Credit and the Real Economy: Macroeconomic and Microeconomic Aspects

by

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Abstract

In the last decades several economists and practitioners have pointed out the importance of financial markets for real economic activity. In this dissertation we analyse the interaction between credit, especially banking, and real activity. While we deal also with the interaction between credit and firms' behaviour at the microeconomic level, our main emphasis is on the impact of credit on aggregate variables. Our target is, taking as primitive distinguishing features of intermediaries (banks), to understand how these features affect the link between intermediation (banking) and real variables. In the dissertation we focus both on features of the financial structure of intermediaries, like the structure of banks' liabilities, and on features of their activity, like intermediaries' superior ability in gathering information and monitoring borrowers. The dissertation offers several policy implications. The banking sector is one of the most regulated sectors in modern economies: besides being subject to regulation directly, the activity of banks is also constrained by other branches of the legal framework like the bankruptcy law. Throughout the dissertation we devote particular attention to regulatory and legal prescriptions and to the way they are concretely implemented. Overall, the dissertation suggests several mechanisms of interaction between the credit sector and the real economy that deserve further attention in future research.

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0.1 Introduction

0.1.1 Related Literature

In this dissertation we analyse the interaction between credit, especially banking, and real economic activity. While we also deal with the interaction between credit and firms' behaviour at the microeconomic level, our main emphasis is on the impact of credit on aggregate economic activity.

The impact of credit on real variables has received increasing attention in the last twentyfive years or so. Previously, most of the literature had treated financial and real aspects in isolation, relying on the results of Modigliani and Miller (1958). Modigliani and Miller had shown in fact that, under a number of assumptions such as absence of taxes and perfect capital markets, the composition of external finance did not affect firms' investment and production decisions. From the seventies a growing literature has departed from their result showing that financial and credit markets matter. The literature on asymmetric information and agency problems has been crucial for this change of perspective. Many studies have shown that adverse selection and agency (hidden action and hidden information) problems are linked with the mix internal/external finance and with the mix debt/equity of a firm.

In the seventies the main applications were in corporate finance and analysed at the microeconomic level how the financial structure of a firm affects its value. The pioneering contributions of Jensen and Meckling (1976) and Ross (1978) showed that the ratio debt/equity of a firm affects agency problems and concurs to signal its value, respectively. From the eighties this new perspective has found widespread application also in macroeconomics, particularly in the explanation of business fluctuations (see Freixas and Rochet, 1997, for a review).[1] Starting from Farmer (1984) and Bernanke and Gertler (1989) several studies have constructed frameworks in which the link between firms' ratio internal/external finance and the cost of external finance acts as a "financial accelerator" of exogenous shocks. The idea of these studies is that a lower (higher) firms' net worth encourages (discourages) firms to

[1] For an analysis of the implications of credit frictions for growth see, for instance, Bencivenga and Smith (1991).

undertake "worse" (e.g. riskier) projects, thereby increasing (decreasing) the cost of external finance. Since the cash flow of firms and the value of their assets change prociclically, the cost of external finance moves anticyclically (see Bernanke and Gertler, 1989 and 1990 for models emphasising the role of cash flow and Kiyotaki and Moore, 1997, for a model emphasising assets values).[2] For instance, when, during recessions, firms' cash flow and assets value fall, impairing their net worth, adverse selection and moral hazard problems become more severe, leading to an increase in the cost of external finance. In turn, the increase in the cost of external finance depresses investment and production, amplifying the recession and further eroding firms' net worth. Credit frictions have been introduced in a broad range of macroeconomic frameworks. Credit frictions have been introduced in otherwise standard real business cycle models and have been shown to propagate technological shocks (Carlstrom and Fuerst, 1997). Credit frictions have also been introduced in models with money and nominal rigidities and have been shown to magnify the effects of monetary policy shocks (Bernanke, Gertler and Gilchrist, 2000).[3]

The last decade has witnessed a further step forward in this literature. Instead of considering external finance as a black box, several studies have differentiated external finance according to its nature (debt or equity) (see, for instance, Williamson 1986 and 1987) and, especially, to differentiate credit according to its source. In particular, the literature has differentiated credit extended by non-atomistic intermediaries (banks, finance companies, credit companies etc.) from credit provided by dispersed investors (bond-holders). Given their overwhelming importance among financial intermediaries, banks have received a special attention. At the microeconomic level an increasing emphasis has been placed on understanding how the mix bank/dispersed debt of a firm affects its decisions (Diamond, 1991; Besanko and Kanatas, 1993; Rajan, 1992).[4] At the macroeconomic level some studies have explored the role of intermediaries in the business cycle (Bernanke and Gertler, 1987;

[2]Gertler (1992) extends the Bernanke and Gertler (1989) framework, showing that with multiperiod contracts future profits partially act as substitutes of internal finance in lowering agency costs. Greenwald and Stiglitz (1993) considers a framework in which, unlike in Bernanke and Gertler (1989), employment is flexible and agency costs affect labour demand.

[3]In this introduction we focus mainly on the theoretical literature. For a review of the empirical analyses on credit frictions and aggregate economic activity see Chapter 7 of Walsh (1998).

[4]Most of this literature has focused on the different implications of dispersed debt versus bank debt in periods of corporate distress, when this difference seems to matter the most.

Holmstrom and Tirole, 1997); other studies have proposed a bank lending channel of transmission of monetary policy, showing how the presence of retail, reservable deposits among banks' liabilities leads banks to respond differently from other intermediaries or from dispersed investors to a monetary policy shock (Bernanke and Blinder, 1988). In some macroeconomic frameworks the imperfect substitutability between intermediate and dispersed credit, which makes intermediaries relevant, is derived endogenously from arguments of corporate finance and banking. For instance, in Holmstrom and Tirole (1997) intermediaries are seen as active monitors which enable firms with low net worth to commit to safe projects, thereby giving them access also to public debt. In other frameworks (Bernanke and Blinder, 1988) the presence of intermediaries is simply assumed, relying on the empirical observation that especially for some categories of firms, like small ones, banks are the main source of financing.

Our thesis finds its suitable collocation in this literature on the link between intermediate credit and real activity. Our target is, taking as primitive distinguishing features of intermediaries (banks), to understand how these features affect the link between intermediation (banking) and real variables. In the dissertation we focus both on features of the financial structure of intermediaries, like the structure of banks' liabilities, and on features of their activity, like intermediaries' superior ability in gathering information and monitoring borrowers.

0.1.2 Contents

The thesis is divided in five chapters, of which three have a macroeconomic cut while two have a microeconomic perspective. Broadly speaking, in the first three chapters we analyse how nominal and real shocks can get propagated by affecting banks' balance sheets (in particular capital and deposits). In the first chapter we construct an economy where, in the presence of binding regulatory capital requirements, a two way interaction between banks' capitalisation and the quality of funded projects propagates negative shocks to technology or regulation. By shrinking the scale of their activity, a crunch in bank loans discourages entrepreneurs from sustaining the set-up effort of high quality technologies, pushing them to shift to lower quality projects. This shift in technology choice erodes the value of bank assets and, hence,

banks' capitalisation and loanable funds. We show that lack of information on the quality of bank assets in the secondary market magnifies the propagation and makes it robust to agents' reactions to the shock.

In the second chapter, employing evidence from banks' balance sheets and from construction activity, we find empirically a two way link between banks' capitalisation and real estate activity in the Nordic crisis (1990-1994). We also find that an inaccurate banking supervision magnified this link, exacerbating the impact of the decline in real estate activity on banks' capitalisation.

In the third chapter we analyse whether monetary policy shocks affect households' residential investment by draining deposits from banks and, hence, inducing a contraction of bank mortgages. We employ a structural VAR approach to test a credit channel of monetary policy and especially a bank-lending channel in four European housing markets (Finland, Germany, Norway and the UK). We relate the relevance of the credit channel to the structural features of their housing finance system, in particular efficiency and institutional organisation. The results of this chapter support the existence of a broad credit channel and, in some contexts, of a bank-lending channel. More importantly the results show across countries a clear-cut relationship between presence of a credit (bank-lending) channel, efficiency of housing finance and type of institutions active in mortgage provision.

In the fourth chapter we focus on the advantage of banks as information collectors and on the use that banks can make of their superior information during the reorganisation of distressed firms. By emphasising the double use that banks can make of information (to increase their bargaining power in the reorganisation of a firm and to restructure more efficiently), we construct a model that rationalises the choice of a firm to borrow simultaneously from relationship and from arm's length banks. We show that, by borrowing simultaneously from relationship and from transactional banks ("diversified funding"), a firm minimizes the risk that banks opportunistically restructure bad projects with the only intent of seizing assets during the reorganisation. Transactional banks veto the continuation of bad firms that relationship banks would continue with the only intent of seizing assets during the restructuring. They do so, because, having less information than relationship banks, they expect to be "losers" in the seizure of assets. At the same time, be-

cause of this asymmetry in the information between relationship and transactional banks, diversified funding reduces the probability that banks succesfully coordinate the reorganisation of a good project. We characterise the conditions under which a firm prefers diversified funding both when screening on projects' quality is feasible and when it is not.

The model in the fourth chapter can be thought as the reduced form of several real world examples. A bank with superior information could be able to detect a situation of distress earlier, gaining an additional security interest in the assets of the firm. Alternatively, when the assets of the distressed firm are heterogenous in their redeployability, during a reorganisation a well informed bank could be able to "cherry-pick" the most easily redeployable assets leaving other creditors with specific, hence, less saleable assets. In the fifth chapter we develop a simple model that captures the latter idea. Having better information on asset redeployability and on the prospects of restructuring, relationship banks could have the incentive to continue a firm only to recover the most generic assets. By creating an asymmetry between the information of relationship banks and of transactional ones, diversified funding creates a conflict among banks that prevents the opportunistic continuation of bad projects. However, we show that this informational asymmetry can lead to the premature liquidation of good projects.

We believe that the model presented in the fifth chapter is more than a specialisation of the model in the fourth chapter. First, it allows to derive the optimal degree of diversification of the firm-banks links endogenously; secondly, it allows to relate the degree of diversification to observable characteristics of the firm, especially the nature (redeployability and heterogeneity) of its assets, and the costs of restructuring the firm in distress.[5] In related work (Guiso and Minetti, 2002) we are testing the empirical implications of the model presented in the fifth chapter using data from small US businesses.

It is important to clarify what our dissertation is not about. In each chapter we isolate one distinguishing aspect of intermediation (banking) and we study its implications for real economic activity. In none of the chapters do we rationalise

[5]However, the lower level of generality of the model in chapter 5 hinders the tratment of other issues, such as the implications of screening on projects' quality for the choice of diversified funding.

the presence of intermediaries (banks). Moreover, we do not try to endogenise any of the distinguishing characteristics of intermediaries (banks) that are at the core of our results, taking them as given. For instance, in chapters 1 and 2 we focus on capital and capital regulation but we do not rationalise the existence of bank capital or the presence of regulatory requirements on its level.[6] In chapter 3 we explore the implications of the presence of retail, reservable deposits among banks' liabilities for the transmission of monetary policy to housing demand, but we take the financial structure of banks as given.[7] In chapters 4 and 5 we focus on the strong ability of banks in information gathering and we analyse how this affects firms' reorganisation but we do not endogenise the advantage of banks as information-collectors.[8]

0.1.3 Policy Implications and Future Research

The banking sector is one of the most regulated sectors in modern economies. Besides being subject to regulation directly, the activity of banks is also constrained by other branches of the legal framework like the bankruptcy law. Therefore, the role of the regulatory and legal frameworks emerges naturally in many analyses on the interaction between intermediation and the real economy. Throughout the dissertation we devote particular attention to regulatory and legal prescriptions and to the way they are concretely implemented. We defer to the single chapters the discussion of the resulting policy implications.

We are working on a number of developments, some of which represent extensions of the chapters while others follow lines of research more broadly connected with the dissertation.

We are currently exploring an extension of chapter 1 in which capital regulation is endogenous. In this richer framework we allow the regulator to adjust the required capital adequacy to projects' quality in order to minimise a loss function. Precisely, we introduce depositors explicitly and we assume that the regulator aims

[6] See Besanko and Kanatas (1993) and Holmstrom and Tirole (1997) for models that endogenise bank capital and market determined capital adequacy. We are developing an extension of the first chapter of the dissertation in which capital regulation is endogenous (see 1.3).

[7] See Diamond and Rajan (2001) and Calomiris and Kahn (1991) for models that endogenise the presence of deposits on the liability side of banks' balance sheets.

[8] See Diamond (1984) for a model in which intermediaries act as delegated monitors of dispersed investors.

at minimising the volatility of depositors' return (for instance because depositors are risk averse). The results show that such an endogenous banking regulation can further exacerbate the link between bank capital and real activity.

Currently, we are also testing the empirical implications of the model in chapter 5 using data from US firms. We construct indicators of the heterogeneity of firms' links with banks and we relate them to a number of firms' observable characteristics, along the predictions of the model.

As to broader lines of research, in the next future our purpose is analysing the interaction between the structure of the credit (banking) sector and aggregate economic activity. Currently, the issues we are considering are the relative importance of trade credit versus bank credit and, within the banking sector, the penetration of foreign banks into the banking system.

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Chapter 1

Bank Capital, Firm Liquidity and Projects' Quality

Abstract

We construct an economy where, in the presence of binding regulatory capital requirements, a two way interaction between banks' capitalisation and the quality of funded projects propagates negative shocks to technology or regulation. By shrinking the available liquidity and the scale of their activity, a crunch in bank loans discourages entrepreneurs from sustaining the set-up effort of high quality technologies, pushing them to shift to lower quality projects. The shift in technology choice erodes the value of bank assets and, in turn, banks' capitalisation and loanable funds. We show that lack of information on the quality of bank assets in the secondary market magnifies the propagation and makes it robust to agents' reactions to the shock.

1.1 Introduction

The link between declines in real activity and banking busts is regarded as an important propagation mechanism of recent crises (Texas, 1985-1987; New England, 1991-1992; Nordic countries, 1990-1994; South East Asia, 1997-1998). During these crises, banks experiencing big loan losses were allegedly forced to shrink their loans to satisfy regulatory capital requirements. Anecdotal evidence suggests that many entrepreneurs who were denied funds from their customary banks were unable to compensate with other sources of funding, being forced to a downward revision of production plans (Harris, Boldin and Flaherty, 1994; Peek and Rosengren, 2000). On the financial side, the crunch in bank capital and lending took place in environments characterised by lack of information on the loans extended

during the previous booms. In many countries, the booms had been associated with financial liberalisation and banks, facing tougher competition, had tried to preserve profit margins redirecting their lending towards sectors "unfamiliar" to them. Such a portfolio-reshuffling had strained banks' credit assessment (Klingebiel, 2000; Wihlborg, Hutchison and Mueller, 1994). During the crises the resulting lack of information made it difficult for outsiders, like bank supervisors or buyers in the secondary market, to carry out a fair valuation of banks' assets (Peek and Rosengren, 1992; Wojnilower, 1992).

The target of this chapter is to shed light on the link between banks' financial status and real activity and on the role that the opaqueness of banks' portfolios plays in this link. We construct an economy where, in the presence of binding regulatory capital requirements, a two way interaction between banks' capitalisation and the quality of funded projects propagates negative shocks to technology or regulation. The key elements behind this financial accelerator are: i) entrepreneurs' dependence on loans of customary banks; ii) moral hazard in entrepreneurs' choice of projects related to the scale of their activity and, hence, to the available liquidity; iii) lack of information in the secondary market on the projects funded by banks.

