not random.

A variety of models have been adopted in the literature based on selection mechanisms and data collection problems. Wooldridge (2002) provides a survey of these models. We will introduce some basic models and literature on measurement and correction of selection bias in the next section. The discussion will highlight possible methods that are likely to be used to test for selectivity bias concerned with the FAME

sample. In the third section we carry out some estimations based on simple methods discussed in the previous section in order to test the hypothesis of selection bias for the FAME sample. In the final section the findings will be summarised.

7.2. Theoretical Background

As outlined above, truncated regression estimates a model of a dependent variable on independent variables from a restricted part of a population. Truncation is a characteristic of a distribution from which the sample data are drawn. Assuming the following linear conditional expectation model;

$$y_i=x_i\beta+u_i \quad \text{where } E(y_i/x_i)=x_i\beta \tag{7.1}$$

The standard regression analysis is not valid here to estimate β if the data are drawn based on a selection rule. Unlike in the case where the selection is based only on x_i, the selection based on y_i causes problems for standard *OLS* analyses. Assume that y_i is truncated based on the following selection rule,

$$s_i = 1[a_1<y_i<a_2] \tag{7.2}$$

where a_1 and a_2 are constant numbers. If y_i and x_i are drawn randomly and y_i falls in the interval (a_1, a_2), then both y_i and x_i are observed, otherwise y_i or x_i is not observed. The density function of y_i is formulated conditional on s_i and x_i.

$$f(y/s_i=1,x_i) = f(y)/[F(a_2/x_i, \beta)-F(a_1/x_i, \beta)] \tag{7.3}$$

If the population conditional distribution is assumed to be normal $(x_i\beta, \sigma^2)$, and the parameters are estimated by the 'maximum likelihood method', then this model is called truncated Tobit or truncated normal regression. If the selection mechanism is defined in terms of a regression equation, this model may be called *type II Tobit*, that is,

$$y_1=x_1\beta_1+u_1 \tag{7.4}$$

$$y_2= 1[z\delta_2+v_2>0] \tag{7.5}$$

where y_1 is observed only when $y_2=1$, u_1 and v_2 are independent of x and z with zero mean (exogeneity of x and z). v_2 has a standard normal distribution and $E(u_1/v_2)= \gamma_1 v_2$ and z is a set of explanatory variables possibly including some of x_1. If these assumptions hold we get the following equation.

$$E(y_1/z, y_2=1) = E(y_1/z, v_2) = x_1\beta_1 + E(u_1./ v_2) = x_1\beta_1 + \gamma_1 v_2 \qquad (7.6)$$

If the hypothesis of $\gamma = 0$ is not rejected, that is u_1 and v_2 are not correlated, then $E(y_1/x_1) = x_1\beta_1$. In other words, there is no selectivity bias with the sample and β_1 can be consistently estimated by *OLS* by using the selected sample. What would be the case if the hypothesis of $\gamma = 0$ is rejected?

$$E(y_1/z, y_2=1) = x_1\beta_1 + \gamma_1 E(v_2/z,y_2) = x_1\beta_1 + \gamma_1 h(z,y_2) \qquad (7.7)$$

where $E(v_2/x,y_2) = h(z,y_2)$. If we observe $h(z,y_2)$, the coefficients, β_1 and γ_1, can be estimated from equation (7.7) directly. That is, because the selected sample has the dependent variable $(y_2=1)$, we need only find out the following term:

$$h(z,1) = E(v_2/y_2> -z\delta_2) = \lambda(z\delta_2) \qquad (7.8)$$

where $\lambda(x\delta_2)$ is called the inverse Mills ratio and is equal to $\phi(z\delta_2) / \Phi(z\delta_2)$; the numerator is the density function and the denominator is the distribution function. Heckman (1974, 1976) used this method to overcome inconsistent estimations in case of selectivity bias that can be considered as an omitted variable problem in the selected sample.

$$E(y_1/x, y_2=1) = x_1\beta_1 + \gamma_1 E(v_2/z,y_2) = x_1\beta_1 + \gamma_1 \lambda(z\delta_2) \qquad (7.9)$$

In the case where δ_2 is not known, the additional regressor cannot be estimated directly. Nevertheless, δ_2 can be estimated consistently by using the first stage probit of the selected equation. This method allows us to test the selectivity bias if the selection rule is known. Once $y_{i1} = x_{i1}\beta_1 + \gamma_1 \lambda(z\delta_{i2})$ is estimated by using OLS, we can test for selectivity bias under null hypothesis of no selection bias, $Ho: \gamma_1=0$.

A similar methodology can be adopted for a standard *censored Tobit* model given below:

$$y_1=x_1\beta_1+ u_1 \text{ and } u_1 /x_1 \sim normal\ (0, \sigma^2) \qquad (7.10)$$

$$y_2= max(0, z\delta_2 + v_2) \qquad (7.11)$$

where (x, y_2) is observed in the population and y_1 is observed only if $y_2 >0$. u_1 and v_2 are assumed to be independent of z with zero mean, v_2 has a standard normal distribution and $E(u_1/v_2)= \gamma_1 v_2$. These assumptions are similar to the truncated model given above. The only difference is that the variance of v_2 is unknown, since y_2 is censored (as opposed to using a binary variable).

An example given by Wooldridge (2002), below, shows how the selection rule or mechanism does not constrain the dependent variable but the explanatory variables[1]. The structural equation of interest is

$$log(wage)= z_1\delta_1 + ability + v \quad \text{where } E(v/z_1, ability, IQ)=0$$

and assume that IQ is a proxy for ability, that is,

$$ability = \theta_1 IQ + e, \quad \text{where } E(e/z_1, IQ)=0$$

$$log(wage)= z_1\delta_1 + \theta_1 IQ + u \quad \text{where } u = v + e \text{ and } E(u/z_1, IQ)=0$$

Assume that the sample excludes people whose IQ is below a fixed value. Let s be a binary selection indicator representing a random draw from the population and $s=1$ if we use the draw in estimation and $s=0$ if we do not because data for at least some elements of variables in concern are unobserved due to survey design, non-response, or incidental truncation. In this example the selection indicator is a deterministic function of an exogenous variable, IQ, then $E(u/z_1,s;IQ) = 0$. Therefore, *OLS* estimation of the wage equation will be consistent. However, if the probability of missing data is higher at lower

[1] In the FAME data set, selection is not directly related to dependent variable of our empirical model estimated in Chapter Five, but the dependent variables, the mix, inventory investment and employment growth are conditional on firm size.

IQs (because of people's reluctance to give permission to obtain *IQ* scores), then the conditional expected value of *u*, $E(u/z_1,s;IQ)$, is not equal to the unconditional expected value, $E(u)$. The reasons for missing data may be systematically related to disturbance term and in this case leads to inconsistent *OLS* estimators. In short, even though *IQ* is exogenous in the population equation, the endogenous selection rule makes it endogenous. Therefore, we need to adopt a correction mechanism for the selectivity bias to have consistent estimations. One way to do that is to introduce a variable, *V*, which controls for selection mechanisms. This variable should be independent of the explanatory variables but not necessarily independent of the disturbance term, *u*.

$$log(wage) = z_1\delta_1 + \theta_1 IQ + \beta V + \varepsilon$$

In this example, it is assumed that the selection indicator, *s*, is a function of z_1, *IQ* and *V*, therefore $E(\varepsilon/z_1, IQ, V, s)=0$. Including *V* in the regression of the selected sub-sample eliminates the selection bias and allows us to consistently estimate δ_1 and θ_1. Since *V* is independent from z_1 and *IQ*, we would not have to include it to obtain consistent estimates if we had a random sample. If the hypothesis, $\beta=0$, is not rejected then the sample selectivity problem can be ignorable. Including *V* would result in asymptotically more efficient estimators when the conditional variance of the dependent variable is homoscedastic.

If missing observations in a panel data set are non-random applied estimators may be inconsistent as in the case of truncated and censored samples. Therefore, the problems of non-response and attrition in panel data should be considered in detail in addition to understanding the selection rules to make decisions on whether these rules are ignorable or not in terms properties of the estimators concerned (Verbeek and Nijman, 1996). Firms may not report the information under concern regularly through the sample period depending on various reasons or because of selection rules or firms may not be categorised in the sample. For example, in addition to the selection mechanism underneath the FAME data set, firm entry or exit rates, flexibility in data collection rules, and other reasons of poor reporting determine the extent of missing observations. In fact, panel data sets on firms' balance sheets and profit loss accounts are more likely to be unbalanced rather than balanced.

Understanding the selection rule and correcting, if any, the selectivity bias involves some computational difficulties. Therefore, the best strategy is to adopt some preliminary and computationally easy techniques to establish whether selectivity bias is present or not and ignorable or not. Verbeek and Nijman (1992) and Wooldridge (1995) proposed some methods for testing and correcting for sample selection bias in panel data models. We summarise what these papers suggest and then discuss the possible techniques that we can use in our empirical models estimated in Chapters Five and Six in relation to the FAME data set.

Even if the selection mechanism or response process is known, the estimation of a full model, which includes a response equation, may be quite difficult because of missing observations. A Lagrange Multiplier test *(LM)* may be one solution, which estimates the model only under the null hypothesis; however, there are some difficulties with the *LM* test. By this method it may not be straightforward to calculate the *LM* test statistics because the value of this statistic is very much dependent upon the specification of the selection mechanism and distributional assumptions. Instead, it may be more practical to have some simple test to check for the presence of selectivity bias without having to estimate the full model, or to specify a response or selection equation (Baltagi 2002).

Verbeek and Nijman (1992) proposed some simple tests for cases where observations for endogenous variables are missing for some individuals in some periods. They produced fixed effects *(FE)* and random effects *(RE)* estimators for two models. Firstly, coefficients are estimated from an unbalanced panel sample where the dependent variable is not observed for some periods. Secondly, a sub-balanced panel sample where the dependent variable is observed across all time and individuals is extracted from an unbalanced sample. Based on these estimators, they construct quasi-Hausman tests of selectivity bias given as;

$$\xi_D = N\hat{\beta}'D'(D\hat{V}D')^{-}D\hat{\beta} \qquad (7.12)$$

where $\hat{\beta}$ is 4k dimensional vector with *FE*, and *RE* estimates of coefficients in balanced and unbalanced samples. N is the number of observations, D denotes the matrix of restrictions, and $\hat{V}$ is the variance covariance matrix given in Verbeek and Nijman (1992).

Verbeek and Nijman (1992) also proposed some tests based on variable addition; the LM test and two-step estimation and testing procedure in the spirit of Heckman (1976, 1979). In addition, they have shown that the *FE* estimators are more robust for selectivity bias than the *RE* estimator. Nijman and Verbeek (1992) use similar techniques to test selectivity bias in a life cycle consumption function. For the random effects model, Verbeek and Nijman (1992) suggest to include three simple variables in the regression to check for the presence of selection bias. First, there is a variable that shows the number of waves for the ith individual in the panel, T_i, second there is a binary variable taking the value one if and only if the ith individual is observed over entire the sample, $\prod_{t=1}^{T} s_{it} = 1$, and third, there is a variable that indicates whether the individual was present in the last period, $s_{i,t-1}$. Such tests have the advantage of computational simplicity and need only observation, x_{it}, when $s_{it}=1$.

Wooldridge (1995) relaxes some assumptions of this approach and uses *FE* allowing correlation between unobserved component and observable explanatory variables to test and correct for selectivity bias. Verbeek and Nijman (1992) consider a *RE* model under the assumption of normality and independence of the idiosyncratic error in both the selection and regression equations and time invariant unobserved effects in both equations are assumed to be normally distributed.

Wooldridge (1995) derives some simple variable addition tests of selection bias as well as estimation techniques correcting for selection bias in linear fixed effects model. He produced some additional variables for the selection bias based on whether the selection mechanism is observed (or partially observed) or not. For the observed selectivity bias, the Tobit model is used, while for the unobserved, the probit model is used, to produce additional repressors. For the former model Tobit residuals and for the latter model inverse Mill's ratio are added to the empirical model. This framework allows for arbitrary serial correlation and unconditional heteroskedasticity for disturbances in the model. Wooldridge (1995) points out that the random effects estimates suggested by Verbeek and Nijman (1992) maintain a null hypothesis of no correlation between unobserved effect and regressors. Therefore, random effects estimates could be rejected even in the absence of selection bias if the unobserved effect and regressors are correlated or if the selection is based on the unobserved effect.

In this chapter we employ the technique proposed by Wooldridge (1995) where only the selection indicator is observed not the selection rule itself. This procedure is shown below. Suppose the following model with an implicit selectivity mechanism:

$$y_{it} = \alpha_i + x_{it}\beta + u_{it}$$

$$h_{it}^* = x_i\delta + \upsilon_{it} \qquad (7.13)$$

$E(u_{it}/\alpha_i, x_i, \upsilon_i) = \rho\upsilon_{it}$ implying a selectivity bias and s_i is a binary variable taking the value one if variables are not missing and zero otherwise. Then,

$$E(y_{it}/\alpha_i, x_i, \upsilon_i, s_i) = E(y_{it}/\alpha_i, x_i, \upsilon_i) = \alpha_i + x_{it}\beta + \rho\upsilon_{it} \qquad (7.14)$$

In our case where only selection indicator is observed as given above, y_{it} is not conditioned on υ_i but on s_i.

$$E(y_{it}/\alpha_i, x_i, s_i) = \alpha_i + x_{it}\beta + \rho E(\upsilon_{it}/\alpha_i, x_i, s_i) \qquad (7.15)$$

If υ_{it} were independent across t and (α_i, x_i) then $E(\upsilon_{it}/\alpha_i, x_i, s_i) = E(\upsilon_{it}/x_i, s_{it})$. However, this assumption is not valid when the structural selection equation contains unobserved effects.

$$E(\upsilon_{it}/x_i, s_{it}=1) = E(\upsilon_{it}/x_i, \upsilon_{it} > -x_i\delta) \qquad (7.16)$$

Assuming the variance υ_{it} of is unity, then we have

$$E(\upsilon_{it}/z_i, s_{it}=1) = E(\upsilon_{it}/z_i, \upsilon_{it} > -x_i\delta) = \lambda(x_i\delta) \qquad (7.17)$$

$\lambda(x_i\delta)$ is the inverse Mill ratio. An estimator for the inverse Mill ratio is added to the model to test the selectivity bias. More specifically, the steps are given below based on the assumption that $E(u_{it}/\alpha_i, x_i, s_i) = 0$, where $t = 1, 2, \ldots, T$.

(i) For each t, estimate the equation

$$P(s_{it} = 1/x_i) = \Phi(x_i\delta)$$

Using standard probit and for $s_{it} = 1$ compute estimator for the inverse Mill ratio.

(ii) Estimate $y_{it} = \alpha_i + x_{it}\beta + \rho\lambda(x_1\hat{\delta}) + e_{it}$ by using fixed effects model

(iii) Test the *Ho:* $\rho = 0$ using t statistic for $\hat{\rho}$

As mentioned before, the FAME sample does involve a selection rule in which the data set is truncated in the sense that only firms that satisfy size criteria report some variables. More specifically, individual companies, which meet criteria for small and medium-sized status, have some advantages of not preparing detailed accounts relative to large companies. For small-sized companies, to file a profit and loss account or details on turnover and the number of employees are not obligatory, they have to file only abridged balance sheet information that obviously includes some items of assets and liabilities. On the other hand, medium-sized companies do not have to disclose turnover details. Currently, companies should satisfy two out the three criteria, namely turnover, balance sheet (total assets) and number of employees to be classified in terms of size. Based on this mechanism, the sample is expected to represent relatively the upper tail of the population in terms of firm size distribution and this may limit the extent to which the sample represents the population.

However, although missing observations are overwhelmingly connected with the selection rule, there are other reasons for missing observations. For example, there are a number of missing observations (supposed to be reported) in turnover even though firms are classified as large firms based on employment and balance sheet criteria while some small firms have reported almost complete information even though they are not obliged to report. The sample includes a large number of missing observations especially during the first couple of years of the sample period. This implies that the efficiency in the data collecting process has improved over time.

In addition, some variables have been reported more often relative to others across years and firms. For example, investment or intangible assets are poorly reported relative to tangible assets, turnover or rating variables. Therefore, variables that are used in the model should be selected by considering this fact in the sense that alternative variables

can be used instead of poorly reported variables or potentially missing variables. For example, the item of intangible assets involves quite a number of missing observations as a component of total assets, thus using total assets as a variable in the empirical model may lead to bias. Because every missing observation for intangible assets is assumed to be zero in the FAME sample even though we realise that some of these missing observations are different from zero, and some of them are missing as indicated in the data set by cross-checking with Datastream and One Source data sets. This implies a potential problem with the FAME sample in which it is difficult to decide whether the missing observations are zero or truly missing. It would be worthwhile using an alternative variable for those firms having a large number of missing observations. In this respect, it is extremely difficult to employ a regular truncated or censored selectivity framework for our sample. We rather use the methodology proposed by Verbeek and Nijman (1992) to test for the selectivity bias.

7.3. Test Results

We will adopt the techniques produced by Verbeek and Nijman (1992) and Wooldridge (1995) to test whether the selectivity problem is ignorable or not for the FAME sample. We use four alternative artificial variables to test the selectivity problem in addition to the quasi-Hausman selectivity test. If the coefficients of additional variables are significantly different from zero, the sample involves a selectivity bias. We test this hypothesis for the empirical models given in Chapters Five and Six, namely the mix and inventory investment. Assume that we have the following model,

$$y_{it}=\alpha_i+X_{it}\beta+\varepsilon_{it},$$

We added four alternative variables to this model to test the hypothesis of $\gamma=0$,

$$y_{it}=\alpha_i+X_{it}\beta+\gamma Z+\varepsilon_{it}$$

Selectivity bias occurs when the conditional expectation of the error terms, $E(\alpha+\varepsilon_{it}/s_i)$, is not equal to zero. If the conditional expectation of the error term based on the selection rule were known one could add regressors, Z, leading to a zero conditional expectation of the error term. Then standard two step regression procedures would lead to consistent

estimates. However, $E(\alpha + \varepsilon_{it}/s_i)$ is not identifiable if the selection rule is not known. One may use some artificial variables, Z_i that are likely to determine the probability of selection (i.e. affecting the distribution of selection score, s_i) or variables that are a function of s_i.