The propagation mechanism works as follows (a summary is in Figure 1). A negative regulatory or technological shock induces a crunch in bank loans extended to entrepreneurs. Entrepreneurs cannot compensate for the squeeze in loans from their customary banks. The resulting drain in available liquidity pushes some entrepreneurs to shift to lower quality (productivity) projects, negatively affecting the value of related bank assets. The shift in technology choice occurs because the shrinkage in the scale at which entrepreneurs can run their projects makes some entrepreneurs "more lazy", discouraging them from sustaining the set-up effort that high quality projects require.[1] In turn, the fall in the value of banks' assets, increasing banks' loss provisions and depleting their capital, negatively affects bank

[1]There are several real-world counterparts of this set-up effort. For instance, it could be the effort that an entrepreneur must bear to screen high quality from low quality projects or to accumulate human capital or training necessary to run a high quality technology. It could also stand for the care that an entrepreneur must have in selecting good materials for building highly productive assets. In a different context a similar assumption can be found, for instance, in Aghion, Dewatripont and Rey (1999). Note that in the model we treat interchangeably a non-monetary private benefit for a low quality project and an effort for a high quality one.

lending. In fact, all the banks have to shrink their loans further in order to keep complying with regulatory capital requirements. This further credit crunch pushes other entrepreneurs, initially not involved in moral hazard, to shift to lower quality projects and save the set-up effort of high quality projects and so on, propagating the shock.

We show that lack of information on the quality of funded projects in the secondary market magnifies the propagation and is crucial for its robustness. It magnifies the propagation because also banks with sound portfolios, i.e. whose borrowers, facing a lower set-up effort for high quality projects, have not shifted to lower quality ones, see their loans and collateral underpriced in the secondary market. This way, the credit crunch spreads to entrepreneurs who keep running highly productive projects, magnifying the output loss and possibly leading also these entrepreneurs to shift eventually to low quality projects. Asymmetric information in the secondary market is crucial for the robustness of the propagation because it shields the propagation from strategies aimed at dampening the capital crunch, like banks' refined strategies in shrinking credit or renegotiations of lending contracts that would bail out banks. This occurs because an uninformed secondary market, by pooling the assets of all the banks, prevents the single bank or entrepreneur from internalising the benefits of these strategies.

Even though broadly applicable, we believe that the model is well suited for rationalising the link between banking busts and declines in the activity of some segments of firms, like small firms, or sectors, like real estate. In real estate (especially commercial real estate) the idiosyncratic nature of many projects makes an assesment difficult for new lenders, hindering the substitutability of the loans of customary banks (Peek and Rosengren, 2000). As to small firms, their size makes them "opaque" and dependent on local, informed banks (Harris, Boldin and Flaherty, 1994). Besides inducing dependence on customary loans, we think plausible that this opaqueness hinders the correct valuation of projects and assets in the secondary market, particularly when this market is thin as, for instance, during a recession.

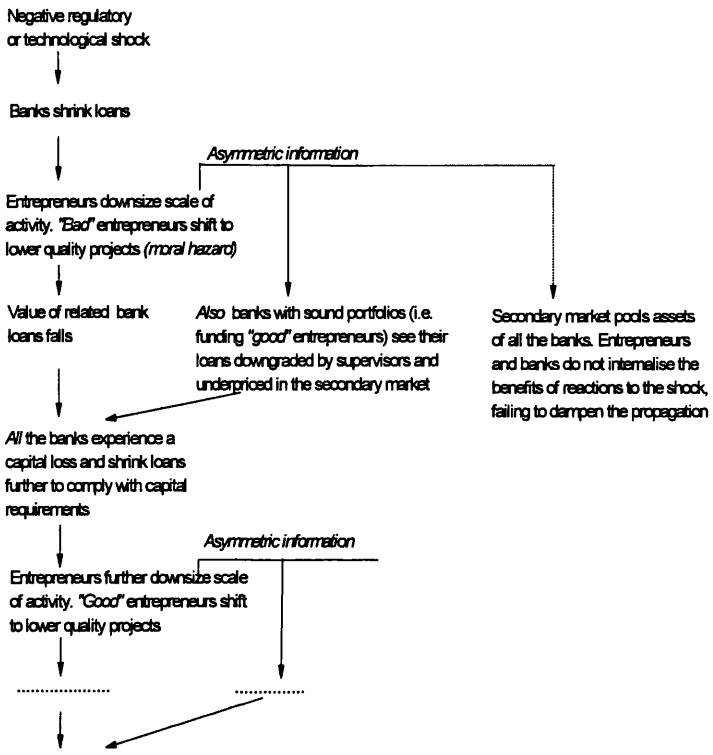

Figure 1. Propagation Mechanism

The chapter is linked with the literature on the role of credit in business fluctuations (Bernanke, Gertler and Gilchrist, 2000; Holmstrom and Tirole, 1997; Kiyotaki and Moore, 1997; Greenwald and Stiglitz, 1993; Bernanke and Gertler, 1989 and 1987; Farmer, 1984). The closest papers are Holmstrom and Tirole (1997) and Bernanke and Gertler (1987) that, like us, focus on the role that bank capital plays in affecting the real sector. The first difference with these two studies is the channel by which bank capital affects the real sector. The shift in borrowers' technology choice that drives the propagation is primitively related to the scale at which entrepreneurs run their activity according to the available liquidity and is independent of the ratio between borrowers' net worth and external funding that is key in these papers. Hence, the chapter contributes in establishing a link between the "liquidity flows" approach, that stresses firms' access to liquidity rather than contracting problems related to their net worth, and the studies on the role of bank capital in aggregate economic activity. In addition to proposing a different channel of propa-

gation,[2] we describe a two way propagation mechanism that goes from bank capital to entrepreneurs' choice of projects and then, from entrepreneurs' choice of projects, feeds back on bank capital rather than restricting the analysis only to the impact of bank capital on real activity. It is analysing the feed-back from changes in projects' quality to bank capital that we can disentangle a "macroeconomic" role for the opaqueness of banks' assets in magnifying the propagation and making it robust. This asymmetric information, external to the credit sector (i.e. to the relationships between lenders and entrepreneurs), has been neglected by the above literature, that has focused on lenders' lack of information on borrowers.

The model empirical implications differ from those of related papers. The model predicts that the strength of the propagation is inversely related to firms' liquidity but indipendent of firms' ratio internal net-worth/external finance. This is in contrast with the literature mentioned, including Holmstrom and Tirole (1997) in which the impact of a capital crunch on real activity is inversely related to firms' ratio internal net-worth/external finance. Moreover, our model emphasises a link between banks' capitalisation and the productivity of projects undertaken but not necessarily the number of projects funded. In Holmstrom and Tirole (1997) a fall in bank capital leads to a fall in investment but has no impact on the average productivity of projects undertaken. Finally, the model implies a negative correlation between the strength of the propagation and the information on banks' assets in the secondary market. Provided that a reliable proxy for the informational depth of the secondary market can be found, interacting projects' productivity with this proxy should show that the better information is the lower is the feed-back from projects' quality to banks' capitalisation. To our knowledge such an implication cannot be derived, either directly or indirectly, from related studies.

[2] In Holmstrom and Tirole (1997) banks' monitoring allows firms with low net worth to commit to safe projects, allowing them access to the public debt market. However, banks themselves are subject to moral hazard and need enough own capital to commit to monitoring ("market-determined capital adequacy"). When banks' capital and loan supply crunch increasing the cost of monitored finance, firms' incentives to take risk increase. As a result, firms that before the crunch had just enough net worth to commit to safe projects become rationed and give up projects. In a section of their paper Caballero and Krishnamurty (2000) obtain mutiple equilibria following a reasoning similar to the one in Kiyotaki and Moore (1997). High (low) interest rates self-validate implying low (high) collateral values, low (high) banks' capital and low (high) credit supply. Building a dynamic general equilibrium model on Holmstrom and Tirole (1997), Chen (2001) calibrates a mechanism that shares some of the main features of Caballero and Krishnamurty' s. These mechanisms and ours should be seen as complementary.

The chapter is organised as follows. Section 2 presents the model. Section 3 examines its robustness. Section 4 concludes. The proofs are in the Appendix.

1.2 The Model

1.2.1 Setup

Environment The economy lasts for two periods and three dates (t=0,1,2). The population consists of M agents (M large) of which nM ($n < 1/2$) are entrepreneurs and $(1-n)M$ are bankers. All agents care about their date 2 consumption of final good c_2 deriving from it a utility of $u(c_2) = c_2$. There are initially two goods, the final good and assets ("buildings" henceforth).

Entrepreneurs and Production Technology At date 0 each entrepreneur has only one non-equipped building of size H. Entrepreneurs can run projects for producing final good.

In the first period, between date 0 and date 1, each entrepreneur can equip one building *necessary* in production in the second period. Each entrepreneur can transform her building into a good one ($\overline{H}$) or into a bad one ($\underline{H}$) where a good and a bad building differ in quality but not in size. Until date 1 the entrepreneur can switch from a good equipment to a bad one and viceversa at no cost but, once perfectioned at date 1, the quality of the building is irreversible.

Also during the first period each entrepreneur can invest $X \leq 1$ units of final good obtaining at date 1 $X_I = X$ units of intermediate input *useable,* in combination with the building personally equipped, to produce final good in the second period. For simplicity we assume that all the investment takes place at an intermediate time (t=1/2).

At date 1 each entrepreneur dies with probability s. If an entrepreneur dies all the intermediate input X_I depreciates and the residual project is the equipped building. The event "death" is independent across entrepreneurs; since M is large this implies no aggregate uncertainty.

In the second period, between date 1 and date 2, each living entrepreneur can use the building personally equipped with any intermediate input personally trans-

formed in a good (high-productive) technology or in a bad (low-productive) one. While the intermediate input is generic, a good (bad) building can be used only in the good (bad) technology. Each living entrepreneur derives also a non-transferable private benefit b from using a bad building personally equipped in period 1. This private benefit could easily be reformulated as the additional effort necessary for implementing a good building equipment instead of a bad one during the first period.

Let y_{re} be the final good produced by an entrepreneur active in the real estate sector (real estate output henceforth). Including any private benefit, the date 2 returns that a living entrepreneur obtains from using the building and the intermediate input personally transformed are

$$\begin{aligned} \text{Good technology} \quad &: \quad y_{re} = R(X_I + \overline{H}) \\ \text{Bad technology} \quad &: \quad y_{re} + b = r(X_I + \underline{H}) + b \end{aligned}$$

Entrepreneurs derive a different private benefit from using a bad building personally equipped. In the simplest framework $b = B$ for a fraction G of the entrepreneurs (hereafter "bad" entrepreneurs) and $b = 0$ for a fraction $(1-G)$ ("good" entrepreneurs).

We introduce restrictions on the parameters:

Assumption 1

$$\frac{1}{(1-s)} < r < R < 2$$

Assumption 2

$$H(R-r) < B < (1+H)(R-r)$$

Assumption 1 places lower and upper bounds on the productivity of the two technologies. Assumption 2 restricts the private benefit of the bad entrepreneurs. In particular, Assumption 2 implies that, *ceteris paribus*, if a bad entrepreneur runs her project close enough to its minimum scale (H) she prefers the bad technology, while, if close enough to its maximum scale ($1+H$), she prefers the good technology. Throughout the analysis we assume that, when indifferent between two technologies, an entrepreneur chooses the one with the highest private benefit.

Bankers and Lending Contracts At date 0 each banker is endowed with 1 unit of final good; hence bank funds are more than enough to finance all the projects at their maximum size ($(1-n)M > nMmax(X) = nM$). Bankers can store, obtaining a certain zero net return, and lend. For simplicity, we focus on the case in which in period 1 each banker either stores all her funds or lends to one entrepreneur only and each entrepreneur is funded by one bank only. In 3.2 we will discuss why a framework in which each bank funds no more than one entrepreneur implies no loss of generality.

The date-0 contract between a banker and an entrepreneur looks like a credit line.[3] The contract specifies the maximum amount of final good L that the entrepreneur can borrow from the banker at t=1/2 and the repayments to the banker conditional on the entrepreneur's survival and death.[4] For any L the optimal date-0 contract implies trivially the collateralisation of the whole equipped building contingent on the verifiable entrepreneur's death. In fact, since the entrepreneur enjoys utility only from consuming at date 2, she will always prefer pledging the whole residual project to the bank in case of death to obtain a "discount" on the repayment in case of survival. We restrict the gross interest rate R^B due at date 2 in case of survival on each unit of borrowed funds to be a non-contingent one. For instance, contingency on the output of the completed project could be hindered by a verification problem.

Throughout the analysis we assume that a banker cannot deny any loan contractually committed at date 0, *unless* forced by the regulator. Moreover, the bank suffers a dead-weight loss $1 - \ell$ on each unit of loan committed at date 0 but that it cannot make available at $t = 1/2$. The presence of this loss, due to the need of reorganising personnel and accounts, penalties for the unfulfilled commitment etc.,

[3]Note that we also abstract from an active interbank market at date 0. The banks have no incentive to reallocate funds through an interbank market at date 0 and transaction costs would make it inactive. Allowing for interbank claims would not alter the core message of the paper but it would complicate the analysis.

[4]The chosen nature of the contract, while useful to simplify the analysis, is *not* crucial for its results. For instance, we could reason in terms of a contract with a partial extension of the loan at date 0 and a commitment for future dates or, with few changes, of a sequence of spot loan contracts. In our framework the agents are indifferent ex-ante between a spot loan contract and a loan commitment and we could think that, when indifferent, they choose a loan commitment. Alternatively, transaction costs, or other reasons not explicit in the paper, could make a loan commitment strictly preferable.

does not matter for the results.

Banking Regulation At $t = 1/2$ bankers have to comply with a regulatory capital requirement. A third group of "shadow" agents, the bank supervisors, assess capital adequacy and enforce the requirement. We will assume that at time $t = 1/2 - \varepsilon$ a *zero-probability* regulatory shock (change of the requirement) occurs.

We assume that the supervisors force each bank to satisfy $L' \leq \sigma' E'(K_2)$, where L' stands for the loan extended by the bank at $t = 1/2$, $E'(K_2)$ for the supervisors' expectation at time t=1/2 of the date 2 net worth (capital) of the bank and σ' for the inverse of the capital requirement at $t = 1/2$.[5] At $t = 1/2$ supervisors enforce the requirement calculating and communicating to each pair banker-borrower the maximum loan consistent with the capital requirement. In so doing they use all their information, including information on the contractual terms, interest rate and collateralisation, agreed between each banker and her borrower (see below for the information structure).