Table 7.1 and 7.2 show the estimation results of the model by adding the variables defined above for two alternative monetary policy stance variables, namely the apparent interest rate and cumulative base rate, respectively. We only report the results of the model where the dependent variable is *MIX1*, the ratio of short-term loans to current liabilities for three periods, namely whole sample covering 1991-1999, and two sub-periods in terms of monetary stance, i.e. tight and loose periods. *Model 1* shows the random effects results without adding artificial variables for all periods to compare with the other four models in which each includes an artificial variable. Four different variables are generated (indicated by *SVAR*) to test for selectivity problems. All models are estimated by using fixed effects estimators.

Three artificial variables used in *Model 2, Model 3* and *Model 4* were adopted from Verbeek and Nijman (1992). The first one that was used in *Model 2* is a binary variable taking the value one if and only if the *i*th individual is observed over the entire period (balanced sample), $\prod_{t}^{T} s_{it} = 1$. The second artificial variable that was used in *Model 3* is a binary variable taking the value of one if the individual was present in the last period $s_{i,t-1}$. The third one is the number of waves the *i*th individual participates in the panel, T_i. The fourth artificial variable in *Model 5* was calculated based on Wooldridge (1995) where the selection mechanism is not observed but a binary variable indicating whether variables in the model are observed or not is used to calculate the inverse Mill ratio by using probit model[2]. In contrast to *Model 2, Model 3* and *Model 4* where estimations are carried out by random effects procedure; the fixed effects procedure is used in *Model 5*.

In all estimations, all alternative artificial variables (except for *Model 5* in the loose period) are significantly different from zero. This implies that our sample in general involves a selectivity bias. Alternatively, in fact, this result is confirmed by using the

[2]Wooldridge (1995) uses a Tobit model to test selectivity problem if the selection variable is partially observed.

statistic proposed by Verbeek and Nijman (1992) (quasi-Hausman test of selectivity bias)[3]. On the other hand, the results for the inventory and employment models are mixed across sub-samples based on firm characteristics. The coefficients of the artificial variables for the random effects models are not generally significant while the coefficients of the artificial variable in the fixed effects model proposed by Wooldridge (1995) are generally significant.

At this stage, it is important to decide whether the selectivity bias is ignorable or not. A change in the coefficients of the other variables after adding an artificial variable in the models may give us an idea about the seriousness of the selectivity problem. By adding the artificial variables the estimations become more consistent (Wooldridge, 2002). Looking at the results in Table 7.1, when the artificial variables are added into the model, the coefficients of the monetary stance variable, and the apparent interest rate, *ARATE* does not change significantly, and these results are consistent with the hypothesis given in Chapter Five in which the mix is more sensitive to monetary policy during the tight period than the loose period. More specifically, the coefficients of *ARATE* are negative in all periods but they are relatively larger in absolute value in the period of 1991-1992[4]. Similarly, coefficients of rating, *SCORE*, total real fixed assets, *RASSET*, solvency ratio, *SOLV* and gearing ratio *GEAR*, do not change significantly across different models. However, they generally change across sub-periods reflecting monetary policy stance as expected. However, the coefficients of *AGE* and the ratio of tangible assets to total assets excluding intangible assets representing the collateral position of firms, *COL*, change across models as well as periods significantly. The difference between the fixed effects estimation, *Model 5*, and the random effects estimates are significant especially for these variables.

In Table 7.2 where the cumulative base rate, *BRATE* (only varied across time) is used as a measure of monetary stance, adding artificial variables to the model leads to a significant change in the coefficients of the base rate in the loose period and thus the whole sample, especially for the models estimated by fixed effects. In fact, the coefficients for the base rate are generally robust across random effects estimations as in

[3] In fact, we calculate these statistics by using Mathematica where it is possible to calculate Pseudo inverse (generalised inverse) of a matrix.
[4] We did not include the year 1990 in estimations because we observe a large number of missing observations for this specific year.

the case of *ARATE* observed in Table 7.1. The coefficients of the rating, and asset size, solvency and gearing ratio are quite robust across alternative measures of monetary stance and selectivity bias. However, the coefficients of the variable reflecting collateral differentiate generally across all models, while the coefficients of age differentiate between fixed effects and random effects estimations.

We carry out the same tests for the inventory and employment models in Chapter Six even though these models are in dynamic in structure, and where fixed effects or random effect estimates lead to inconsistent estimators. We estimate these models by splitting the sample according to the criteria used in the same chapter. The evidence is mixed; for some sub samples the coefficients of the artificial variables are significantly different from zero while for some others they are not significantly different from zero especially the fixed effects estimates. However, since we adopt dynamic panel estimators in Chapter Six not fixed or random effects, these conclusions may not be important.

7.4. Conclusion

Although the techniques that we employed for testing selectivity bias in this chapter have some weaknesses, the findings we discussed so far imply that the FAME sample, to some extent, contains selectivity bias. But importantly, the estimation results with the fixed effects model imply that the selectivity problem is not serious while the random effects results generally imply the opposite. The quasi-Hausman test proposed by Verbeek and Nijman (1992) support the selectivity bias. One may claim that the selection problem in the FAME sample is ignorable in terms of the implications of the hypothesis given in the empirical models but it does not reject completely the existence of selectivity bias. In other words, the coefficients of the key variables are robust after adding the artificial variables.

The fixed effects model results imply that the selectivity bias is ignorable in the model explaining the mix for the period of 1993-1999 when the data is reported more regularly. In addition, it is observed that for the inventory and employment models, splitting the sample estimations leads to insignificant coefficients for the artificial variables mostly in the fixed effects estimation. Further correction techniques are studied in the literature. These techniques may also be adopted to improve the consistency and

efficiency of the estimated coefficients in our models but our sample allows us limited applications because we do not observe the selection rule properly.

Table 7.1: Estimation Results for Testing Selection Bias in the Mix Model

	OBS	*ARATE*	*RASSET*	*SCORE*	*AGE*	*SOLV*	*COL*	*GEAR*	*SVAR*	R^2
Whole Period (1991-99)										
Model 1	**117,868**	**-0.002**	**3.523**	**-0.598**	**0.049**	**0.183**	**0.734**	**0.004**	**-**	**0.190**
		-3.62	43.24	-120.06	7.74	32.00	1.58	33.17	-	
Model 2	**117,868**	**-0.002**	**3.332**	**-0.597**	**0.041**	**0.183**	**0.500**	**0.004**	**3.573**	**0.199**
		-3.60	40.40	-119.83	6.61	32.12	1.08	33.72	11.74	
Model 3	**112,149**	**-0.002**	**3.129**	**-0.592**	**0.041**	**0.178**	**0.091**	**0.004**	**5.625**	**0.208**
		-3.71	38.09	-116.21	6.71	30.55	0.19	34.49	32.93	
Model 4	**117,868**	**-0.002**	**2.815**	**-0.590**	**0.048**	**0.216**	**-0.026**	**0.004**	**-0.001**	**0.269**
		-3.95	36.53	-123.83	8.18	39.56	-0.06	34.65	-105.77	
Model 5	**117,859**	**-0.002**	**2.729**	**-0.609**	**0.541**	**0.179**	**1.576**	**0.003**	**17.188**	**0.086**
		-3.56	12.20	-116.33	25.91	28.02	2.74	26.57	7.07	
Tight Period (1991-92)										
Model 1	**23,345**	**-0.012**	**2.841**	**-0.713**	**0.011**	**0.302**	**2.219**	**0.005**	**-**	**0.230**
		-3.42	23.89	-62.18	1.38	23.81	2.55	21.75	-	
Model 2	**23,345**	**-0.012**	**2.421**	**-0.710**	**0.004**	**0.313**	**1.407**	**0.006**	**6.496**	**0.248**
		-3.41	20.16	-62.31	0.43	24.85	1.63	23.13	17.35	
Model 3	**18,995**	**-0.011**	**2.442**	**-0.694**	**0.012**	**0.284**	**0.682**	**0.006**	**5.044**	**0.232**
		-3.22	18.97	-54.51	1.34	20.30	0.71	19.59	11.77	
Model 4	**23,345**	**-0.013**	**2.278**	**-0.687**	**0.015**	**0.333**	**1.539**	**0.005**	**-0.001**	**0.295**
		-3.74	19.93	-62.10	1.88	27.26	1.85	22.58	-42.37	
Model 5	**23,343**	**-0.009**	**5.530**	**-0.756**	**1.552**	**0.407**	**-0.512**	**0.004**	**-38.805**	**0.022**
		-2.44	4.28	-44.75	7.73	16.30	-0.22	10.92	-2.46	
Loose Period (1993-99)										
Model 1	**94,523**	**-0.002**	**3.489**	**-0.586**	**0.043**	**0.172**	**0.498**	**0.004**	**-**	**0.183**
		-3.30	39.48	-105.06	6.47	27.03	0.96	28.85	-	
Model 2	**94,523**	**-0.002**	**3.276**	**-0.585**	**0.035**	**0.173**	**0.268**	**0.004**	**3.582**	**0.192**
		-3.29	36.50	-104.89	5.29	27.16	0.52	29.45	11.21	
Model 3	**93,154**	**-0.002**	**3.163**	**-0.586**	**0.038**	**0.174**	**-0.022**	**0.004**	**5.706**	**0.205**
		-3.41	36.15	-104.65	5.88	27.28	-0.04	31.10	30.53	
Model 4	**94,523**	**-0.002**	**2.691**	**-0.581**	**0.041**	**0.208**	**-0.055**	**0.003**	**-0.001**	**0.267**
		-3.62	32.20	-109.28	6.56	34.32	-0.11	30.08	-99.36	
Model 5	**94,516**	**-0.002**	**3.829**	**-0.596**	**0.746**	**0.162**	**0.597**	**0.003**	**0.734**	**0.057**
		-3.26	14.90	-100.30	27.69	21.99	0.90	21.49	0.29	

Table 7.2: Estimation Results for Testing Selection Bias in the Mix Model

	OBS	*BRATE*	*RASSET*	*SCORE*	*AGE*	*SOLV*	*COL*	*GEAR*	*SVAR*	R^2
Model 1	**117,868**	**-0.006**	**3.513**	**-0.598**	**0.047**	**0.183**	**0.803**	**0.004**	**-**	**0.190**
		-2.30	43.05	-120.09	7.43	32.01	1.72	33.18	-	
Model 2	**117,868**	**-0.007**	**3.318**	**-0.597**	**0.039**	**0.183**	**0.582**	**0.004**	**3.612**	**0.200**
		-2.85	40.16	-119.87	6.23	32.13	1.25	33.75	11.85	
Model 3	**112,149**	**0.002**	**3.130**	**-0.592**	**0.042**	**0.178**	**0.070**	**0.004**	**5.624**	**0.208**
		0.81	38.09	-116.19	6.77	30.56	0.15	34.49	32.93	
Model 4	**117,868**	**-0.012**	**2.794**	**-0.591**	**0.045**	**0.216**	**0.117**	**0.004**	**-0.001**	**0.270**
		-5.10	36.21	-123.94	7.56	39.60	0.27	34.69	-105.86	
Model 5	**117,859**	**0.028**	**3.185**	**-0.609**	**0.626**	**0.177**	**1.410**	**0.003**	**9.618**	**0.074**
		9.88	13.95	-116.29	27.74	27.70	2.46	26.43	3.78	
Tight Period (1991-92)										
Model 1	**23,345**	**-0.075**	**2.842**	**-0.712**	**0.010**	**0.300**	**2.349**	**0.005**	**-**	**0.231**
		-8.02	23.92	-62.15	1.24	23.69	2.70	21.84	-	
Model 2	**23,345**	**-0.082**	**2.412**	**-0.709**	**0.002**	**0.311**	**1.529**	**0.006**	**6.648**	**0.248**
		-8.82	20.13	-62.27	0.25	24.76	1.77	23.27	17.77	
Model 3	**18,995**	**-0.045**	**2.468**	**-0.693**	**0.011**	**0.282**	**0.719**	**0.006**	**4.883**	**0.231**
		-4.21	19.15	-54.38	1.27	20.17	0.75	19.60	11.35	
Model 4	**23,345**	**-0.073**	**2.279**	**-0.686**	**0.014**	**0.331**	**1.662**	**0.005**	**-0.001**	**0.295**
		-8.02	19.96	-62.07	1.74	27.15	2.00	22.67	-42.36	
Model 5	**23,343**	**-0.085**	**5.549**	**-0.757**	**-**	**0.407**	**-0.466**	**0.004**	**-39.069**	**0.218**
		-7.76	4.30	-44.79	-	16.31	-0.20	10.92	-2.48	
Loose Period (1993-99)										
Model 1	**94,523**	**0.060**	**3.424**	**-0.588**	**0.037**	**0.172**	**0.585**	**0.004**	**-**	**0.185**
		13.30	38.73	-105.45	5.51	27.05	1.13	28.91	-	
Model 2	**94,523**	**0.062**	**3.203**	**-0.587**	**0.029**	**0.173**	**0.348**	**0.004**	**3.707**	**0.194**
		13.64	35.67	-105.29	4.28	27.19	0.68	29.53	11.61	
Model 3	**93,154**	**0.058**	**3.111**	**-0.588**	**0.033**	**0.174**	**0.056**	**0.004**	**5.683**	**0.206**
		12.69	35.55	-105.02	5.02	27.31	0.11	31.15	30.43	
Model 4	**94,523**	**0.049**	**2.643**	**-0.582**	**0.036**	**0.208**	**0.016**	**0.003**	**-0.001**	**0.268**
		11.20	31.61	-109.60	5.77	34.32	0.03	30.12	-99.06	
Model 5	**94,516**	**0.009**	**3.909**	**-0.596**	**0.728**	**0.163**	**0.596**	**0.003**	**-0.433**	**0.059**
		1.79	14.97	-100.26	25.20	22.05	0.90	21.51	-0.16	

CHAPTER EIGHT

Conclusion

8.1. Introduction

The main objective of this thesis has been to investigate empirically how monetary policy affects non-financial firms' real activity with a special emphasis on external finance. We use a large panel of UK manufacturing firms to test various hypotheses related to the credit channel of monetary transmission. The thesis contributes to the empirical literature mainly by identifying the responses of firms to monetary policy across policy regime periods and firm-groups where they are categorised according to their financial positions and degree of informational asymmetries. We provide evidence for the credit channel of monetary transmission by adopting a micro-level analysis. This line of research may provide an alternative for solving the problems associated with the generalisations and some other empirical issues.

This chapter provides a summary of the thesis in the context of its main findings and contributions. It also discusses the limitations of the analysis and offers some suggestions for further research in this area. The remainder of this chapter is organised as follows. Section Two presents a summary of the main findings chapter by chapter. Section Three assesses what this thesis adds to the literature and provides some further study suggestions.

8.2. Summary of Main Findings

The literature survey that we have provided in Chapter Two shows that monetary policy affects aggregate demand through a variety of channels. More attention has been recently paid to the credit channels of monetary transmission that focus mainly on interactions between policy and financial positions of firms. This approach recognizes the importance of informational asymmetries and agency costs. The role of financial intermediaries and firms' financial positions for macroeconomic performance can be discussed within this

setting where the choice of firm finance among equity, bond, bank loans, internal finance or any other finance is important for firms' real activity. Therefore, monetary policy and the underlying transmission mechanism as well as information about the basic tendencies in financial markets are crucial for macroeconomic stability and economic efficiency. In fact, financial crises and their impacts on the redistribution of wealth and resources can be understood well within this framework.

The monetary policy transmission is now a more complicated issue as innovations in the financial markets set in, and it needs to be properly identified for an efficient macroeconomic policy. There are some difficulties associated with identifying monetary transmission channels empirically because of a simultaneity problem in the supply-demand dynamics, the endogenous nature of policy actions, and the non-observable nature of some critical variables such as the real interest rate. As firm level data have become more available, these issues are less relevant. Before going into the empirical results, we are going to discuss our main findings from the comparative statics of Chapter Three.

Firms in the model have three different profiles. Firstly, high profile firms are expected to invest in good projects that are financed directly from the capital market at a low cost because they are rich in collateral, highly profitable and have good reputation. Secondly, firms with an intermediate profile are more likely to adopt good projects and to get finance from the banks by paying a monitoring cost. Lastly, firms with a low profile invest in risky projects and get high cost funds from the market to finance these projects. There are many factors that determine the firms' profile and their financial positions such as size, collateral level, profitability, probability of choosing a project type (the risk factor), indebtedness, monitoring cost, and the interaction of these variables with monetary policy shocks. In this chapter, we have derived some comparative statics that provide important implications for the impact of monetary policy on the firms' choice of finance and its interaction with firm characteristics.

As the market interest rate increases as a result of tight monetary policy, the demand for bank finance increases. However, since we assume that bank loans shrink during tight periods, firms who previously had access to bank loans are no longer able to do it and thus they move to the low profile category where they are more likely to invest

in bad projects. Similarly, since an increase in the market interest rate weakens the net worth positions of some firms, they are no longer able to finance their investment from the capital market at a low cost and therefore have to rely more on bank finance. Therefore, firms that were initially in the intermediate profile will have lower bank finance versus market finance and firms in the high profile now would have high bank finance versus market finance. Since it is costly to shift among different sources of finance, a shock that changes the composition of firm finance is likely to be influential over the investment and production decisions of firms.[1] Again, an increase in the market interest rate would increase demand for bank finance more for those firms whose net-worth ratios are more sensitive to changes in the interest rate. If the net worth ratios of firms were not sensitive to the interest rate (those firms that hedge against policy changes), the demand of these firms for intermediary or bank finance would be less relative to those that are financially weak. This result confirms the financial accelerator theory where credit market conditions amplify and propagate the impacts of monetary shocks on the real activity of financially weak firms (Bernanke, Gertler and Gilchrist, 1996). We summarise the remaining predications of the model in the following paragraph.