Secondary Market At date 1 banks can sell the equipped buildings recovered from dead borrowers on a spot secondary market. Let p be the resale price of an equipped building of size 1. We assume that buyers in the secondary market consist of more than snM new entrepreneurs who are born at date 1, while entrepreneurs survived from the first period cannot employ any building in addition to the building and the intermediate input personally transformed. The new entrepreneurs are identical to the dead ones except that they live for one period and have no initial endowment. Each new entrepreneur can use one liquidated building bought on the secondary market. Buyers can finance purchases of equipped buildings borrowing,

[5]This requirement captures in a simple way the aspects of capital regulation relevant for the analysis. First, the bank's assets are weighted: storage, proxying for cash or central bank reserves, has a 0 weight and the loan to the entrepreneur a 100% weight. Second, the capital base $E'(K_2)$ subtracts from loans and storage any loan-loss provision for expected losses on these assets. This loan loss provisioning, and more so the possible inclusion of expected profits, could appear more forward looking than what implied by the accounting standards of some countries. For instance, while in the US, during the 1990-1992 crisis, examiners implemented many anticipatory write-downs on loans that were still performing (Wojnilower, 1992), in Japan loan-loss provisioning has traditionally been much slower. However, we can always think of a bank holding in its portfolio several loans of the described type maturing at different moments. At each moment, the bank will make provisions for non-performing loans and will realise profits, if any, on maturing performing loans. In our framework we simplify considering only one loan with principal and interests due on a single date.

for instance, from the bankers not active in the credit market in the first period. If the share of entrepreneurs (n) is small enough (in particular $n < 1/(2 + sRH)$), these bankers will certainly have enough funds to finance the purchase of liquidated buildings.[6]

Information In the economy there is asymmetric information on the chosen quality of the projects. Each entrepreneur privately observes the level of her own private benefit b at some time between date 0 and the time of the unexpected regulatory shock ($t = 1/2 - \epsilon$) and the quality of the chosen equipment/technology. In the secondary market buyers cannot observe the quality of the single building but only the average quality of liquidated buildings. Even if unnecessary for the results of this section we assume that buyers are pretty unsophisticated: they are unaware of the underlying market mechanism and the only thing they can observe is the average quality of liquidated buildings.

Summary We summarise the sequence of events:

-Date 0: contracts are signed

-Period 1: from date 0 to date 1 entrepreneurs can equip one building. At t=1/2-ϵ a zero-probability shock to the capital requirement occurs. At t=1/2 banks extend loans to entrepreneurs; from t=1/2 to date 1 entrepreneurs can transform the borrowed final good in intermediate input

-Date 1: entrepreneurs die or survive. Banks recover equipped buildings from dead entrepreneurs and sell them on the secondary market. Dead entrepreneurs' intermediate input depreciates completely

-Period 2: living entrepreneurs can combine the intermediate input and the building personally transformed. Buyers can use alone buildings purchased on the secondary market

-Date 2: entrepreneurs repay loans and interests. Agents consume

[6] In fact at date 1 the storage of these bankers is at least $M(1 - 2n)$, the number of dead entrepreneurs is snM and R is the maximum price of a building. It is easy to see that, provided the final output is verifiable, if a banker writes a standard debt contract with a gross interest rate of no lower than R/r with a new entrepreneur, she will be guaranteed a net return of 0 on the loan for the purchase of one building.

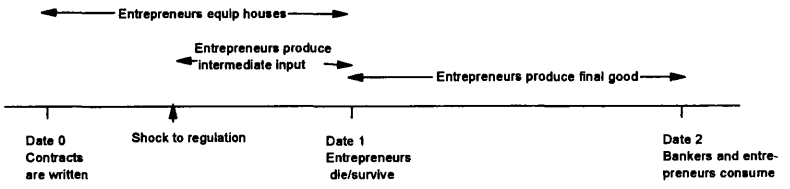

Figure 2. Time Line

1.2.2 Equilibrium

Since at date 0 the credit market is competitive, the date 0 optimal contract between a banker and an entrepreneur maximises the entrepreneur's expected return with respect to R^B and L subject to the relevant constraints. We assume that the value of σ' announced (expected) at date 0 is high enough to make the regulatory constraint redundant. Clearly, the exact value of $\sigma' \geq 1$ is irrelevant.

The optimal contract is found by solving

$$
\begin{aligned}
Max_{R^B,L} \quad & (1-s)E_0\left(R^E(b)\right) \\
s.t. \quad & R^E(b) = \max\left[R(L'(b)+H), r(L'(.)+H)+b\right] - R^B L'(.) \\
& (1-s)R^B E_0(L'(.)) + sHE_0(p) \geq E_0(L'(.)) \\
& L = \max L'(.) = \max\left\{\arg\max\left[R^E(.) \mid L' \leq L\right]\right\} \\
& 0 \leq L \leq 1
\end{aligned}
$$

The first constraint is the resource constraint. It explicitly expresses the entrepreneur's return in case of survival $R^E(b)$, taking into account her technology choice, the realisation of her private benefit b and the amount $L'(b) \leq L$ that she borrows at $t = 1/2$. The second constraint imposes that the bank expects at least zero profits, i.e., adding to both the LHS and the RHS storage $1 - E_0(L'(.))$, imposes that $E_0(K_2) \geq 1$. The third rules out trivial contracts in which L exceeds the maximum amount of final good that the entrepreneur is expected to borrow at the agreed contractual terms ($max(L'(b))$). The fourth constraint writes in a compact way the non-negativity and the capacity constraints on investment.

Lemma 1 *At date 0, in equilibrium*

$$\begin{aligned} L &= L'(.) = 1 \\ R^B &= \frac{1 - sHR}{1 - s} \\ & E_0(p) = R \end{aligned}$$

Lemma 1 shows that at date 0 each entrepreneur is guaranteed and expected to borrow at $t = 1/2$ a loan big enough to run her project at its maximum scale $(1+H)$. As a result, all entrepreneurs are rationally expected to choose a good equipment of their building, i.e. the good technology, and the expected liquidation price of each equipped building on the secondary market is $E_0(p) = R$.

1.2.3 Impact of an Unexpected Shock

We analyse the impact of an unexpected regulatory shock at time 1/2-ϵ. It should be made clear that there is nothing special in a regulatory shock. All the qualitative results of the analysis could be obtained assuming, for instance, that at date 0 the regulator announces $\sigma' = 1$ irrevocably and that at time 1/2-ϵ a technological shock (say an increase of the probability of entrepreneurs' death-distress s) occurs. Although regulatory shocks certainly occur less frequently, several pieces of evidence point to a stiffening of capital regulation in recent crises and to its role in initiating capital crunches.[7]

We assume that at time 1/2-ϵ a new, higher capital requirement is announced so that at t =1/2 bank supervisors force each bank to satisfy $L' \leq \sigma' E'(K_2)$ with σ' <1. The contractual terms (in particular the gross interest rate R^B that each entrepreneur has to repay for each unit of borrowed funds) are assumed to be non-renegotiable (see 3.1 for an analysis with renegotiation). Intuitively, the regulatory shock imposes a limit on the loan that each banker can extend to the entrepreneur lower than the one agreed upon initially. We crucially assume that at this stage

[7]In the US, regulators introduced conservative criteria in capital valuation, forcing banks to make provisions for declining repayment prospects and collateral values of perfoming loans (Peek and Rosengren, 1992; Wojnilower, 1992; Berger, Kyle and Scalise, 2001). In the Nordic countries, regulators increased their pressure on banks for a more timely recognition of loan losses in the accounts.

each entrepreneur is locked-in with her original bank and cannot offset the loan crunch by obtaining funds from other banks; analogously, we assume that at this stage no bank can sell loans to other banks. If the loan crunch due to the regulatory shock is big enough, *bad* entrepreneurs, i.e. the ones with the high private benefit, will switch to the bad building equipment (remember that, from Assumption 2, when the project is close to the minimum scale, a bad entrepreneur prefers the bad technology). Moreover, since, because of asymmetric information in the secondary market, the capital base of each bank $E'(K_2)$ depends on the expected *average* quality of a residual project (through $E'(p)$), this shift in technology choice determines a depletion of the capital base of *all* the banks active in the credit market, including the ones funding "good" entrepreneurs. As a result, supervisors force *all* banks to shrink their loans further so that banks keep complying with the regulatory capital requirement. In our framework the propagation stops at this point. In a framework in which also the good entrepreneurs enjoy a private benefit B' from the bad technology (with $H(R-r) < B' < B$) and hence are prone to moral hazard, this further loan crunch, if big enough, induces also them to switch to the bad building equipment. This determines a new fall in the expected average quality of the buildings, and hence a further crunch of bank capital, loans and output. In the Appendix we analyse this straightforward extension. This two way interaction between bank capital and loans and projects' quality can be a powerful propagation mechanism determining an output loss far larger than the one that would be induced by the shock alone.

Proposition 1 assesses the additional loan crunch due to the propagation mechanism. As a benchmark we take the loan that would be extended after the shock in an economy without moral hazard ($b = 0$ for all the entrepreneurs). Trivially, in this economy the date 0 equilibrium would be the same.

Proposition 1 *Let L^* be the level of the loan at and below which the bad entrepreneurs choose the bad building equipment. L^* satisfies*

$$L^* = \frac{B}{R-r} - H$$

Let $\widehat{L}'$ be the level of the loan that would be extended to each entrepreneur after

the regulatory shock in an economy without moral hazard ($b = 0$ for all the entrepreneurs). $\widehat{L}'$ *satisfies*

$$\widehat{L}' = \frac{\sigma'(sRH + \ell)}{1 - \sigma'(1 - sRH - \ell)} < 1$$

Let the new regulatory ratio σ' *be such that* $\widehat{L}' \leq L^*$ *("big shocks"). The amount lent to each entrepreneur after the shock is*

$$\widehat{\widehat{L}}' = \frac{\sigma'(s((1-G)R + Gr)H + \ell)}{1 - \sigma'(1 - sRH - \ell)} < \widehat{L}'$$

From now on we restrict the attention to a regulatory shock such that $\widehat{L}' \leq L^*$. In Proposition 2 we assess the real estate output loss due to the propagation mechanism with respect to three benchmark economies. Note that, in each of these three cases, while we emphasize the loss of the output produced in the credit sensitive sector, the loss of total output (including storage), can be derived immediately from the real estate output loss (for details see note 7).

$\Delta Y_{re,1}$ measures the overall real estate output loss due to the propagation mechanism, i.e. to entrepreneurs' moral hazard and asymmetric information on projects' quality. To assess $\Delta Y_{re,1}$ we consider as benchmark an economy in which there were no moral hazard (b=0 for all the entrepreneurs). $\Delta Y_{re,2}$ measures the loss of real estate output due to "lack of regulatory forbearance", i.e. due to the decline in the valuation of the buildings $E'(p)$ and, hence, in banks' loans. To assess $\Delta Y_{re,2}$ we consider as benchmark an economy like ours but in which bank supervisors kept on evaluating the buildings at their initial expected liquidation price ($E_0(p) = R$). Note that in both these first two benchmark economies the loan extended to each entrepreneur after the shock would be $\widehat{L}'$. Finally, $\Delta Y_{re,3}$ measures the loss of real estate output due to asymmetric information only. To assess $\Delta Y_{re,3}$ we consider as benchmark an economy like ours but in which buyers in the secondary market knew the quality of each building.

Proposition 2 *Consider a regulatory shock such that* $\widehat{L}' \leq L^*$.

(i) *The loss of real estate output due to the propagation mechanism (i.e. to entrepreneurs' moral hazard and to asymmetric information on projects' quality)*

is

$$\Delta Y_{re,1} = \left\{ \frac{\sigma' \left[sH((2-G)R + Gr) + \ell \right]}{1 - \sigma'(1 - sRH - \ell)} (1-s) + H \right\} G(R-r)nM \quad (1)$$

(ii) *The loss of real estate output due to lack of regulatory forberance, i.e. to the decline in the valuation of the buildings* $E'(p)$ *and to the resulting credit crunch, is*

$$\Delta Y_{re,2} = \frac{\sigma' sHG(R-r)\left(R(1-G) + rG\right)}{1 - \sigma'(1 - sRH - \ell)} (1-s)nM \quad (2)$$

(iii) *The loss of real estate output due exclusively to asymmetric information on projects' quality in the secondary market is*

$$\Delta Y_{re,3} = \frac{\sigma' sHG(1-G)(R-r)^2}{1 - \sigma'(1 - sRH - \ell)} (1-s)nM \quad (3)$$

We have already explained the rationale behind $\Delta Y_{re,1}$ and $\Delta Y_{re,2}$.[8] It can easily be seen that both $\Delta Y_{re,1}$ and $\Delta Y_{re,2}$ are positively related to the productivity gap between the good and the bad technology $(R - r)$ and to the share of bad entrepreneurs (G).

As to $\Delta Y_{re,3}$, the presence of asymmetric information spreads the capital crunch to banks that have funded good entrepreneurs, implying that also these banks experience a decline in the expected resale price of their building and have to shrink credit further. If the secondary market properly evaluated each building, only the bad entrepreneurs would experience a downgrading of their loans and a further crunch. Hence, the overall crunch would be stronger for the bad entrepreneurs but weaker for the good ones. Since the bad entrepreneurs choose a less productive technology, this would lead to a smaller loss of real estate output (by $\Delta Y_{re,3}$). This spill-over on sound banks can magnify the propagation even more dramatically in a framework in which also the good entrepreneurs are prone to moral hazard (see the Appendix). In this framework, if some conditions on the parameters hold, following

[8] To get the loss of total output with respect to the first two benchmark economies just add to $\Delta Y_{re,1}$ and $\Delta Y_{re,2}$ the funds that in our economy are initially committed to real estate but then are stored. On average each unit invested in real estate returns $(1-s)\left[R(1-G) + rG\right]$ while each unit committed but then stored gives ℓ $(1-\ell$ is lost). Since, from A1, $(1-s)\left[R(1-G) + rG\right] > 1 > \ell$ the total output in both the benchmark economies is higher than in ours.

the further credit crunch suffered because of asymmetric information, also the good entrepreneurs will shift to the bad building equipment. In turn, their moral hazard will lead to a further downgrading of *all* the loans and to a further shrink of capital, loans and output.

1.2.4 Numerical Example

For a quantitative assesment of the propagation, we have calibrated expression (4) below. Expression (4) gives $\Delta Y_{re,2}$ scaled by the real estate output that would realise both in our economy and in the benchmark economy with regulatory forbearance in the absence of the shock (i.e. $Y_{re,0} = nM(1-s)R(1+H)+nMsRH = nMR(1-s+H)$). Hence, (4) measures the additional percentage loss of real estate output due to lack of regulatory forbearance. For simplicity, we set ℓ=1-sHR. In (4) σ' stands for the ratio between the inverse of the capital requirement after the shock and the inverse of the capital ratio planned by banks at date 0 (in the model the latter is normalised to 1).

$$\frac{\Delta Y_{re,2}}{Y_{re,0}} = \frac{\sigma' sHG(R-r)\left(R(1-G)+rG\right)}{(1-s+H)R}(1-s) \quad (4)$$

We choose the parameter values as follows. i) σ'=0.98: we assume that the regulatory shock is such that new capital requirement exceeds the capital ratio planned by banks approximately by 2%. ii) we set s, that can be interpreted as the amount of non-performing (real estate) loans expressed as a percentage of total (real estate) loans, equal to 12%. iii) RH=1.085: RH stands for the value of the building per unit of loan expected at the contractual stage. We proxy it with the reciprocal of the maximum LTV ratio, that measures the maximum loan as a fraction of the value of the building. We assume a LTV ratio of 92% (i.e. RH=108%). iv) R=1.24 and r=1.14 ($R-r$= 10%): the per-period productivity of the good entrepreneurs is set equal to 111.3%. The bad entrepreneurs are assumed to have a per-period productivity of 106.7%. v) we set G, i.e. the fraction of bad entrepreneurs, equal to 0.7.

Substituting these parameter values, $\Delta Y_{re,2}/Y_{re,0}$ is approximately 0.34%.

1.3 Robustness

In this section we show that asymmetric information on the quality of bank assets, besides magnifying the propagation, can make it robust to banks' and entrepreneurs' reactions to the shock. In 3.1 and 3.2 we explore two reactions of the agents to the shock that could dampen the propagation. In 3.1 we allow for renegotiation of the contracts; in 3.2, in a context in which banks fund more than 1 project in period 1, we allow banks to shrink loans in a "selective" way, i.e. to squeeze some loans more and others less. The result in 3.2 will also vindicate the claim that a simplified framework in which each bank funds only one project in period 1 implies no loss of generality.

The intuition behind the results of this section is that an anonymous and uninformed secondary market, by pooling the assets of the banks at date 1, prevents the single entrepreneur or bank from internalising the benefits of these strategies, discouraging their use. In 3.3 we discuss welfare implications.

1.3.1 Renegotiation

In the model in section 2 the parties cannot renegotiate the contract after the shock. We now show that, even allowing for a costless revision of the contractual terms (interest rate and building collateralisation), for big enough shocks renegotiation will fail and the post-shock equilibrium will be as in Proposition 1.

We assume that after the shock each banker can offer a new contract to the funded entrepreneur but the entrepreneur can reject this offer and stick to the initial contractual terms (i.e. renegotiation occurs only if it leads to an improvement for *both* parties). First, observe that after the shock neither the entrepreneur nor the banker would want to reduce the collateralisation of the building. A lower collateralisation would only reduce the banker's capitalisation and loanable funds damaging banker and entrepreneur. Therefore, we can focus on a renegotiation of R^B. The reason renegotiation can fail is the following. A banker will agree to a new contract only if it sets a higher interest rate R^B and hence increases the expected return on her loan. The increase in the expected repayment on the loan will increase

her capital base $E'(K_2)$ allowing her to extend a bigger loan to the entrepreneur.[9] Intuitively, the entrepreneur will reject the new contract if the gain from a bigger loan is overwhelmed by the loss due to the higher interests to be repaid.

Let us consider the polar case in which the bank offers a new contract with a higher interest rate and a new loan limit equal to the maximum one consistent with the new capital requirement at this higher rate. Proposition 3 shows that, even in this case, if the new capital requirement is high enough, the entrepreneur will reject the contract offered.

Proposition 3 *If*

$$\sigma' \leq \frac{1}{(1-s)R-\ell}$$

no entrepreneur will accept renegotiation.

If the regulatory ratio σ' such that $\widehat{L}' = L^*$ exceeds $1/\left[(1-s)R-\ell\right]$, Proposition 3 shows that we can partition the regulatory shocks identified in Proposition 1 in two regions. For shocks sufficiently strong, the bigger financing allowed by the increase in the interest rate will not be enough to compensate an entrepreneur for the higher cost of the loan and the entrepreneur will reject renegotiation. For smaller shocks renegotiation will instead redistribute surplus from entrepreneurs to bankers dampening the credit and output crunch. Proposition 3 also shows that renegotiation is easier the higher the productivity of the good technology (R) and the probability of entrepreneur's survival $1-s$ and the bigger the bank's loss per unit of denied credit $1-\ell$.[10]

Asymmetric information on the quality of equipped buildings in the secondary market can play a role in the failure of renegotiation. If at date 1 buyers observed the quality of each single building, the entrepreneur could find convenient to accept an increase of the interest rate sufficient to keep the loan above L^* and signal to the supervisors the choice of a good equipment (remember that when $L' > L^*$ an entrepreneur always chooses a good equipment). Signalling the choice of a good equipment the entrepreneur would sustain the expected liquidation price of her building,

[9] For the impact of interest rate changes on bank capital see Jackson and Lodge (2000).

[10] The bigger $(1-\ell)$, the bigger the capital and loan crunch will be if the contract is not renegotiated.

increasing the capital base of her bank and receiving a bigger loan. However, asymmetric information in the secondary market prevents the single entrepreneur from internalising this benefit of renegotiation.

1.3.2 "Selective" Crunch

In the model in section 2 each bank funds one project in period 1. This automatically implies that loans are shrunk homogeneously. We argue that, if the concentration of the banking system is low, this assumption implies no loss of generality.

Let us assume that at date 0 each bank had more units of final good and funded more projects, with each project still funded by only one bank. Let us assume also that at $t = 1/2$ each bank could impose a limit on the loan extended to any of its borrowers lower than the one contractually committed at date 0, facing a cost or penalty of $1-\ell \geq sHR$ for each unit of loan denied. It is straighforward that Lemma 1 would be unaffected, i.e. $L = L'(.) = 1$ and $R^B = \frac{1-sHR}{1-s}$ for each entrepreneur and $E_0(p) = R$.[11] In this framework, however, after the shock each bank could follow two strategies: it could squeeze loans homogeneously among its borrowers or could concentrate the downsizing on few entrepreneurs (*"selective crunch"*). If the single bank were *big* enough relatively to the banking system, it would opt for a selective crunch. In fact fewer of its borrowers would have their loans cut and would potentially switch to the bad technology. By improving the average behaviour of its borrowers, the bank would increase the average quality of the buildings in the secondary market and hence $E'(p)$, dampening the propagation.

Conversely, if the single bank were *tiny*, it would take the market resale price of any recovered building as given. Strictly speaking this would leave banks indifferent on the strategy to follow in shrinking loans and simply assuming that, if indifferent, they would opt for an homogeneous crunch could appear somewhat *ad hoc*. However, several reasons would make an homogeneous crunch necessary or preferable:

[11] Given the cost or penalty for denial $1-\ell$, at $t = \frac{1}{2}$ a bank would never have the incentive to deny voluntarily any loan committed at date 0. Note also that, to match the basic model in full, each bank should fund either all good entrepreneurs or all bad ones. For instance, entrepreneurs could be clustered in groups ("cities"), with the members of each group having the same private benefit. In turn, each bank could specialise in lending to one group, for instance to save transaction costs. A perfect correlation within the single bank's portfolio is an extreme, simplifying assumption but the role of asymmetric information in magnifying the output loss would be preserved also with a moderate correlation.

i) banks could already have extended a fraction of their loans when the shock occurs and be unable to call it back; ii) the most penalised borrowers could severe established relationships; iii) the penalties/costs that banks suffer from downsizing the credit line of a borrower could increase with the denied credit more than proportionately. Note that the basic model could be augmented with any of these three features in a straightforward way: i) allowing for a staggered loan, with a partial extension (say $\widehat{\widehat{L}}'$ itself) at date 0; ii) and iii) assuming that ℓ decreases even marginally as the fraction of commitment denied to the single borrower increases.

To summarise, asymmetric information in the secondary market, together with a sufficiently low banking concentration, does not allow a single banker funding more projects to internalise the benefits of a selective crunch, leading her to behave like the sum of many smaller bankers each funding one project. Hence, we can use the simplified framework of section 3 without loss of generality.

1.3.3 Welfare

If the two strategies just discussed are feasible, the equilibrium that realises after the shock is constrained Pareto inefficient. For instance, assume that banks were run by a planner unable to observe agents' private information. Without any of the additional assumptions discussed in 3.2, this planner would certainly implement a selective crunch, dampening the propagation. Interestingly, the role of the planner could be played by bank supervisors, who could guide banks to adopt better strategies in their loan retrenchment. It would be worth analysing the extent to which regulatory authorities played such a role in recent crises.

1.4 Conclusion

We have analysed a model in which lenders' (banks') capitalisation interacts with borrowers' liquidity and choice of projects, generating a powerful financial accelerator of negative shocks. We have also analysed how the opaqueness of banks' portfolios reinforces this interaction.

There are at least two possible extensions of the analysis. The first is studying the propagation mechanism in an economy in which the shock has non-zero prob-

ability and agents can write contracts contingent on the realisation of the shock. The second extension is endogenising the toughness of capital regulation. A possible direction is studying a framework in which banks also gather funds from risk averse depositors and the regulator adjusts the toughness of capital regulation with the institutional objective of smoothing depositors' repayments. Such a framework would allow to analyse the interaction among toughness of capital regulation, bank capital and projects' quality, offering further insights on the cyclical behaviour of capital regulation.

Finally, we identify two main policy implications of the analysis. First, the analysis suggests that, besides injecting capital,[12] regulators can guide banks' reactions to a capital crunch, weakening the link between bank capital and projects' quality. Secondly, the analysis suggests that transparency of banks' portfolios has a role not only as a deterrent against banks' opportunistic behaviour but also for macroeconomic stabilisation.

1.5 Appendix to Chapter 1

Proof of Lemma 1

For any gross interest rate R^B that solves the zero-profit condition of the bank with the equality sign, i.e.

$$R^B = \frac{E_0(L') - sHE_0(p)}{(1-s)E_0(L')}$$

ex-post the entrepreneur will always borrow the maximum possible L, i.e. $E_0(L') = L'(.) = L$. In fact, using also Assumption 1, $R^B = \frac{1}{1-s} - \frac{sHE_0(p)}{(1-s)E_0(L')} < \frac{1}{1-s} < r < R$, i.e. the entrepreneur's return net of the repayment due to the banker will be monotonically increasing in her borrowing. Trivially, the zero profit condition of the bank will always be binding: if not R^B could be lowered until it becomes binding, strictly increasing the entrepreneur' s expected return. We can then substitute L for $L'(.)$ and solve for L and R^B explicitly. Substituting the above expression for R^B into the objective function $E_0((1-s)R^E(b))$ we obtain

$$(1-s)E_0(R^E(.)) = E_0\{\max[(1-s)R(L+H), (1-s)(r(L+H)+b)]\} - L + sHE_0(p)$$

Now let us maximise the objective function with respect to L. Under Assumption 1, since $\partial E_0((1-s)R^E)/\partial L \geq (1-s)r > 1$, the entrepreneur will prefer L=1 (the capacity limit), whatever technology she chooses.

[12] Not surprisingly, as in Holmstrom and Tirole (1997), a public recapitalisation of the banking system would be unambigously beneficial in our framework.

Since everyone knows that, for any interest rate, at the capacity limit each entrepreneur, whether good or bad, chooses the good equipment, the rationally expected resale price of each project-building on the secondary market will be $E_0(p) = R$. Substituting L=1 and $E_0(p) = R$ into the formula for R^B we obtain the gross interest rate explicitly.

Proof of Proposition 1

First, observe that the level of the loan L^* at and below which the fraction G of bad entrepreneurs choose the bad technology satisfies

$$R(L^*+H)(1-s) = (B + r(L^*+H))(1-s)$$

from which L^* follows straightforward.

Then observe that, since no banker shrinks loans by more than what is strictly imposed by the regulator, $L'=\sigma' E'(K_2)$. Substituing this into the definition of capital base we get

$$E'(K_2) = R^B(1-s)\sigma' E'(K_2) + sE'(p)H + \ell(1-\sigma' E'(K_2))$$

from which we can solve for $E'(K_2)$ and L' as functions of R^B and $E'(p)$. In particular, after substituting R^B from the initial contract, we get

$$L' = \frac{\sigma'\left(sE'(p)H + \ell\right)}{1-\sigma'(1-sRH-\ell)}$$

In an economy without moral hazard ($b = 0$ for all the entrepreneurs) each entrepreneur would choose the good equipment for any L'. Therefore $E'(p) = R$ and, substituing $E'(p)$ into L', $L' = \widehat{L}'$. Consider now a regulatory shock such that the $\widehat{L}' \leq L^*$. In equilibrium $L' = \widehat{\widehat{L}}'$. In fact even at the maximum price of the building (R) the corresponding loan $\widehat{L}'$ would be lower than L^*. Hence the bad entrepreneurs will shift to the bad equipment and the expected resale price of each building will be $E'(p) = (1-G)R + Gr$. Substituting the latter value of $E'(p)$ into L' we get $\widehat{\widehat{L}}'$.

Proof of Proposition 2

i) Derivation of $\Delta Y_{re,1}$. In an economy without moral hazard each entrepreneur would receive a loan of $\widehat{L}'$ and, if living in the second period, would use her building and the intermediate input produced with the loan in the good technology (with productivity R). In our economy each entrepreneur receives a loan of $\widehat{\widehat{L}}'$ and, if living, produces on average $R(1-G) + rG$. In fact a fraction $(1-G)$ of entrepreneurs choose the good technology and a fraction G the bad one. In addition buyers use in period 2 the buildings left by dead entrepreneurs. Again, while in the benchmark economy all the recovered buildings would be well equipped, in our economy a fraction $(1-G)$ of these buildings are well equipped and a fraction G are bad buildings. Hence the difference in the real estate output produced in the two economies is

$$\Delta Y_{re,1} = nM\left\{\begin{array}{c}(1-s)\left(R(\widehat{L}'+H) - [R(1-G)+rG](\widehat{\widehat{L}}'+H)\right) + \\ +sRH - s[R(1-G)+rG]H\end{array}\right\} =$$

$$= \quad nM\left\{(1-s)\Delta L'R+(1-s)G(R-r)\widehat{\widehat{L}}'+HG(R-r)\right\}$$

In the above expression $\Delta L' = \widehat{L}' - \widehat{\widehat{L}}'$ is the loan crunch that each entrepreneur suffers because of the declining value of projects, i.e.

$$\Delta L' = \widehat{L}' - \widehat{\widehat{L}}' = \frac{\sigma' sHG(R-r)}{1-\sigma'(1-sRH-\ell)}$$

Substituting $\Delta L'$ and $\widehat{\widehat{L}}'$ in the above expression and operating simple algebraic manipulations we get $\Delta Y_{re,1}$.

ii) Derivation of $\Delta Y_{re,2}$. The loan crunch that each entrepreneur suffers because of the declining value of buildings is $\Delta L' = \widehat{L}' - \widehat{\widehat{L}}'$. Of the initial population of entrepreneurs a fraction (1-s) survives at date 1 while a fraction s dies (and all their intermediate input depreciates). Hence the contraction in loans due to the declining projects' value affects only the output of a fraction (1-s) of projects. Of the surviving entrepreneurs a fraction $(1-G)$ adopts the highly productive technology so that a reduction of one unit in the loan implies a loss of R units of real estate output; a fraction G adopts instead the low-productive technology so that a reduction of one unit in the loan implies a real estate output loss of r units. Combining these steps we obtain $\Delta Y_{re,2}$.

iii) Derivation of $\Delta Y_{re,3}$. Asymmetric information affects only the relative size of the loan extended to good and to bad entrepreneurs. Hence we can focus on the output of the projects in which the living entrepreneurs use the building personally equipped (say y^p_{re}). With asymmetric information each entrepreneur receives a loan of $\widehat{\widehat{L}}'$ at $t = 1/2$. Hence, at date 2 she obtains a real estate output of

$$y^p_{re} = \left[\frac{\sigma'((s((1-G)R+Gr)H+\ell)}{1-\sigma'(1-sRH-\ell)}+H\right][(1-G)R+rG]$$

In an economy without asymmetric information the expected resale price of the project/equipped building of a good entrepreneur would be $E'(p) = R$. Hence she would receive a loan of $\widehat{L}'$ and

$$y^p_{re} = \left[\frac{\sigma'(sRH+\ell)}{1-\sigma'(1-sRH-\ell)}+H\right](1-G)R$$

while for a bad entrepreneur $E'(p) = r$ and

$$y^p_{re} = \left[\frac{\sigma'(srH+\ell)}{1-\sigma'(1-sRH-\ell)}+H\right]Gr$$

To get the average per-living entrepreneur y^p_{re} in the benchmark economy let us take the weighted sum of the last two expressions. By subtracting the first expression from this weighted sum and operating simple algebraic manipulations, we get the loss in the average per-capita output of living entrepreneurs due to asymmetric information

$$\Delta y^p_{re} \quad = \quad \frac{\sigma' sH\left[(R^2(1-G)+r^2G)-((1-G)R+Gr)^2\right]}{1-\sigma'(1-sRH-\ell)} =$$

$$= \frac{\sigma' sHG(1-G)(R-r)^2}{1-\sigma'(1-sRH-\ell)}$$

Finally, multiplying by $(1-s)nM$, we get $\Delta Y_{re,3}$.