If the project size is proportional to total assets, an increase in firm size, *ceteris paribus*, leads some firms in the lower profile to invest in good projects and finance these projects by bank funds. In addition, low risk, *ceteris paribus,* increases the number of firms that have access to the low-cost market finance. In an environment where risk is substantial, firms tend to choose inefficient projects, which in turn impedes investment and overall real activity. Moreover, as collateral assets increase firms are more likely to have access to market finance and small firms are more sensitive to a change in the value of their collateral assets. This prediction may explain the fact that in relatively rich countries with developed financial markets where firms on average have large assets, the share of bank finance gets smaller, as only constrained firms raise funds from intermediary institutions.

[1] Based on these predictions and Kashyap, Stein, Wilcox (1993), we estimated the econometric models in Chapter Five and Chapter Six.

In Chapter Four, we have carried out a descriptive analysis of the UK manufacturing sector and highlighted stylised facts of the data set employed in the empirical analysis. Evidence shows that the recession in the early 1990s has been very destructive for corporate economic activity. Monetary policy supported the upward movement of real interest rates in this period, which in turn created harsh conditions for financially weak firms. The closure rate increased very rapidly especially for small and young non-financial firms. Young and small firms which could not pay their bank loans back, in turn, increased bad debts. The recession was followed by a stable economic environment where low and stable inflation led to a fall in the cost of external finance premium through a decline in equity and the inflation risk premium during the second half of the 1990s. We carried out our analysis considering two sub-periods reflecting the recession in the early 1990s and the following recovery and stable period.

The distribution of firms' rating scores highlights the impact of the recession in the early 1990s on the firms' financial reputation. While the share of unstable and high risky firms are higher during the recession relative to the recovery period, the share of secure and stable firms are higher during the upswing period. Large firms have relatively high rating scores over the business cycle while the average rating during the recession is lower than it is in the upswing period and the margin between periods becomes wider as firm size declines.

Our sample contains rich information on variables that are important for our empirical analysis even though there are some missing observations. Missing observations are more frequent during the recession periods for small, young and risky firms. We have cross-checked key variables of some quoted firms extracted from our *FAME* sample with their corresponding figures in *Datastream* and *One Source* data sets. We have found some differences among data sets for some particular variables. The differences are mainly due to definitions and missing observations. The FAME sample fits our expectations concerning the data in the sense that a large number of firms with rich variety allows us to test our hypotheses.

Chapter Five is one of the empirical chapters in this thesis. We have estimated our empirical model using the fixed effects, the *IV-2SLS* procedures. However, we have mainly focused on the estimations obtained from the fixed effects model that produced

similar results with the *IV-2SLS* procedure. We have provided estimations for three different versions of the mix to extract information about the impact of monetary policy, firm characteristics and other control variables on the liabilities composition of firms. The mix variables are regressed on a number of financial variables, the GDP growth, monetary policy stance, and interaction terms that capture the impact of monetary policy stance across firm characteristics and monetary policy regimes. The main findings for *MIX1* and *MIX2* do not differ significantly therefore we will summarise findings for the former, which has implications for both the bank lending channel and the broad credit channel as suggested by Kashyap, Stein and Wilcox (1993) and Oliner and Rudebush (1996). In addition, we have used two alternative monetary stance variables, namely the cumulative base rate and the apparent interest rate. We will provide the results of estimations where the former variable is used as an explanatory variable.

Estimations results show that *MIX1* is generally more sensitive to monetary policy stance for small, risky, young, and highly indebted firms than their counterpart firm groups, namely large, secure, old, and low indebted firms during the recessionary period. Firms in the former groups are assumed to be financially constrained and therefore are more likely to be subject to a moral hazard problem. Evidence shows that financially constrained and poorly collateralised firms are less likely to have access to low cost market finance and therefore they depend on bank or equity finance. However, it is even more difficult to get bank credits when monetary conditions tighten with an increase in the interest rate. During tight periods, firms have to give up investment and production activities, which is consistent with the broad credit channel.

We have observed an asymmetry concerning the impact of monetary policy stance. By using dummy variables that capture two different monetary policy regimes as components of interaction terms in addition to firm characteristic dummies, it is found that financially weak firms had hardly any access to bank finance during the tight period. Some financially strong firms who used to get finance directly from the market also faced difficulties during the tight period and therefore they shifted towards bank finance. Since the bank loan supply declines during a tight monetary policy period, some bank dependent firms did not obtain bank finance either. However, during the recovery period, relatively weak firms were more likely to get bank finance and some relatively strong firms shifted from bank finance to low cost market finance. These results show us that

monetary policy can affect the activity of firms asymmetrically over the business cycles. Financially strong firms are more persistent to the negative shocks than financially weak firms; therefore monetary policy shocks can affect the real activity of firms and thus the distribution of wealth in the economy.

We also find evidence that *MIX1* decline for all firm groups during the tight period conditioning on interaction terms for various firm characteristics. The decline in the share of bank finance across firm groups implies a restrictive monetary policy on bank loans. Evidence shows that less financially constrained firms are more likely to have access to bank loans during the tight periods compared to more financially constrained firms therefore we may expect an increase in *MIX1* for these firms. However, our findings clearly show that the restrictive impact of the tight policy dominates the shift of bank finance across firm types. This result indirectly confirms that monetary policy affects the choice of finance also through the bank lending channel by reducing the overall supply of bank loans.

We also found evidence that asset size, rating score, gearing ratio, the share of tangible asset in total assets, and age have significant effects on the mix variables. As firms' rating score increases they are more likely to get market finance while asset size, and the age of the firm that capture firm reputation increase the likelihood of getting bank finance. In addition, the ratio of short term debt to current liabilities increases with the ratio of tangible to total assets in the fixed effects estimations but it declines with this ratio in the *IV-2SLS* estimations. Only the results for the latter estimation method confirm the theoretical predictions derived from the model in Chapter Three where firms tend to get more non-bank finance as their collateral assets increase relatively. Similarly, the ratio of short term debt to total debt decline with this ratio. This result confirms that firms with high value collateral assets are more likely to get the long term debt. We also find out that an increase in general economic activity (the increase in the GDP growth rate) reduces the mix, that is, firms are more likely to have access to market finance as the economy grows.

We have already pointed out that monetary policy affects the choice of firm finance. In Chapter Six we test whether the choice of finance is important for real activity. Our empirical model is based on a cash flow-investment setting which hypothesises that the lack of internal funds imposes a constraint on inventory investment and employment

because the external finance is costlier than the internal finance. We use cash flow, the share of short term debt to current liabilities, and cumulative base rate among the explanatory variables of inventory investment and employment growth to test the Modigliani and Miller theorem and the credit channel of monetary transmission. The cumulative base rate, as a proxy of the user cost of capital, explains the interest rate channel while the mix and cash flow capture the credit channel. Investments have been mostly modelled within a dynamic framework. We use the lags of dependent variables to explain inventory investment and employment growth rates using the difference *GMM* procedure. Contrary to the empirical model in Chapter Five, we could not capture the impact of the monetary policy regime periods because we lost observations for the tight period in this estimation procedure. As in Chapter Five, we carry out estimations by using interaction terms that capture the impact of financial variables across various firm types.

The coefficients of the ratio of short term debt to current liabilities are positive and significant across firm groups for both the inventory investment and employment growth models but they are relatively smaller in the employment growth model. In other words, a contractionary monetary policy, which squeezes the bank loan supply, reduces both inventory investment and employment by changing the cost and availability of bank finance but the effect is limited for employment growth. This result implies that having access to bank finance is special: it reduces the extent of informational problems and has a positive impact on firms' real activity. The estimation results in Chapters Five and Six confirm the bank lending channel. The coefficients of interaction terms do differ significantly across firms groups implying that financial variables affect firms' activities heterogeneously.

The coefficients of the cumulative base rate are negative and generally significant in the inventory investment growth model but they are smaller and generally insignificant in the employment growth model. These coefficients are larger when we do not control for interaction terms. This result confirms the interest rate channel where high interest rates reduce firms' investment. This finding also confirms that there is a credit channel that is complementary to the interest rate channel.

Cash flow captures the impact of net worth on inventory and employment activity. The coefficients for the first lag of cash flow are positive and they are generally

significant across firm groups in both inventory the employment models. Although the findings do not support the cash flow hypotheses forwarded by Fazzari *et al.* (1988) directly, they imply that internal funds or net worth of firms are very important for their investment and employment activity. The cash flow hypothesis is more likely to hold when some firms are in financial difficulties but the sample that we use for our estimations belongs to a period when macro and micro conditions have been supportive for the finance of potentially constrained firms, therefore our results are not surprising.