A Framework with Good Entrepreneurs' Moral Hazard

Let us assume that also good entrepreneurs enjoy a private benefit B' from the bad technology, with $H(R-r) < B' < B$. The ex-ante equilibrium is not affected: each entrepreneur (whatever her type) will choose to borrow and invest up to the capacity limit and will be expected to implement the good technology. Let us define as L^* and L^{**} the levels of loan at and below which respectively the bad and the good entrepreneurs shift to the bad technology. L^* is as in the basic analysis; L^{**} solves

$$\begin{aligned} R(L^{**}+H)(1-s) &= (B'+r(L^{**}+H))(1-s) \qquad i.e. \\ L^{**} &= \frac{B'}{R-r}-H \end{aligned}$$

Now we show that if $\widehat{L}' \leq L^*$ and $\widehat{\widehat{L}}' \leq L^{**}$ the amount lent to each entrepreneur at $t=1/2$ will be

$$\widehat{\widehat{L}}' = \frac{\sigma'(srH+\ell)}{1-\sigma'(1-sRH-\ell)}$$

In fact, if $\widehat{L}' \leq L^*$ and $\widehat{\widehat{L}}' \leq L^{**}$ (i.e. if also the crunch induced by the shift in the project choice of the bad entrepreneurs is strong enough) necessarily also the good entrepreneurs will shift to the bad technology. In this case $E'(p) = r$ and, after substituing $E'(p)$ into L', $L' = \widehat{\widehat{L}}'$. In this economy the total real estate output will be $\left[(1-s)\widehat{\widehat{L}}' + H\right] rnM$.

Proof of Proposition 3

We prove that, if the condition stated in Proposition 3 is met, an entrepreneur running the good technology will reject renegotiation. As argued below, this trivially implies that also an entrepreneur running the bad technology will reject renegotiation. An entrepreneur's expected net return from running the good technology is

$$\begin{aligned} (1-s)R^E(.) &= (R-R^B(.))(1-s)L' + RH(1-s) = \\ &= (R-R^B)(1-s)\frac{(sE'(p)H+\ell)\sigma'}{1-R^B(1-s)\sigma'+\ell\sigma'} + RH(1-s) \end{aligned}$$

where the RHS of the equality comes simply from substituting the equilibrium value of L'. Taking the first derivative of $R^E(.)$ with respect to the gross interest rate R^B, and considering that the entrepreneur and the bank take as given the liquidation price $E'(p)$ (that is a market price determined by the decisions of all the agents), we get

$$\frac{d\left[(1-s)R^E(.)\right]}{dR^B} = (1-s)(sE'(p)H+\ell)\sigma' \frac{(1-s)\sigma' R - 1 - \ell\sigma'}{(1-R^B(1-s)\sigma'+\ell\sigma')^2}$$

Clearly if the condition stated in Proposition 3 holds the entrepreneur will reject the offered contract and renegotiation will fail. If the entrepreneur runs the bad technology this will hold a fortiori since the productivity of the bad technology is $r < R$ (just subtitute r to R in the above expression).

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Chapter 2

Bank Capital, Bank Supervision and Real Estate Activity

Abstract

Employing evidence from banks' balance sheets and from construction activity, we find evidence of a two way link between banks' capitalisation and real estate activity in the Nordic crisis (1990-1994). We also find that an inaccurate bank supervision magnified this link, exacerbating the impact of the decline in real estate activity on banks' capitalisation.

2.1 Introduction

The link between declines in real estate activity and banking busts has been a stylised fact of several recent crises (Texas, 1985-1987; New England, 1991-1992; Nordic countries, 1990-1994; South East Asia, 1997-1998). During these depressions banks experienced big loan losses, with an important fraction of their losses concentrated in real estate loans (development loans and mortgages). Because of the resulting capital fall, banks were allegedly forced to shrink their loans to satisfy regulatory capital requirements. Real estate activity appeared to suffer particularly from this credit crunch. Anecdotal evidence suggests that many developers who were denied funds from their customary banks were forced to a major downward revision of construction plans (Harris, Boldin and Flaherty, 1994; Peek and Rosengren, 2000). On the regulatory side, in many countries the contraction in bank capital and lending followed episodes of financial liberalisation that challenged bank supervision. Because of the tougher competition induced by liberalisation, banks had tried

to preserve profit margins redirecting their lending towards sectors "less familiar" to them, like real estate (Sheng, 1996). This portfolio-reshuffling had strained supervisors' monitoring and credit assessment (Klingebiel, 2000; Wihlborg, Hutchison and Mueller, 1994).

The objective of this chapter is twofold. The first target is to assess whether a two way link between banks' capitalisation and real estate activity was at work during the crisis that hit Finland, Norway and Sweden from 1990 to 1994. Our hypothesis is that a fall in bank capital, resulting in a crunch of the loans extended by customary banks to developers and real estate buyers, led to a contraction of real estate activity. In turn, by eroding builders' returns, the decline in real estate activity negatively affected repayments on outstanding bank development loans, leading to a further capital and credit crunch and so on. The strong reliance on customary banks of developers and, to a lower extent, of real estate buyers is generally recognised as a distinguishing feature of the real estate sector. In commercial real estate the idiosyncratic nature of many projects makes an assesment difficult for new lenders, hindering the substitutability of loans of customary banks (Peek and Rosengren, 2000); in residential construction the small size of many builders makes them "opaque" and dependent on local, informed banks (Harris, Boldin and Flaherty, 1994). In turn, it is frequently argued that real estate activity has a relatively strong impact on banks' financial status and capitalisation (Browne and Case, 1992). Jaffee (1994) analyses the reasons for which banks are inclined to accumulate risky real estate loans in their portfolios during real estate booms, ending up with suffering disproportionate losses on these loans during real estate crises. According to his hypothesis, bank lending can create a self-generated expansion of demand, with a loan increase spurring a rise in real estate prices and activity and this in turn increasing the demand for loans. Sheng (1996) maintains that, when lending to real estate, "[...] banks assume that collateral value alone, particularly real property, is sufficient to demonstrate good credit, instead of assessing the underlying cash flow capacity of real estate developers to service their debt". Moreover, "[...] there is a fallacy of composition problem in real estate lending. Each developer assumes that his or her project is good at the margin, but forgets (as does the banker) that if all developers were to make the same assumption, there would be such an oversupply

of property that prices would fall sharply".

The second target of the chapter is to assess whether the accuracy of bank supervision affected the magnitude of the link between banks' capitalisation and real estate activity. As argued in more detail below, our hypothesis is that low quality of bank supervision magnified the feedback from declines in real estate activity to banks' capitalisation. Jaffee (1994) argues that during the Swedish real estate boom and bust bank supervisors were probably as inexperienced as the bankers in dealing with the recently deregulated environment. Sheng (1996) maintains that "[...] in the 1990s the failure to adequately address bank supervision resulted in weak banks that were unprepared to compete in global markets".

We verify our hypotheses in two stages. In section 2, we check whether the conditions behind the two hypotheses were satisfied, using anecdotal and circumstantial evidence from bank supervisors, from developers and from real estate buyers. In section 3, we perform a simple econometric analysis to test our hypotheses, using data from banks' balance sheets and from banking supervisory authorities. Overall, the evidence supports our hypotheses, even though the small number of data, severely limiting the degrees of freedom, suggests strong caution in interpreting the econometric results.

The chapter is related to the recent analyses on the effects of capital crunches on real activity (Bernanke and Lown, 1991, Peek and Rosengren, 1995, 1996, 2000 and Hancock and Wilcox, 1997 for the US; Vihriala, 1997 for Finland). From a methodological point of view, our econometric analysis on Nordic countries is close to that of Hancock and Wilcox (1997) for the US. They carry out a panel analysis for 47 US states relating five measures of real estate activity to bank capital surpluses and shortages. Our approach differs from theirs in two ways. First, we explicitly analyse the two way interaction between real estate activity and bank capital, testing the dependence of bank capital on real estate activity and on relevant banking and macroeconomic variables. Second, we take a preliminary step towards analysing whether the accuracy of bank supervision affects the feedback from real (estate) activity to banks' capitalisation.

2.2 Anecdotal and Circumstantial Evidence

From 1990 to 1994 Finland, Norway and Sweden were hit by a deep recession with a remarkable fall in real estate activity and prices and a deep banking crisis (for an overview see Bordes, Currie and Soderstrom, 1993 and Jaffee, 1994). Banks experienced huge losses, especially on real estate loans, and a fall in their capitalisation. By the end of 1994 (earlier in Norway), thanks also to public support, the crisis was over and banks' capitalisation had recovered.

In this section we employ anecdotal and circumstantial evidence to detect whether the conditions behind our hypotheses were satisfied. We identify four aspects: i) loan loss provisioning; ii) link bank capital-real estate lending; iii) substitutability of the loans of undercapitalised banks; iv) accuracy of bank supervision.

Throughout this section we will consider both loans to developers and to buyers of real estate. Since we focus on the link between bank capital and real estate activity rather than real estate prices, for our purposes it is irrelevant whether a crunch in bank credit hit the supply or the demand for real estate.

Loan Loss Provisioning If supervisors allowed long delays in loan loss provisioning, the impact of a decline in real (estate) activity on bank capital would be weak and diluted over time. Nordic Supervisory Authorities were stricter than before the crisis forcing banks to a more realistic evaluation of their portfolios in order to prevent further moral hazard, but greater flexibility was used in writing-off loans than in the US (Koskenkyla, 2000; Berger, Kyle and Scalise, 2001). The internal report prepared by the Swedish Regulatory Authority to summarise supervisors' experience during the crisis (Finans-Inspektionen, "*Experiences from the Swedish Financial crisis from a supervisory perspective*") highlights supervisors' stiffening in the statement of losses in the accounts. According to the report Swedish regulators required that

> "[...] expected losses and reduced values of assets be shown in the accounts when incurred [...]". In this way "[...] the size of the problems could be clarified [...]" even though "[...] the major risk of this method is that the dimension of the problems could be exaggerated".

For Finland we gathered anecdotal evidence with direct interviews. During the crisis Finnish regulators adopted a flexible attitude towards problem loans and

implemented the Basle capital requirements gradually from 1991 to 1994. However, according to a former head of the Government Fund Support:

> "[...] the private auditors of the Scopbank or of the Savings Bank of Finland (to a lower extent those of the troubled commercial bank Kansallis-Osake-Pankki), lobbied for a faster writing off of loans and a stricter implementation of capital requirements. This happened also under the pressure of banks' shareholders who feared that without a rapid clearing of the banks' portfolios the likelihood of a public intervention would increase, together with the risk of a dilution of their value at stake in the banks".[1]

Plausibly, this moderate stiffening in loan loss provisioning requirements exacerbated banks' undercapitalisation. However, especially in the late stage of the crisis, for a number of banks this stiffening was part of a plan of public support. This public support took place directly through capital infusions and indirectly through ad hoc asset management companies (AMCs), like Arsenal in Finland and Securum and Retriva in Sweden (for an overview of this public support see Koskenkyla, 2000). AMCs bought many impaired loans at a price above their market one dampening their impact on bank capital. In other cases they were only assigned the task of improving the marketability of some bad loans, obtaining however mixed results. For instance, while it is generally agreed that the AMCs helped in exploiting economies of scale in asset securitization, it is unclear whether they improved the collection and transmission of information on bad loans (Klingebiel, 2000).

Link Bank Capital-Real Estate Lending When suffering a depletion of their capital, banks could shrink non-zero weight securities rather than loans, especially if they want to preserve long-term relationships with their borrowers. In a companion empirical paper (Minetti, 1999) we tested the presence of a capital crunch on the liability side of banks' balance sheets using the same data-set on Nordic banks employed in the econometric analysis of section 3. The results appear substantially consistent with a capital crunch.[2] That said, even in the presence of a link between bank capital and total bank loans, Nordic banks could have squeezed loans

[1] "[...] even though it was also clear that the Government would not take actions like the nullification of shareholders' equity in the banks that had been implemented in Norway".

[2] The analysis tests whether changes in banks' capitalisation have explanatory power for changes in deposits. For results contradicting the capital crunch hypothesis in the Finnish recession see, instead, Vihriala (1997).

asymmetrically across sectors, shielding real estate.[3] Figures 1 and 2 respectively show real housing (or real estate) loans and the share of total bank loans given for housing (or real estate) purposes in Finland and in Norway (Swedish statistics do not contain analogous figures).[4]

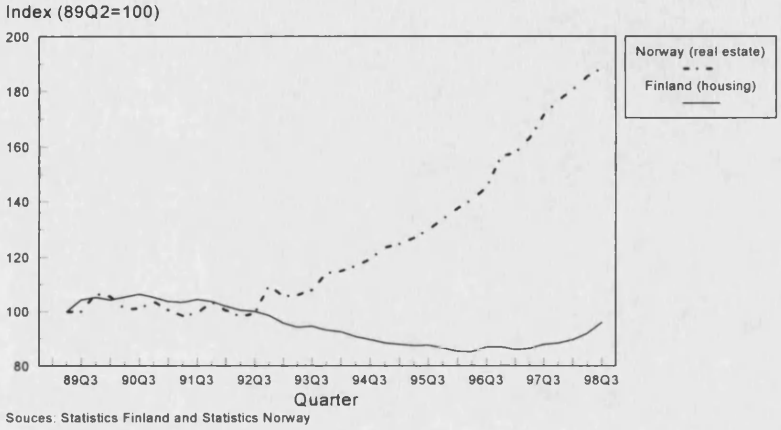

Figure 1. Real Housing (Real Estate) Loans. Finland and Norway

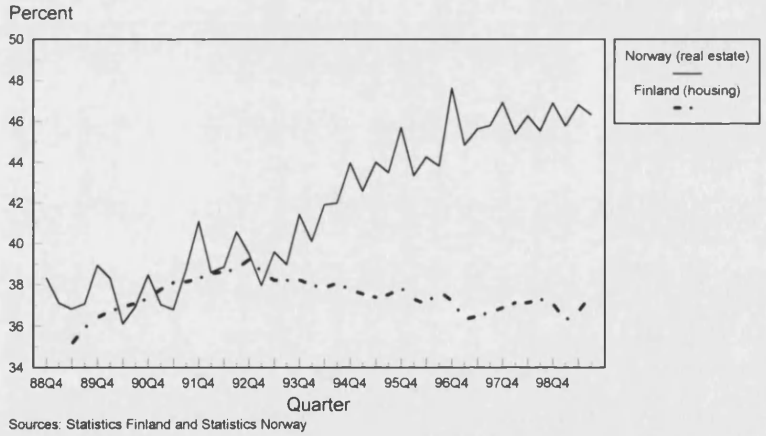

Figure 2. Housing (Real Estate) Bank Loans as a Percent of Total Bank Loans (Finland and Norway)

[3]Peek and Rosengren (1996) find that in New England, in the early nineties, undercapitalised banks crunched real estate loans strongly and that this crunch was large especially for those real estate borrowers most likely to be bank dependent.

[4]Bank housing (real estate) loans: for Finland banks outstanding housing loans; for Norway housing loans from commercial banks+savings banks. Total bank loans: for Finland banks' lending outstanding; for Norway total loans from commercial banks+savings banks.

In Norway real estate loans are depressed until the beginning of 1993 while in Finland housing loans decline later (1990-1995). This different timing is consistent with the fact that the recession started earlier in Norway, partly as a result of the 1986 oil shock. In relative terms, in Finland the share of housing loans is increasing until 1992 and then decreasing until 1996; in Norway the share of real estate loans falls or is stable over the first three years of the nineties recovering after 1994. Bank loan dynamics is not very informative since it is not possible to disentangle the extent to which the loan shrink resulted from a fall in the demand or in the supply. To obtain sharper evidence, in figure 3 we report the mix (ratio) between housing (real estate) bank loans and total housing (real estate) loans in Finland and Norway.[5]

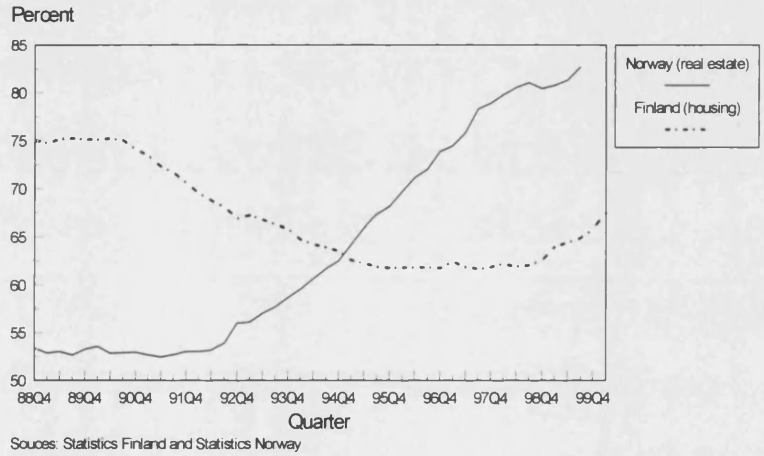

Figure 3. Mix (Ratio) Bank Housing (Real Estate) Loans versus Total Housing (Real Estate) Loans (Finland and Norway)

In both countries, the mix appears lower during the alleged credit crunch (note again the different timing).

The reduction in the mix suggests that the contraction in bank housing (real estate) loans would have derived not from a reduction in the demand, that presumably would have affected homogeneously all the sources of real estate finance, but from a crunch in the *supply* of bank credit. Note, however, that, while this hints

[5]Bank housing (real estate) loans: see note 5. In both countries total housing (real estate) loans consist of the housing (real estate) loans extended by all lenders, including the State.

at a possible role of the decline of banks' capitalisation in the crunch of bank real estate funding, the correlation between banks' capitalisation and the mix could be spurious. For instance, the decline in this real estate finance mix could have been the outcome of the contractionary monetary policy followed by the central banks of Norway and Finland in the late eighties/ early nineties associated with the workings of a bank lending channel. Testing the presence of a bank lending channel in four European housing markets, Iacoviello and Minetti (2000) find that monetary policy shocks affect the above mix in Finland but not in Norway. Moreover, long run institutional factors related to changes in the involvement in real estate finance of the different financial institutions and of the State could have mattered.

Substitutability in the Sources of External Finance Even if undercapitalised banks shrank real estate loans remarkably, in the presence of high substitutability with alternative finance (loans by well-capitalised banks, mortgage banks, finance and insurance companies or by the State) the impact on real estate would be marginal. Previous evidence for Finland and Norway hints at low substitutability between bank and non-bank finance, at least for residential real estate. Iacoviello and Minetti (2000) find that the "mix bank-mortgage lending/total mortgage lending by all the housing finance institutions" has power in explaining changes in real house prices in Finland and Norway.[6] However, low substitutability with non-bank finance is not enough to lock borrowers into their customary banks. Thanks also to injections of public capital, several Nordic banks avoided capital depletion and could have offset any credit crunch of undercapitalised banks. However, anecdotal evidence suggests that the fall in bank funding constrained developers and real estate buyers. For Norway the "*Report on the building and construction markets*" of 1992 (Norwegian Real Estate Association) reads:

> "The banking crisis has intensified and it appears that both the public and the industry are facing far more difficulties to cover financial needs than we assumed in September (1991)". And also: "The crisis in the banking sector has reduced banks' willingness to give out loans, and has also hardened their requirements for collateral. As a result many potential real estate buyers have been forced to withdraw their loan applications to banks".

[6]This analysis follows the spirit of Kashyap, Stein and Wilcox (1993). They study the impact of the mix bank loans/commercial paper on real activity in order to disentangle a bank lending channel of monetary policy from a balance sheet channel.

Accuracy of Bank Supervision We focus on supervisors' information on problem loans. Low quality of supervisors' information could signal that supervisors did not monitor banks efficiently, allowing them to take excessive risks. In addition, during the crisis, a low quality of supervisors' information could have hindered the correct assessment of banks' assets, leading supervisors to put pressure also on sound banks. The mentioned internal report of the Swedish Regulatory Authority (Finans-Inspektionen, "*Experiences from the Swedish Financial crisis from a supervisory perspective*") highlights supervisors' lack of information on problem loans

> "[...] in many banks it has not been possible to measure the profitability of products, groups of products or customers. Such deficiencies had serious consequences –such as- [...] incorrect pricing of loans, products and services [...] ". The assessment was problematic also because " [...] at the level of banks' management sufficient information about the quality of loan portfolios seems to have been missing [...]".

Analogously, the "*Valuation Guidelines*" of the Valuation Board read:

> "The current problem in evaluating non-completed projects and collateral is that the turn-over is low and the information weak. The consequence of this lack of information is that the market estimates become more uncertain [...] " and also " [...] in today's situation there is lack of marketing information which creates fundamental uncertainty. Furthermore other important information is missing about relevant revenue-influencing factors so that a meaningful treatment of information becomes impossible".

Also for Finnish banks, according to a former head of the Government Fund Support,

> "[...] not only supervisors, but also auditors and the bank management often lacked information about the prospects of loans during the crisis".

2.3 Econometric Evidence

2.3.1 Methodology

Overview In this section we test: i) the presence of a two way interaction between the capitalisation of the banking system and construction activity; ii) the negative correlation between the accuracy of supervision and the magnitude of this interaction.

To investigate the two way link between banks' capitalisation and construction activity we estimate a two-equation model using data from Finland, Norway and

Sweden. The first equation relates investment in construction to an indicator of banks' capitalisation and to other relevant explanatory variables. The second equation relates the indicator of banks' capitalisation to construction investment and to other relevant explanatory variables. In principle, construction investment is only one of the possible measures of real estate activity and, perhaps, not the most indicated for capturing a feed-back from a decline in real estate activity to developers' loan repayments and, therefore, to banks' capitalisation. A better proxy would be, for instance, the number of construction projects started and not completed or, to a lower extent, the value of total new construction projects. However, for the three Nordic countries analysed unavailability of data on alternative measures of real estate activity forced us to choose construction investment.[7]

To investigate whether the accuracy of supervision affects the feed-back from construction to banks' capitalisation, in the second equation we include an interactive variable obtained by multiplying construction investment by a proxy of the accuracy of bank supervision. As an input-side proxy we take the number of professional supervisors employed in the regulatory agency (see below for details).

The period of observation is 1989-1996, for a total of 24 annual observations, 8 for each country. The first annual observation will be lost because of the way we construct the indicator of banks' capitalisation. The small sample size and the resulting limited number of degrees of freedom will lead us to interpret the results of this econometric analysis with strong caution.

Variables Below we describe the variables (exact definitions and data sources are in Appendix). In deciding whether to specify the variables in levels or first differences we generally adopted the criterion of the goodness of fit.

Dependent variables

The dependent variable of the first equation is the "investment in construction of residential and non-residential buildings and other construction" realised in the country (*const*). We scaled investment (expressed in Swedish Kronas and deflated

[7]For the US, Peek and Rosengren (2000) use four measures of real estate activity: value, number and square footage of total new construction projects and the percentage change in employment in the construction industry.

by the consumer price index) by the population of the country. The results were almost identical scaling construction by GDP.

The dependent variable of the second equation is the "country aggregate bank capital deficit" (*bd*). We can roughly define this country aggregate capital deficit as "the sum of the discrepancies between the regulatory capital and the actual capital of each bank of the country". To calculate the real aggregate bank deficit we used a modified version of the method used by Hancock and Wilcox (1997) for the US. We gathered data on 71 Nordic banks or groups of savings banks (21 for Sweden, 15 for Finland, 35 for Norway) from the international rating agency IBCA. The three samples of banks cover between 90% and 95% of the bank loan provision in their countries. For each bank we estimated a proxy of the *required* TIER-1 capital at the end of year t, set by the Basle agreement at 4% of risk-weighted assets, in the absence of asset adjustments during year t (i.e. with the bank keeping risk weighted assets at their end-of-year t-1 level). Lacking detailed data on risk weighted assets, especially for the first years, we multiplied the outstanding loans of each bank at the end of year t-1, adjusted by a correction factor, by 0.04. Since loans are likely to underestimate risk weighted assets and it is reasonable that banks want to build a buffer above regulatory capital we tried a grid of correction factors ranging from 1.1 to 1.5, obtaining qualitatively similar results. We report the results obtained multiplying loans by 0.055, i.e. using a correction factor of 5.5/4. We then subtracted this proxy of the required TIER-1 capital in the absence of asset adjustments from the *actual* equity capital at the end of year t reporting the difference when negative (when positive we set the capital shortage at 0). Finally, we summed the capital shortages of the banks of each country to obtain a proxy of the aggregate capital shortfall (*bd*) of each country in each year (expressing it in positive terms). For each country (sample) we scaled the aggregate capital shortage by the total assets (a) of the banks in the sample, calculated at the end of the previous year.

The hypothesis of the model is that in each year the banks used the available information to estimate the equity capital at the end of the year. Whenever they detected a discrepancy between the projected capital and the required capital in the absence of asset adjustments they strove to reach the targeted capital/asset

ratio cutting loans, including real estate ones, during the year. In turn, the crunch in loan supply affected real estate activity, forcing developers to revise construction plans downward and, through a reduction of the repayments on the outstanding construction loans, depleting bank capital. The resulting increase in capital shortage further squeezed real estate loans and so on.

Exogenous variables: first equation

With perfect credit markets, construction investment can be thought as a function of general economic conditions, of population dynamics and of the user cost of real estate (Jaffee, 1994). We include the change in the unemployment rate (Δu) to capture the effect of general economic conditions, expecting a negative sign on its coefficient. We include the population growth rate ($\Delta pop/pop$) to capture the role of demographic factors in real estate demand, expecting a positive coefficient. Finally, we include the lending rate (lr) and the house price inflation ($\Delta hp/hp$) to capture the impact of the user cost. We expect a positive sign of the coefficient of house price inflation. As to the lending rate, while in principle we would expect a negative coefficient, it would not be entirely surprising to find a positive one. In fact, as Browne and Case (1992) argue, interest on construction loans is commonly accrued until the project is completed and does not impose an immediate cash flow constraint; moreover the interest rate could pick up investors' hopes of appreciation not entirely captured by house price inflation.

Exogenous variables: second equation

The most interesting exogenous variable in the second equation is the interactive variable obtained by multiplying $const/pop$ by our proxy for the accuracy of bank supervision. As anticipated, for each country as a proxy we use the number of professional supervisors employed by the regulatory agency, scaled by the M2 of the country expressed in US dollars ($supvs/M$). The intuition is that a bigger pool of professional supervisors allows a more accurate information gathering on banks' assets. In turn, this helps to contain banks' moral hazard in loan granting and facilitates the correct evaluation of banks' assets. Therefore, we expect the interactive variable to have a positive sign, dampening the negative relationship between construction and the aggregate capital shortage.

There are two problems associated with the use of this variable. First, the number of professional supervisors is a rough input-side proxy for the accuracy of bank supervision. Second, we were unable to trace the number of supervisors back to the period under study with enough confidence. Therefore, we consider the number of supervisors employed in 1998-2000 scaled by the M2 of the country in 1998. The data were obtained either directly from the regulatory authority (for Norway) or, for Sweden and Finland, from the database recently constructed by Barth, Caprio and Levine (2001). While we have the obvious incentive to gather older and more accurate data, there are reasons to believe that supervisory practices change relatively little over time (Barth, Caprio and Levine, 2001). In view of these problems we adopt a cautious step-wise approach including this interactive variable only in a second specification.

The second equation includes two additional groups of exogenous variables. The first consists of sector-specific "banking" variables that can affect banks' capitalisation through profitability and loan loss reserves. We include the ratio operating expenses/(average of the last two end-of-year total assets) ($opex/a_{av}$) expecting a positive sign and, in the second specification, the total public recapitalisation scaled by GDP ($pubk/gdp$), expecting a negative sign. The second group consists of indicators of general economic conditions. We include the change in the unemployment rate (Δu), expecting a positive sign. We include the consumer price inflation ($\Delta cpi/cpi$) to take into account the possible impact of inflation shocks, expecting a positive sign. Finally, we include the short term interest rate (r). An increase of the interest rate can have a positive direct impact on banks' profitability through higher repayments and a negative indirect one reducing borrowers' net worth; hence ex-ante its expected sign is ambiguous.

Specification Considering banks' practice in loan provisioning, we expect that the decline in construction investment affects the aggregate capital shortage with some lag. This looks a reasonable prior also in the light of the anecdotal evidence presented in the previous sub-section, where we showed that Nordic supervisors adopted a stiffening but cautious approach in pushing banks to make provisions. Except for this prior the choice of lags is somewhat arbitrary, especially because

construction includes short projects, like those for single-family houses, and longer projects, like those for office buildings. We tried similar lag structures with no qualitative difference in the results.[8]

Below we report the *basic* specification (i.e. not augmented with public recapitalisation and with the proxy for the accuracy of bank supervision). In the second specification public recapitalisation appears in the second equation lagged one year.

We estimate both specifications by OLS. A drawback of using OLS is that some of the explanatory variables, such as the indicators of general economic conditions or house price inflation, could be endogenous, leading to inconsistency of the OLS estimates. Including such variables in lags shields somewhat from their possible endogeneity. A more robust method to prevent possible endogeneity would be IV estimation. However, besides the difficulty of identifying reliable instruments, the limited sample size discouraged us from using IV estimation. It is well known that, while they feature appealing asymptotic properties, IV estimators can have very bad small-sample properties.[9]

$$(\frac{const}{pop})_t = \alpha(\frac{bd}{a})_t + \beta\Delta u_{t-1} + \gamma(\frac{\Delta pop}{pop})_{t-1} + \delta(\frac{\Delta hp}{hp})_{t-1} + \epsilon lr_t$$

$$(\frac{bd}{a})_t = \zeta(\frac{const}{pop})_{t-1} + \eta(\frac{opex}{a_{av}})_t + \theta\Delta u_{t-1} + \iota(\frac{\Delta cpi}{cpi})_{t-1} + \kappa r_{t-1}$$

2.3.2 Results

In Table 1 we report the results obtained with the two chosen specifications. In the first equation the aggregate bank capital shortage affects construction investment with the expected negative sign (at the 5% level of significance). In the second equation we find a negative impact of construction on banks' capitalisation (with the coefficient being weakly significant at the 10% level in the first specification).[10]

[8] We also included linear trends in the two equations with no significant difference in the results.

[9] For instance, in small samples it can be the case that the probability that the IV estimators are closer than the OLS estimators to the true coefficients is below 0.5. For a discussion of the finite sample properties of IV estimators see Davidson and Mackinnon (1993). For a related study that estimates an equation for real estate activity with similar explanatory variables by OLS see Browne and Case (1992).