Since our sample is truncated from below in terms of firm size and there are quite a number of missing observations, we carried out preliminary selectivity tests in Chapter Seven. We have found out that the FAME sample, to some extent, contains selectivity bias. The quasi-Hausman test proposed by Verbeek and Nijman (1992) supports the selectivity bias. We got mixed evidence from variable addition tests for the hypothesis that the selectivity bias can be ignored. However, our empirical results are robust after adding artificial variables implying that our main findings in Chapter Five and Chapter Six are still valid.

8.3. Contributions, Limitations and Further Study Suggestions

The main contribution of this thesis has been the empirical identification of the credit channels of monetary policy transmission by using a large firm level panel sample. We identify the broad credit channel, and the interest rate channel directly and the bank lending channel indirectly using UK data. Kashyap, Stein and Wilcox (1993) identified the bank lending channel by using the mix and found evidence for US aggregate data while Oliner and Rudebusch (1996) criticized this study and did not find evidence for the bank lending channel for US data when they split the sample according to the size of firms. Following this debate, we have carried out further estimation tests by considering various firm characteristics. Therefore, in addition to size we split the sample according to rating score, dividend, age, indebtedness, and sectors, and we have used panel data techniques that control for firm specific effects over the business cycle.

We also employ a number of financial variables that explain the financial mix based on an extended moral hazard model through which we test the impact of monetary policy on the choice of bank versus market finance taking into account various firm

characteristics. Therefore, we control for endogeneity problems sourced from the interaction between the monetary policy stance and financial variables. We use a very large firm level sample during the period 1990-1999 to test our empirical models (over one hundred thousand firm year observations for some estimation). This sample allows us to split data across the firm characteristics mentioned above and monetary policy regime periods. Therefore, we could control for the structural change in the policy regime and for firm heterogeneity. We also cross check some key variables used in the analysis with other data sets. We think that our data set is suitable and rich enough for our analysis although it includes some missing observations.

We also test how inventory investment and employment growth rates respond to the monetary policy stance and variations in financial variables based on the framework of cash flow hypothesis. We add the ratio of short term debt to current liabilities to test the validity of the Modigliani and Miller theorem in this setting. We also confirm that inventory investment has lower adjustment costs than employment because the former is more sensitive to monetary policy and the choice of finance.

One limitation of the thesis is to find a better measure of the monetary policy stance. We used the firm invariant cumulative base rate and the apparent interest rate, which is an exogenous variable, to control for monetary policy stance, however, both of them have some weaknesses. In fact, we overcome the problem of a firm invariant monetary stance to some extent by using firm group dummies in the regressions. Future work could make use of alternative measures of monetary stance by a variable resembling Romer dates based on Monetary Policy Committee minutes for the UK.

Another limitation of the thesis is associated with difficulties in identifying a selectivity rule that would allow us to do further statistical analyses including the Heckman procedure, bootstrapping for testing the selectivity bias. Here we have carried out only preliminary tests on whether this bias can be ignored or not.

The theoretical model that we discussed in Chapter Three considers only the demand side dynamics thus it has a weakness in capturing the supply side of funds. In addition, we could not capture the supply side effects when we interpret the sensitivity of the mix variables to monetary policy. Therefore, further research may be carried out to

study the reactions of bank credit to monetary policy controlling for other financial variables, and to find out the determinants of variables that make up the mix variabels separately by including supply side variables in the analysis. In fact, we have some difficulties in identifying whether the changes in the mix variables are associated with variations in the numerator or the denominator.

We suggest extending the research on the monetary policy transmission through analysing the impact of monetary policy on firm exit and entry rates in the UK. We have already discussed in Chapter Four that small firms are important for creating employment. An adverse macroeconomic environment led the closure rate to increase sharply during the recession in the early 1990s. In this context, it is worthwhile to answer the following questions. To what extent do monetary policy shocks affect firm exit and entry rate, do the choice of finance and financial factors that capture supply and demand dynamics have any impact on exit and entry rates? There is already theoretical literature that investigated the effects of financial market imperfections on entry and exit rates (See Cooley and Quadrini; 2001, Gomes; 2001). Capturing issues related to the choice of external finance would add value to this theoretical literature. Existing data sets allow access to information on financial variables for already bankrupted or liquidated and newly-created firms and thus to empirically test the role financial factors in firm exit and entry rates.

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DATA APPENDIX

Construction of Variables

We provide detailed information about the data set used in this thesis (the FAME) in Chapter Four. We use firm level balance sheet, and profit-loss account information for 22 manufacturing industries in the UK over the period of 1990-1999. Initially, the sample includes 16,356 manufacturing firms. Since some firms do not report most of the variables used in the regressions, these firms have been removed from the sample. Therefore, we start our empirical analysis with 15,996 firms in Chapter Five. The variables that have very large dispersion (having very high maximum values and very low minimum values relative to their means), have been trimmed from the upper and the lower tails of distribution to remove outliers. For the regressions of Chapter Five, we trim 0.5 percent of observations both from above and the below to remove the outliers for the apparent interest rates, the gearing ratio, the age of firms and real tangible assets. The rest of variables are ratios and take values in a certain range, that is, mix variables, rating score and the collateral ratio are in the range of zero and one hundred therefore we did not trim these variables. The number of firms actually used in the econometric estimations is further reduced after removing the outliers in the sample. For example, in the *MIX1* regression, the number of firms actually used is 15,491.

In Chapter Six, we start from the original sample -untrimmed- in order to avoid loss of observations originated from trimming that has been done for the empirical estimations in Chapter Five. We trim all variables that are used for the empirical estimations of inventory and employment growth equations in Chapter Six except for *BRATE* and *MIX*. The number of firms that are used in the inventory investment model is 8,609, while it is 8,594 for the employment model. We define the individual variables used in the econometric estimations in the following pages.

Variables Used in Chapter Five

$MIX1_{it}$: The ratio of short-term debt to total current liabilities in percentage. This variable is used as dependent variable for econometric estimations to identify the credit channel. The short-term debt is made up of bank overdraft and other short-term debt and thus it is supposed to reflect bank finance. We also use *MIX1* as an explanatory variable in the models used in Chapter Six.

$MIX2_{it}$: The ratio of total debt to total liabilities in percentage. This variable is also used as a dependent variable in the econometric estimations. The $MIX2_{it}$ is a version of the $MIX1_{it}$, which considers also long-term liabilities. For our analysis, the $MIX1_{it}$ is expected to be more informative as it is made up of current liabilities that are more likely to be subject to fluctuations for the constrained firms during tight periods. Therefore, it contains more information in testing the credit channel.

$MIX3_{it}$: The ratio of short-term debt to total debt in percentage. We use $MIX3_{it}$ as a dependent variable in our analysis in order to identify the impact of monetary policy on the debt structure rather than identifying the credit channel directly. In other words, the credit channel is identified more often by focusing on the relative variation of bank versus-non-bank finance rather than short-term debt versus long-term debt.

$BRATE_t$ (Cumulative base rate): We create an index for the Bank of England base rate to reflect the change in the monetary policy stance. Percentage changes in the base rate are added to the previous year value starting from the base year, *1990=100*. We adopt this methodology to smooth the fluctuations in the base rate. This variable does not change with firms but it does with time. We also use the cumulative base rate as an explanatory variable in the models used in Chapter Six.

$ARATE_{it}$ (Apparent interest rate): The ratio of interest payment to total debt in percentage. This variable varies across time and firms. It is supposed to capture the interest burden on firms.

$SCORE_{it}$ (Credit Rating Score): This rating score is produced by Qui Credit Assessment Ltd. and measures the likelihood of company failure in the twelve months following the date of calculation. The score is between zero and 100; a larger score implies a lower probability of failure for firms.

RASSET$_{it}$ (Real tangible assets in logarithm)[1]: The nominal value of tangible assets for each firm is deflated by a sectoral *input price index* that reflects the input costs for specific sectors. This price index is calculated by the Office for National Statistics and is called the *MM17* (see on http://www.statistics.gov.uk/CCI/SearchRes.asp?term=mm17). It contains detailed indexes for revaluation of assets and stocks and it is a guide to capital replacement costs. That is, it contains price indexes for specific types of assets, namely, plant and machinery bought as fixed assets, stocks, stocks held as materials and fuel (excluding electricity, gas and water) including imports, wholesale distribution (including imports), road motor vehicles. Since these price indexes do not include all sub-sectors in the manufacturing industry we fill the gap with another price index that is called the *MM22*. This index also contains input and output prices on UK manufactured products at detailed industry level.

AGE$_{it}$ (Age of Firms): This variable is supposed to capture the importance of track record for financial and real activities. Only firms that are incorporated before 1990 are considered in our analysis. We intend to use as much as possible active firms over the estimation period in order to identify their reactions across policy regime periods (tight versus loose periods) otherwise we could not identify the impact of tight policy in the early 1990s for the firms that were incorporated sometime after the recession.