[10] As to the other independent variables, in the first equation the coefficients of the change in unemployment rate and of the lending rate appear significant and with the expected sign. House price inflation and population growth rate are not significant. In the second equation none of the

In the second specification the interactive variable $(const/pop)(supvs/M)$ is not significant even though, interestingly, it appears with the expected positive sign. Overall, the results suggest the presence of a two way interaction between banks' capitalisation and construction investment but offer little evidence on the role of bank supervision in this interaction. More evidence is clearly needed, especially on the latter point.

Given the low number of degrees of freedom these results should be treated with caution, even though we obtained analogous estimates with alternative specifications. In particular, the results for the second equation are weak. This again could derive from the low number of degrees of freedom. However, we offer one alternative explanation for the difficulty in capturing banks' capitalisation, based on the afore-mentioned role of Asset Management Companies in the late stage of the Nordic crisis. AMCs bought many impaired loans at a price above their market one, dampening their impact on banks' balance sheets (Klingebiel, 2000). It is reasonable that, despite the stiffening of banking regulation, this contained the impact of real estate activity and of economy-wide fundamentals on banks' capitalisation. However, a rigorous test of this argument is beyond the scope of this analysis.

2.4 Conclusion

We have presented evidence on the link between banks' capitalisation and real estate activity in the Nordic crisis of the first half of the nineties, exploring also the role

exogenous variables is significant but, except for unemployment, they appear with the expected sign.

Table 1: Regression Results
Ordinary Least Squares Estimates

1^{st} equation	Dep. var.= const/pop	
	(1)	
bd/a	-0.263	**
	(0.12)	
Δu	-0.121	***
	(0.039)	
Δpop/pop	-0.359	
	(0.61)	
Δhp/hp	0.006	
	(0.009)	
lr	0.079	**
	(0.03)	
R^2	0.907	

2^{nd} equation	Dep. var. = bd/a		
	(1)		(2)
const/pop	-1.20	*	-1.49
	(0.636)		(1.33)
opex/a_{av}	0.154		0.179
	(0.224)		(0.25)
(const/pop)(supvs/M)			0.33e+06
			(1.14e+07)
pubk/gdp			-0.123
			(0.177)
Δu	-0.141		-0.119
	(0.133)		(0.147)
Δcpi/cpi	0.152		0.193
	(0.122)		(0.144)
r	0.130		0.151
	(0.091)		(0.104)
R^2	0.682		0.696

Notes: *, * *, * * * Coefficient significant at the 10%, 5%, 1% levels respectively
Standard errors in parentheses. The regressions include country-dummies

that the accuracy of bank supervision could have played in this link. The analysis has implications that go well beyond the real estate sector. Being a very volatile component of aggregate demand, real estate investment is thought to have an important role in the business cycle (Bernanke and Gertler, 1995). In addition, in countries in which the banking sector represents the bulk of the financial system, like in the three Nordic countries we have analysed, a decline in real estate activity

could propagate to the rest of the economy by eroding banks' net worth.

Our analysis hints at a role of an accurate bank supervision in weakening the link between real estate activity and banks' financial status. The next pressing step is finding stronger evidence on this point, starting from the use of more precise indicators for the accuracy of bank supervision.

2.5 Data Appendix to Chapter 2

Micro bank balance sheets data

-Loans, Equity Capital and Total Assets (end of year): IBCA Bank Data Scope 1998

Aggregate banking variables

-Operating Expenses as Percent of Average Assets: OECD Profitability of Banks (various numbers)

-Public Recapitalisation: Finland, information kindly provided by the Bank of Finland, Financial Stability Department; Norway, Norges Bank, Financial Markets Department, Economic Bulletin 2/95; Sweden, information kindly provided by the Riksbank

-Number of Professional Supervisors (1998-2000): Norway, data kindly provided by Kredittilsynet (The Banking, Insurance and Securities Commission of Norway); Finland and Sweden, data from Barth, Caprio and Levine (2001)

Macro variables

- Unemployment Rate, Consumer Price Index, GDP (year averages): Primark Data-Stream

- Population (year average): Demographic Yearbook, United Nations

- Investment in Construction of Residential and Non-Residential Buildings and Other Construction: OECD International Statistics (various numbers). Swedish data were corrected from 1993 by a factor suggested by Statistics Sweden;

- Lending Rate (year average), Short Term (Money Market) Interest Rate (year average), Money+Quasi Money (end of 1998): IMF International Financial Statistics;

-House Price Index: Finland (Residential Property Prices): BIS; Norway (New Detached Houses Price Index): Primark Datastream; Sweden: Transacted Houses Price Index: Statistics Sweden

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Chapter 3

The Credit Channel of Monetary Policy and the Housing Market: International Empirical Evidence

Abstract

This analysis tests a credit channel of monetary policy (especially a bank-lending channel) in the housing market. We argue that the relevance of the credit channel depends on the structural features of the housing finance system, in particular efficiency and institutional organisation. We employ a structural VAR approach to analyse this issue in four European housing markets (Finland, Germany, Norway and the UK). Our results support the existence of a broad credit channel and, in some contexts, of a bank-lending channel. More importantly, the findings show across countries a clear-cut relationship between presence of a credit (bank-lending) channel, efficiency of housing finance and type of institutions active in mortgage provision.

3.1 Introduction

Since Bernanke and Blinder (1988), the literature has shown a renewed interest in the credit channel of monetary policy. According to this view, widespread imperfections in the credit market, such as asymmetric information or imperfect contract enforceability, result for consumers and firms in a wedge between the opportunity cost of internal funds and the cost of external funds. In turn, this external finance premium depends on monetary policy. Tight monetary policy not only raises market

rates of interest but also the external finance premium, thus discouraging investment and consumption. The explanations of this link are twofold. The balance sheet view argues that the bridge between monetary policy and the external finance premium is represented by the financial position of borrowers. Tight money affects borrowers' net worth, either reducing their current cash flows (increasing interest on debt burdens) or the value of their pledgeable assets. This feeds back on the external finance premium required by external lenders. The bank lending channel view, on the other hand, focuses on lenders' financial status. Tight money drains reserves and retail deposits on the liability side of banks' balance sheets. Faced with this deposit drain, banks can react by increasing their funding through managed liabilities (such as certificates of deposit) or shrinking assets (loans and securities). In the presence of an upward sloping supply for managed liabilities, banks may find it too costly to fully offset the reduction in retail deposits and opt to reduce their assets. The lending view argues that the impact is relatively stronger on loans than on securities. In fact loans and securities are imperfect substitutes because loans are riskier and less liquid. Therefore tight money causes an inward shift of credit supply that especially affects borrowers with limited access to non-bank sources of external funding.

The credit channel literature has produced mixed results (see Bernanke and Gertler, 1995). A strong focus has been placed on identifying contractions in credit aggregates resulting from inward shifts in the demand for funds (fully consistent with the traditional monetary transmission mechanism) from shifts in supply resulting from a credit channel. A second crucial issue of this empirical literature has been to disentangle the bank-lending from the balance sheet channel (Kashyap, Stein and Wilcox, 1993). In this sense, much work has been done on the relative impact of monetary policy on firms with different dependence on bank funds, such as small and big firms (see Gertler and Gilchrist, 1994).

This chapter extends the analysis of the credit channel of transmission on the households' demand side focusing on the housing market. Our aim is twofold. On the one hand, we want to assess the presence of such a channel in the housing market (possibly disentangling a bank-lending from a balance sheet channel). Secondly, we want to relate its presence, as far as possible, to the structural characteristics

of the housing finance system, especially its institutional organisation and its level of efficiency. Clearly, the analysis has implications that go well beyond the housing market. Housing can play an important role in the business cycle, not only because housing investment is a very volatile component of demand (Bernanke and Gertler, 1995), but also because changes in house prices are thought to have important wealth effects on consumption (IMF, 2000) and investment choices (Topel and Rosen, 1988).

There are three main motivations for our analysis. First, housing markets feature puzzles in terms of quantity and of price dynamics hard to reconcile with the traditional monetary transmission mechanism. For instance, as Bernanke and Gertler (1995) observe, the response of residential investment to innovations in short-term rates is generally sharp and persistent. These feature does not match the dynamic response of long term rates (the ones that mainly drive residential expenditure) that traditionally under-react to innovations in short term rates and revert fast to their initial level. Secondly, as argued in Section 2.1, there are reasons to expect that the housing market is particularly exposed to the credit channel, hence representing a better environment to capture its presence than the broader economy. Lastly, by exploiting the cross-country heterogeneity in European housing finance systems, we can verify whether there exists a "reasonable" link between institutional context and evidence of a credit channel, thus offering an important robustness check for our findings.

The rest of the chapter is organised as follows. Section 2 analyses the credit channel in the housing market emphasising the role of the structural features of the housing finance systems (2.1), especially their institutional framework (2.2) and their efficiency (2.3). Section 3 explains the empirical methodology (3.1 and 3.2) and presents the results of the empirical analysis (3.3). Section 4 concludes. Appendix 1 and 2 respectively describe the structural characteristics of the housing markets analysed and the data used.

3.2 The Credit Channel and Housing Finance Systems

3.2.1 The Credit Channel Sensitivity of Housing

The credit channel of monetary policy can be expected to be relatively effective in the housing market. Starting from the balance sheet channel, "housing demand is linked directly to consumer balance sheets by features like down-payment requirements, up-front transaction costs, like closing costs and "points" and minimum income-to-interest payment ratios" (Bernanke and Gertler, 1995, page 45).[1]

The lending channel is also likely to be relatively strong both at the source (depository institutions) and at the destination (households). At the source, in countries where mortgage standardisation and securitisation are not widespread, the relative illiquidity of mortgages could matter. If banks want to keep a buffer against liquidity shocks, they might be encouraged to shift from less to more liquid loans or to securities. At the destination a crunch in bank mortgages will probably result in actual lack of funds for house purchases whenever mortgage funding from specialist mortgage lenders or from the State is not a sufficient buffer. In fact, households have inherently less financing opportunities than firms.

3.2.2 Credit Channel and the Institutions for Real Estate Finance

The first structural aspect that can affect the credit channel in the housing market (especially the bank-lending channel) is the institutional organisation of the housing finance systems. Broadly speaking, the systems of the countries that we analyse (Finland, Germany, Norway, UK) can be grouped as follows:

- Bank oriented model (Finland, UK, in part Germany);
- Mortgage bond model (in part Germany);
- State model (Norway and in part Finland).

[1] In countries where equity withdrawal is not widespread, we can also expect that homeowners' housing demand is strongly tied to their housing wealth.

The bank-oriented model is characterised by a strong presence of depository institutions (banks and mortgage banks) in mortgage provision. In the early 1990's, Finnish banks provided about 80% of housing funding (Nordic Council, 1992). In the UK, depository institutions have a market share of around 90%. In Germany, commercial and savings banks and credit cooperatives cover about 45% of the market competing mainly with mortgage banks and Bausparkassen. The banking system is the strongest candidate for a bank-lending channel. The dependence of borrowers on depository institutions is generally high. Moreover, the amount of loanable funds is likely to depend strongly on monetary policy, because of the general reliance of banks on reservable retail deposits. In particular, banking systems with low concentration are more prone to the existence of a lending channel, given the traditional difficulty of small banks in accessing wholesale funding (Guiso et al., 1999).

The mortgage bond model is characterised by the strong role of specialist mortgage institutions (mortgage banks). These intermediaries fund themselves mainly through the wholesale market. Outside our sample, Swedish mortgage banks generally fund themselves issuing long-term housing bonds (with adjustable rates) to institutional investors. German mortgage banks adopt a similar mechanism of financing (mortgage and municipal bonds). Bausparkassen, instead, rely on savings generated from long term (6-18 years) housing linked contracts and on government subsidies. Because of this funding mechanism, the mortgage bond model is less likely to be characterised by a bank-lending channel. Monetary policy is likely to have limited credit supply effects if specialist mortgage lenders with easy access to wholesale funding are major players and offer contracts highly substitutable to those of depository institutions.

Finally, the State model is characterised by a relevant State involvement (directly or indirectly trough public banks). In Finland, the State Housing Fund provides between 10% and 20% of mortgage loans. In Norway, this figure has averaged around 40% in the 1990's. State mortgage loans are generally restricted to social housing (Finland) or to particular categories of beneficiaries (Norway).

3.2.3 Credit Channel and the Efficiency of Housing Finance

The second structural feature that is likely to affect the importance of a credit channel is the "efficiency" of the housing finance system. In a comparative study of European housing finance systems, Diamond and Lea (1992) propose a number of qualitative indices to evaluate their efficiency. In particular, three aspects are relevant for the presence of a credit channel:

1. depth of the funding system for housing finance institutions;
2. presence of a diversified range of mortgage lenders and
3. sharing of credit risk.

A deeper market for wholesale funding can undermine at the source the effectiveness of a bank-lending channel by reducing the dependence of housing finance institutions on retail deposits. A wider, diversified range of mortgage finance institutions can weaken at the destination the bank-lending channel reducing the dependence of households' house purchases on bank credit. The sharing of credit risk, instead, mainly determines the strength of the balance sheet channel, as we clarify below.

The efficiency of a housing finance system is the result both of the historical evolution of the system and of regulatory constraints. A regulatory ceiling on deposit rates can prevent banks, after tight money, from offsetting the drain in deposits by increasing the return paid to depositors. Similar arguments apply for restrictions on market funding. In some countries previously, depository institutions have been prevented from issuing bonds in the open market,[2] which has implied a strong link between retail deposits and assets. Entry restrictions are again likely to mainly affect the effectiveness of the bank-lending channel allowing a smaller range of lenders alternative to depository institutions. For these reasons, the lending channel is likely to have become weaker after the financial liberalisation that occurred in many countries during the 1980's.[3] The abolition of ceilings on interest rates and of portfolio

[2]This was for instance the case for UK Building Societies whose ceiling on funds raised from the market was increased from 20% to 40% by the Building Society Act of 1987.

[3]Liberalisation consisted of abolition/relaxation of ceilings on deposit rates and of portfolio restrictions on market funding of lenders; abolition/relaxation of entry and product restrictions in the market for housing finance; abolition/relaxation of quantitative controls on mortgages.

and entry restrictions (disintermediation) would have respectively deepened the market for banks' liabilities and reduced the dependence of households on banks for mortgage funding.

Risk sharing is mainly reflected in the level of minimum income-to-interest-payment ratios and of down-payment requirements. These quantitative controls affect the link between borrower's net worth and the availability of funds from bank and non-bank intermediaries. It is unclear in this case whether financial liberalisation has significantly altered the strength of these balance sheet effects (see Bernanke and Gertler, 1995). As a result, the impact of financial liberalisation on the two channels may have been different, with a tendency to weaken the bank-lending channel but with limited effects on the balance sheet channel.

Table 1 classifies the housing finance systems of Finland, Germany, Norway and the UK according to institutional framework and level of efficiency,[4] in the three aspects previously indicated.[5] As the Table shows, we choose this set of countries because they display strongly diverse housing finance systems, hence fulfilling the heterogeneity criterion mentioned among the motivations of the analysis. Appendix 1 provides additional evidence in support of this argument. Needless to say, this classification is only meant as an approximate qualitative guide for the interpretation of the empirical results and should not be overstated.[6]

3.3 Econometric Evidence

3.3.1 Empirical Methodology

For each country, we run four VARs (in the form of a vector error correction model) in order to assess the presence of a credit channel and to disentangle a balance

[4]For this purpose, we refer mainly to the works by Diamond and Lea (1992), Booth et al. (1994), Lea, Welter and Dubel (1997) and the European Mortgage Federation (EMF, 2000).