GEAR$_{it}$ (Gearing ratio): The ratio of short-term debt and long-term liabilities to shareholders' equity in percentage. This variable captures the indebtedness position of firms and thus their financial healthiness. In fact, even after trimming, there is a large gap between maximum and minimum values of this variable.

COL$_{it}$ (Collateral ratio): The ratio of tangible assets to total assets. This variable reflects the collateral level of firms and thus it may capture the ability of firms getting finance with relatively low cost external finance.

GDP$_t$: The annual growth rate of real gross domestic product. This variable is used in the estimations in order to control for general macroeconomic environment and aggregate demand.

[1] We tend to use this variable as an explanatory variable in order to capture the activity level (size) of firms and it does not necessarily reflect the capital stock of firms. Fazzari *et al.* (1988) and Bond and Meghir (1994) suggest methods for calculating replacement cost of capital. These methods entail information on the age of capital stock. The price index that we used in the analysis reflects the weighted average of the past cost of these industries and therefore it can be used to calculate the replacement cost of capital.

Variables Used in Chapter Six

$GINV_{it}$ (Inventory growth): The change in the logarithm of the real inventory stocks. The nominal values of inventory stock are deflated by the same index used for tangible assets. We tend to use this variable to test the extent to which it is affected by financial variables across various firm types.

$GEMP_{it}$ (Employment growth): The change in the logarithm of the number of employees. The number of employees reflects the activity level of firms and it is less subject to fluctuations compared to inventories and fixed investment.

GS_{it} (Sales growth): The change in the logarithm of the real sales. Real sales are calculated by deflating the nominal sales by two-digit SIC producer price index (Producer Prices-First Release, PPI) that reflects mainly output prices and calculated by the Office of National Statistics (see on http://www. statistics.gov.uk /STATBASE/Product.asp?vlnk=790).

$RINVS_{it}$ (Adjustment term): The ratio of inventory investment to sales. This variable is an adjustment term in the target adjustment model proposed by Lovell (1961) and employed by Kashyap et al. (1994) and others in their estimations.

CF_{it} (Logarithm of real cash flow): Nominal cash flow, profit after tax and interest payment plus depreciation, is deflated by the input price index used for the tangible assets and inventories. This variable is widely used in the financial constraints literature and it reflects the net worth of firms.

$GRTA_{it}$ (Tangible assets growth): Change in $RASSET_{it}$.

GW_{it} (Wage growth): Change in the logarithm of the real wage bill. The oominal value of salary payment is normalized by sectoral producer price index (Producer Prices-First Release, PPI) to calculate real wages. This variable captures the employment cost.

Dividend Payout Ratio: The ratio of dividend payment to total assets. This variable is often used as criterion in order to split firms as more financially constrained and less financially constrained in line of Fazzari *et al.* (1988) and Bond and Meghir (1994). The first study uses the ratio dividend to income as a splitting criterion while the second uses the ratio of dividend to capital stock.

We also use *BRATE* and *MIX1*, which is denoted by *MIX*, as explanatory variables in the empirical models in Chapter Six.

Splitting Criteria According to Firm Type

Firm Type	*Definition*
Small	Small firms meet at least two out of three following criteria; Turnover < £2.8 million, Total assets <£1.4 million, Number of employee< 50
Large	Large firms meet at least two out of three following criteria; Turnover >£11.2 million, Total assets >£5.6 million, Number of employee> 250
Risky	Rating score (under 40 out of 100)
Secure	Rating score (over 60 out of 100)
Young	Lower 25% of age distribution (age<13 years)
Old	Lower 25% of age distribution (age>43 years)
Low Dividend	Upper 25% of dividend payout ratio distribution
High Dividend	Lower 25% of dividend payout ratio distribution
Highly Indebted	Upper 25% of gearing ratio distribution
Less Indebted	Lower 25% of gearing ratio distribution

Table A.5.1. Fixed Effects Estimation Results for the Short Term Debt-Current Liabilities Ratio (MIX1)

	No Inter. Terms (1)	*TYPE- Small (2)*	*TYPE - Large (3)*	*TYPE - Risky (4)*	*TYPE- Secure (5)*	*TYPE – Young (6)*	*TYPE- Old (7)*	*TYPE-High Indebted (8)*	*TYPE- Less Indebted (9)*
ARATE	-0.184***	-0.197***	-0.195***	-0.181***	-0.219***	-0.187***	-0.176***	-0.180***	-0.222***
	(57.82)	(40.47)	(35.67)	(41.45)	(37.74)	(45.28)	(37.25)	(41.04)	(42.84)
ARATE*TP*TYPE		-0.060***	0.016**	-0.025	0.002	-0.029***	0.051***	-0.076***	0.036***
		(5.12)	(2.06)	(1.50)	(0.22)	(3.28)	(4.21)	(5.02)	(3.32)
ARATE*TYPE		0.034***	0.013*	-0.052***	0.064***	-0.000	-0.041***	-0.047***	0.096***
		(3.89)	(1.68)	(4.14)	(7.95)	(0.24)	(4.48)	(3.91)	(11.52)
ARATE*TP		0.021***	0.005	0.006	0.006	0.013**	-0.008	0.014**	-0.004
		(3.14)	(0.89)	(1.03)	(0.74)	(2.05)	(1.25)	(2.34)	(0.62)
TP		0.935***	0.954***	0.972***	0.966***	0.961***	0.958***	1.004***	1.006***
		(3.43)	(3.51)	(3.57)	(3.55)	(3.53)	(3.52)	(3.69)	(3.70)
AGE	0.802***	0.865***	0.864***	0.865***	0.866***	0.866***	0.868***	0.864***	0.863***
	(37.96)	(32.34)	(32.30)	(32.36)	(32.41)	(32.37)	(32.43)	(32.31)	(32.32)
GDP	-0.648***	-0.474***	-0.474***	-0.474***	-0.475***	-0.474***	-0.475***	-0.471***	-0.478***
	(19.59)	(8.32)	(8.31)	(8.31)	(8.34)	(8.31)	(8.32)	(8.26)	(8.39)
SCORE	-0.449***	-0.450***	-0.449***	-0.449***	-0.449***	-0.449***	-0.449***	-0.449***	-0.447***
	(116.42)	(116.40)	(116.31)	(116.39)	(116.23)	(116.37)	(116.38)	(116.43)	(116.01)
RASSET	2.687***	2.646***	2.659***	2.666***	2.644***	2.630***	2.624***	2.645***	2.620***
	(18.84)	(18.52)	(18.61)	(18.66)	(18.52)	(18.38)	(18.34)	(18.52)	(18.36)
GEAR	0.011***	0.011***	0.011***	0.011***	0.011***	0.011***	0.011***	0.011***	0.011***
	(44.72)	(44.72)	(44.74)	(44.43)	(44.39)	(44.78)	(44.79)	(44.09)	(44.28)
COL	1.469***	1.455***	1.452***	1.458***	1.410**	1.448***	1.483***	1.421***	1.452***
	(2.67)	(2.65)	(2.64)	(2.65)	(2.57)	(2.63)	(2.70)	(2.58)	(2.64)
CONS	8.804***	6.621***	6.503***	6.428***	6.594***	6.703***	6.678***	6.665***	6.873***
	(7.57)	(5.04)	(4.95)	(4.89)	(5.02)	(5.10)	(5.08)	(5.07)	(5.24)
Hausman Spec. Test	1,791***	1,457***	1,478***	1,525***	1,525***	1,414***	1,395***	1,412***	1,466***
R-squared	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22

Absolute value of t statistics in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%,

Numbers of firms and of observations are 15,491 and 123,422, respectively.

TYPE represents the respective firm type dummies that interact with the monetary policy stance variable and the tight period dummy.

The Hausman specification test has χ^2 distribution with *k-1* degrees of freedom where *k* denotes the number of estimated coefficients in the regressions. The Hausman test results confirm that there is a systematic difference between the coefficients obtained for the fixed effects and of random effects specifications. Therefore, the results for the consistent specification that is the fixed effects are reported in this study.

Table A.5.2. Fixed Effects Estimation Results for the Total Debt-Total Liabilities Ratio (MIX2)

	No Inter. Terms (1)	*TYPE- Small (2)*	*TYPE - Large (3)*	*TYPE - Risky (4)*	*TYPE- Secure (5)*	*TYPE – Young (6)*	*TYPE- Old (7)*	*TYPE-High Indebted (8)*	*TYPE- Less Indebted (9)*
ARATE	-0.239***	-0.252***	-0.241***	-0.238***	-0.263***	-0.239***	-0.230***	-0.225***	-0.290***
	(75.12)	(51.89)	(44.23)	(54.50)	(45.22)	(57.86)	(48.52)	(51.30)	(55.98)
ARATE*TP*TYPE		-0.023**	-0.020***	-0.039**	0.034***	0.003	0.009	-0.077***	0.054***
		(2.00)	(2.60)	(2.35)	(3.26)	(0.33)	(0.79)	(5.04)	(4.93)
ARATE*TYPE		0.046***	0.028***	-0.008	0.047***	-0.000	-0.035***	-0.102***	0.138***
		(5.22)	(3.70)	(0.61)	(5.85)	(0.23)	(3.89)	(8.51)	(16.63)
ARATE*TP		0.006	-0.001	0.002	-0.016**	-0.003	-0.005	0.009	-0.015**
		(0.85)	(0.22)	(0.34)	(2.05)	(0.39)	(0.72)	(1.39)	(2.14)
TP		0.483*	0.492*	0.501*	0.521*	0.494*	0.494*	0.554**	0.568**
		(1.78)	(1.81)	(1.84)	(1.92)	(1.82)	(1.82)	(2.04)	(2.09)
AGE	0.604***	0.633***	0.633***	0.633***	0.635***	0.633***	0.635***	0.633***	0.632***
	(28.61)	(23.69)	(23.70)	(23.69)	(23.75)	(23.69)	(23.74)	(23.71)	(23.72)
GDP	-0.683***	-0.600***	-0.601***	-0.599***	-0.599***	-0.599***	-0.600***	-0.594***	-0.604***
	(20.66)	(10.52)	(10.54)	(10.51)	(10.52)	(10.51)	(10.53)	(10.43)	(10.62)
SCORE	-0.302***	-0.302***	-0.302***	-0.302***	-0.301***	-0.302***	-0.302***	-0.302***	-0.300***
	(78.32)	(78.23)	(78.19)	(78.27)	(78.12)	(78.26)	(78.28)	(78.43)	(77.86)
RASSET	3.962***	3.941***	3.938***	3.957***	3.941***	3.951***	3.946***	3.932***	3.899***
	(27.79)	(27.60)	(27.57)	(27.70)	(27.60)	(27.63)	(27.59)	(27.56)	(27.38)
GEAR	0.018***	0.018***	0.018***	0.018***	0.018***	0.018***	0.018***	0.018***	0.018***
	(70.67)	(70.70)	(70.72)	(70.49)	(70.38)	(70.67)	(70.71)	(69.57)	(70.13)
COL	16.104***	16.112***	16.113***	16.100***	16.062***	16.098***	16.112***	16.066***	16.100***
	(29.29)	(29.30)	(29.30)	(29.28)	(29.22)	(29.27)	(29.30)	(29.25)	(29.36)
CONS	-2.417**	-3.454***	-3.439***	-3.574***	-3.476***	-3.538***	-3.547***	-3.287**	-3.031**
	(2.08)	(2.63)	(2.62)	(2.72)	(2.65)	(2.69)	(2.70)	(2.51)	(2.31)
Hausman Spec. Test	1,570***	1,289***	1,338***	1,383***	1,320***	1,254***	1,243***	1,290***	1,557***
R-squared	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.22

Absolute value of t statistics in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%,

Numbers of firms and of observations are 15,491 and 123,422, respectively.

TYPE represents the respective firm type dummies that interact with the monetary policy stance variable and the tight period dummy.

The Hausman specification test has χ^2 distribution with *k-1* degrees of freedom where *k* denotes the number of estimated coefficients in the regressions. The Hausman test results confirm that there is a systematic difference between the coefficients obtained for the fixed effects and of random effects specifications. Therefore, the results for the consistent specification that is the fixed effects are reported in this study.

Table A.5.3. Fixed Effects Estimation Results for the Short Term Debt-Total Debt Ratio (MIX3)

	No Inter. Terms (1)	*TYPE- Small (2)*	*TYPE - Large (3)*	*TYPE - Risky (4)*	*TYPE- Secure (5)*	*TYPE – Young (6)*	*TYPE- Old (7)*	*TYPE-High Indebted (8)*	*TYPE- Less Indebted (9)*
ARATE	0.010*	0.029***	0.004	0.048***	-0.043***	0.030***	0.041***	0.030***	0.013
	(1.86)	(3.58)	(0.42)	(6.62)	(4.47)	(4.40)	(5.21)	(4.09)	(1.52)
ARATE*TP*TYPE		-0.214***	0.140***	-0.054**	-0.055***	-0.076***	0.148***	0.001	-0.091***
		(11.22)	(11.07)	(2.00)	(3.27)	(5.27)	(7.55)	(0.03)	(5.04)
ARATE*TYPE		0.006	-0.042***	-0.159***	0.144***	0.000	-0.041***	0.004	0.046***
		(0.39)	(3.31)	(7.59)	(10.87)	(0.21)	(2.78)	(0.22)	(3.30)
ARATE*TP		0.008	-0.045***	-0.043***	-0.016	-0.024**	-0.083***	-0.047***	-0.014
		(0.76)	(4.65)	(4.28)	(1.25)	(2.28)	(7.60)	(4.61)	(1.21)
TP		0.970**	1.047**	1.096**	1.025**	1.063**	1.055**	1.045**	0.943**
		(2.09)	(2.26)	(2.36)	(2.21)	(2.29)	(2.27)	(2.25)	(2.03)
AGE	1.041***	1.072***	1.068***	1.073***	1.074***	1.074***	1.078***	1.069***	1.071***
	(29.03)	(23.66)	(23.55)	(23.66)	(23.70)	(23.67)	(23.75)	(23.57)	(23.62)
GDP	-0.114**	-0.010	-0.003	-0.011	-0.016	-0.012	-0.010	-0.013	-0.013
	(2.02)	(0.11)	(0.03)	(0.12)	(0.16)	(0.12)	(0.11)	(0.14)	(0.13)
SCORE	-0.351***	-0.355***	-0.353***	-0.353***	-0.352***	-0.353***	-0.353***	-0.352***	-0.352***
	(54.00)	(54.58)	(54.36)	(54.30)	(54.12)	(54.21)	(54.25)	(54.12)	(54.02)
RASSET	-2.474***	-2.471***	-2.390***	-2.417***	-2.482***	-2.526***	-2.558***	-2.454***	-2.465***
	(10.25)	(10.23)	(9.89)	(10.00)	(10.27)	(10.43)	(10.56)	(10.15)	(10.19)
GEAR	-0.008***	-0.008***	-0.008***	-0.008***	-0.008***	-0.008***	-0.008***	-0.008***	-0.008***
	(19.46)	(19.61)	(19.60)	(20.00)	(19.94)	(19.41)	(19.42)	(19.37)	(19.53)
COL	-40.03***	-40.04***	-40.05***	-39.98***	-40.09***	-40.02***	-39.93***	-40.01***	-40.04***
	(42.55)	(42.61)	(42.62)	(42.53)	(42.64)	(42.54)	(42.46)	(42.52)	(42.56)
CONS	91.724***	90.433***	89.776***	89.868***	90.434***	90.702***	90.831***	90.193***	90.259***
	(45.76)	(40.02)	(39.73)	(39.76)	(40.02)	(40.08)	(40.15)	(39.88)	(39.91)
Hausman Spec. Test	1,076***	949***	915***	920***	945***	913***	871***	1,032***	1,331***
R-squared	0.05	0.06	0.06	0.05	0.06	0.05	0.05	0.05	0.05

Absolute value of t statistics in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%,
Numbers of firms and of observations are 15,210 and 111,996, respectively.
TYPE represents the respective firm type dummies that interact with the monetary policy stance variable and the tight period dummy.
The Hausman specification test has χ^2 distribution with *k-1* degrees of freedom where *k* denotes the number of estimated coefficients in the regressions. The Hausman test results confirm that there is a systematic difference between the coefficients obtained for the fixed effects and of random effects specifications.
Therefore, the results for the consistent specification that is the fixed effects are reported in this study.

Table A.6.1: Wald Statistics for the Joint Significance of Instrumental Variables

	$GINV_{i,t-1}$	GS_{it}	MIX_{it}	$CF_{i,t-1}$	$RINVS_{i,t-1}$	$MIX*TYPE_{it}$	$CF*TYPE_{i,t-1}$
No Interaction Terms	62,402	1,172	16,170	7,433	6,118		
TYPE=Small	60,997	1,206	16,154	7,717	6,248	1,239	1,377
TYPE=Large	61,142	1,208	16,180	8,547	6,245	5,454	658
TYPE=Risky	61,011	1,212	16,177	7,631	6,282	10,981	5,603
TYPE=Secure	61,087	1,219	16,220	7,542	6,346	3,389	17,800
TYPE=Young	61,081	1,204	16,156	7,442	6,230	3,605	3,311
TYPE=Old	61,043	1,201	16,163	7,463	6,237	3,438	426
TYPE=High Debt	35,319	1,202	16,189	7,459	6,259	9,476	3,418
TYPE=Low Debt	60,955	1,203	16,192	7,448	6,235	1,007	3,352
TYPE=L.Div. Ratio	60,956	1,206	16,157	7,542	6,231	1,281	352
TYPE=H.Div. Ratio	60,956	1,206	16,157	7,542	6,235	5,140	312
TYPE=PS	60,969	1,202	16,158	7,441	6,233	4,359	1,034
TYPE=PO	60,974	1,203	16,158	7,441	6,232	10,139	1,881