[5]Given the impossibility of distinguishing, even at a qualitative level, whether the presence of the state affects the effectiveness of the bank-lending channel, (what we defined as) state and banking model are bundled together.

[6]The literature has recently considered the financial conditions of depository institution in explaining the short-run relevance of the lending channel. Intuitively, the cost for a bank of wholesale funding is correlated to its financial health, as measured by its capitalisation, profitability or share of non-performing loans (Kashyap and Stein, 1998). However the financial status of depository institutions is likely to change often and can be of limited use in explaining the medium-long run relevance of the lending channel.

sheet from a lending channel. The variables used and the identification scheme are summarised in Table 2. Appendix 2 describes data sources and time periods used in the regressions.

1. *The first VAR includes: GDP, CPI inflation, a short term interest rate, real house prices, housing loans by banks and other depository institutions, and total loans by banks and other depository institutions.* The results from this VAR are substantially uninformative for detecting a credit channel. A reduction in total (housing) loans after tight money could reflect a shrink in loan demand, therefore being consistent with the traditional monetary transmission mechanism.[7] However the change in housing loans can give a clue on the quantitative relevance of a possible credit channel.

2. *The second VAR includes: GDP, CPI inflation, a short term interest rate, real house prices and the Spread between a mortgage interest rate on outstanding or, when available, new housing loans and a benchmark interest rate.* A rise in the Spread between the mortgage rate and a safe rate of comparable maturity (e.g. a government bond yield) could capture the increase in the external finance premium associated with a credit channel. However, the use of the Spread encounters three major problems. First, the price is only one of the terms of mortgage contracts. For instance, an increase in the default probability of the borrower could result in higher required collateral rather than higher mortgage rate. Second, if quantity rationing were pervasive in the credit market, the Spread would fail to capture an increase in non-price rationing of mortgage demand. Finally, in the 1980's some of the analysed countries have witnessed a progressive shift from long-term, fixed mortgage rates to variable, reviewable and renegotiable ones. The Spread between a variable mortgage rate and a long-term benchmark rate could also reflect a liquidity premium (possibly time-varying) not associated with agency or monitoring costs. As mentioned above, we tried to match the maturity of the benchmark safe rate

[7] A reduction in loans is not even a necessary condition for a credit channel (Bernanke, 1995): households could try to compensate a reduction in their own wealth by borrowing more from external sources. Hence tight money could elicit an increase in loan demand that, if strong enough, could overwhelm any crunch in loan supply resulting from a credit channel.

with the actual length of fixity of the mortgage rate in order to overcome this problem.

Moreover, unavailability of detailed data on mortgage rates applied by different lenders prevents us from using the analysis of the Spread to disentangle a lending from a balance sheet channel (for instance detecting whether the Spread on bank mortgages increases more than that on mortgages from non-depository institutions). Hence, we generally focus on the spread on mortgages by depository institutions or the one on an average mortgage rate (Germany) inferring from its behaviour only information on the existence of a broad credit channel (balance sheet and/or bank lending).

3. *The third VAR includes: GDP, consumer price inflation, a short term nominal interest rate, real house prices, and the ratio of housing loans by all "non-depository" financial institutions and the State to all housing loans.* We argue that the analysis of the external finance Mix (that is, the fraction of housing loans by "non-banks") is the best way to disentangle a lending channel. As argued in the introduction, if managed liabilities are not a perfect substitute for deposits, a drain in reserves and deposits will lead to a relatively strong crunch in bank mortgages and to an increase in the Mix. The Mix will plausibly increase also as households try to compensate the reduction in bank mortgages with mortgages by other institutions. However, in the presence of imperfect substitutability between bank and other mortgages, this compensation is only partial and the crunch in bank supply affects housing demand. Therefore the analysis of the Mix requires two steps: to analyse whether monetary policy affects the Mix (VAR 3) and if so to analyse whether changes in the Mix affect the housing market (VAR 4).

4. *If monetary policy affects the Mix, we run a fourth VAR with GDP, CPI inflation, external finance Mix and real house prices.* We look at the effects of an exogenous Mix increase, what we call "external finance shock". If the Mix has any explanatory power in a house price reduced form equation that already includes income and inflation as controls, its incremental explanatory

power supports the existence of an independent bank-lending channel.[8]

The analysis of the finance Mix was first proposed by Kashyap, Stein, and Wilcox (1993) (who analysed the response of the Mix between bank loans and commercial paper to innovations in the Fed Funds rate) and has recently been used in the analysis of a lending channel in the automobile market (Ludvigson, 1998). As stressed by Oliner and Rudebusch (1996), the Mix does not completely solve the endogeneity problems. If different types of borrowers address preferentially different institutions for mortgage finance, a change in the Mix could simply reflect a different change in the demand for mortgages by these groups. For instance, in Finland banks compete with the State in the provision of mortgage finance but public funding is restricted to social housing (or single family houses). If tight money reduces the demand for social housing or single-family houses more than other segments of the demand, the Mix bank funding/State funding could decrease; however, this would only capture a different behaviour of consumers on the demand side.[9]

In all the specifications we use house prices as a cyclical indicator in the housing market. In principle, another way to test for the presence of a credit channel in the housing market would be to analyse the behaviour of housing investment. There are reasons, though, to think that house prices are more suitable to our analysis. First of all, since in the housing market quantities adjust sluggishly, prices could be more informative in capturing changes in housing demand in the short run. Secondly, house prices can play a crucial role in the transmission of monetary policy working through credit supply shifts. On the one hand, house prices affect borrowers' (homeowners) wealth and credit capacity (see Stein, 1995, and Kiyotaki and Moore, 1997 for theoretical models). On the other, they influence lenders' net

[8]Following Ludvigson (1998), we do not include the interest rate in this equation. In fact, if the interest rate indicates monetary policy, then including some interest rate measure would mean that changes in the Mix marginally reflect non-monetary effects. If the bank-lending channel is operative, then monetary policy should affect the Mix, and the Mix should affect house prices, but there should be no reason to expect that the Mix affects house prices when some variable that captures monetary policy stance is included in the VAR. Therefore the innovation in the Mix captures both monetary policy shocks and non-policy induced shocks, like, for instance, credit crunch episodes.

[9]As it will become clearer below, in our sample this endogeneity issue arises especially for Finland but lack of long time-series data undermines the possibility of running specific tests on the cyclical behaviour of particular segments of housing demand.

worth and, potentially, the amount of credit they extend. Specifying the VARs using quantities rather than prices would omit these interactions.

3.3.2 The Identification Scheme

The econometric methodology for the identification of the monetary shock in VARs 1, 2 and 3 relies on the common trends approach developed by King, Plosser, Stock and Watson (KPSW, 1991) and Warne (1993). The approach uses the cointegration properties of the data to achieve identification using both short and long run restrictions. When a group of variables in a VAR is found to be non-stationary but cointegrated, a useful specification for their dynamics is a vector-error-correction model (VECM). A VECM places non-linear, reduced rank restrictions on the matrix of long run impacts from a VAR. KPSW distinguish between structural shocks with permanent effects on the level of the variables from those with only temporary effects. The permanent shocks are the sources of the so-called common stochastic trends among the series. The number of these shocks equals the number of variables in the system less the cointegrating relationships between them. The remaining transitory innovations equal the number of cointegrating relationships (intuitively, a cointegrating vector identifies a linear combination of the variables that is stationary thus eliminating the trend, so that shocks to it do not eliminate the steady state in such a system).

The VAR model needs not to be fully identified: partial identification of either the transitory or permanent shocks is possible. Furthermore, one can separate the transitory shocks by adding some untested restriction on their impact effect. *We identify the monetary shock as the transitory innovation that does not affect contemporaneously GDP and CPI inflation, but that can have impact effects on all the other variables. In addition, the shock also has to satisfy long run neutrality, both by having zero long run effect on GDP (and the other real variables) and by keeping relative prices of houses and consumer goods constant.*[10] Therefore, GDP, inflation, real house prices and other real variables will revert back to their initial

[10]The monetary shock will not affect the relative prices of the two goods in the long run, but the permanent shocks in the VAR (that we do not focus upon here) in general will. However, it can affect the CPI and house price index (by the same amount), since we impose the zero long run restriction on CPI changes, not on levels.

steady state once the effects of the shock die out.

We run augmented Dickey-Fuller unit root tests on the levels of the series.[11] The tests show that the variables are integrated of order 1.[12] The results from the cointegration tests are mixed. Depending on the country and the time periods, the rank test statistic signals two to four cointegrating vectors. We rely on widely used plausibility arguments to solve the dilemma, opting for a common rank of 3. This allows us to identify the monetary shock in a neat way, by using zero impact restrictions of the monetary shock on GDP and CPI inflation only.[13] On the basis of this, we specify the first three VARs in the form of a vector error correction mechanism (VECM).[14] This combination of short and long run restrictions turns out to be successful, as the contractionary monetary shock elicits a rise in the interest rate and a negative response of GDP and consumer prices, all suggestive of a tight monetary policy stance.[15]

In VAR 4 we use a more conventional identification scheme to capture the effects of a Mix shock. Economic theory is in fact silent about the permanent effects of a Mix innovation. In order to identify it, we rely on a recursive scheme, ordering the Mix after GDP and consumer price inflation and before real house prices.

3.4 Country Specific Results

3.4.1 Finland

The evidence supports the existence of a bank-lending channel and leaves room for a balance-sheet channel.

Figure 2.A shows the responses of real housing and total loans to a monetary

[11] More details on this and on the cointegration tests are available in the Appendix.

[12] In Germany, the unit root null hypothesis for inflation, interest rates and real house prices is rejected. Note, however, that it is not necessary that each time series in a common trends model is non-stationary. Loosely speaking, a stationary variable is simply cointegrated with itself, and can therefore be fitted in a common trends framework (Warne, 1993).

[13] We departed from this rule only for one of the regressions for Norway. See the first footnote in the subsection on Norway.

[14] Each VECM is estimated with a lag length of 2 to 4, depending on which was sufficient to get serially uncorrelated residuals.

[15] We also tried the recursive identification scheme ordering the interest rate after GDP and CPI inflation in the VAR (not imposing the long run monetary neutrality restriction). The results of this specification were similar to those reported here.

contraction, using quarterly data from 1978:4 to 1999:3, along with one standard error asymptotic confidence bands. Both housing and total loans fall after tight money. Figure 2.B shows the response of the Spread between mortgage rate on new housing loans by banks and 3-year benchmarking interest rate[16] to a negative monetary shock.[17] The Spread increases significantly after the contraction, and its time pattern closely matches that of the money market rate. Its behaviour hints therefore at the existence of a broad credit channel.

In addition, the analysis of the finance Mix supports the workings of a bank-lending channel. We construct the Mix as the sum of housing loans by the State plus other minor non-depository lenders over housing loans by all institutions (including commercial, savings and cooperative banks) and analyse its behaviour in two steps. First, using data from 1987:1 to 1999:3 (that is after the liberalisation of interest rates), we find a significant increase in the Mix following tight money, with the response staying significant until ten quarters after the shock (Figure 2.C). This result looks consistent with the structural characteristics of the Finnish market for housing finance. Finnish banks rely strongly on retail sight deposits (EMF, 2000) and their access to wholesale funding occurs at a higher cost than for mortgage credit institutions in other Nordic countries (Kosonen, 1993, and Booth et al., 1994). These difficulties could explain the response of the Mix. The finding also suggests that financial liberalisation could have had a minor role in weakening a bank-lending channel *at the source* (i.e. increasing the substitutability between retail deposits and wholesale funding).[18]

We then analyse the impact of the Mix (Figure 2.D). Real house prices fall significantly after an increase in the Mix. This suggests that the composition of mortgage finance can play an important role in affecting housing demand. The result appears consistent with the characteristics of the Finnish system. The bulk of mortgages from non-depository institutions come from the State (from 1990, through the State

[16]The benchmark rate maturity reflects the fact that in Finland loans have typically adjustable rates with adjustment periods of 3-5 years (Kosonen, 1993). Maclennan, Muellbauer and Stephens (1999) report a share of 90% of adjustable rates mortgages.

[17]In this case the sample includes quarterly data from 1988:1 to 1999:3. Therefore the sample extends entirely after the abolition of interest rate ceilings (occurred in 1987).

[18]Financial liberalisation in the second half of the 1980's resulted in Finland in the abolition of the ceilings on deposit and mortgage rates and in the progressive deepening of the market for bank bonds.

Housing Fund). State mortgages can represent a buffer for shocks in bank funding only to a limited extent. In fact, state funding is restricted to social housing (rental, cooperative and owner occupied) and to financing the construction of single-family houses. Moreover state loans are means-tested. As a result, the substitutability between private-bank and alternative funding is likely to be imperfect, implying the relevance of mortgage distribution for households' house purchases.

3.4.2 Germany

We find evidence (though not conclusive) of a balance sheet channel but no evidence of a bank lending channel.

Figure 3.A shows responses of total loans and housing loans by banks, using data from 1974:2 to 1998:4.[19] A monetary contraction leads to a significant decline in total bank loans. Housing loans fall only slightly. This could be due to long-term relationships between banks and customers that induce banks to insulate their loan portfolios from monetary disturbances.

The Spread between the average 10 year fixed mortgage rate and the government 10 year bond yield widens after a monetary contraction and stays positive for about 3 years (Figure 3.B). Even in the 1990's mortgages with fixed rate have been originated also by commercial and savings banks, they are more typical of non-depository institutions, such as mortgage banks or Bausparkassen. Since the latter are shielded from fluctuations in reservable deposits, the increase in our Spread could capture the effect on the external finance premium of a deterioration in borrowers' net worth (i.e. a balance sheet channel).

We then analyse the Mix, using data from 1974:2 to 1998:3. The variety of institutions in the German housing finance system renders the construction of the Mix complex. We consolidate all the institutions traditionally relying on reservable, short-term retail deposits. We then construct the Mix as the sum of housing loans from Bausparkassen and Mortgage Banks over total housing loans from all financial

[19]The availability of relatively long time-series and the absence of significant structural changes in the regulation of the housing finance system led us to use relatively long time periods in the analyses. The regression for the Spread starts in 1982, as we found consistent time series for the interest rates only starting after that date.

institutions.[20] Tight money (Figure 3.C) leads to a rise in the Mix, which displays a hump-shaped response, peaking after two years and returning to the baseline after four. This seems consistent with the characteristics of the German market for funding. According to Diamond and Lea (1992), German funding markets are segmented. First, they feature relative sluggishness of market deposit rates. More important is the segmentation of the bond market. In particular, commercial and savings banks can issue unsecured debt but cannot issue mortgage bonds (unlike mortgage banks). They are also strongly discouraged by the regulator from issuing derivative securities. As a result, banks rely mainly on retail general funding and especially on savings deposits (EMF, 2000). The behaviour of the Mix can also be explained by the degree of concentration of the banking system. Except for the three big banks, the system is made by a network of small banks with difficult access to the wholesale market. In particular, the main financiers of house purchases are savings banks and credit cooperatives (approximately two thirds of bank housing loans once we exclude mortgage banks). There is a vast range of sizes among these banks but the majority is small and operates on a regional basis.

The Mix shock (Figure 3.D) does not affect real house prices significantly, indicating good substitutability of depository institution mortgages with mortgages from other institutions. This result is not surprising. The mortgage market in Germany appears well diversified and competitive (Diamond and Lea, 1992). Although the contracts offered by depository and non-depository institutions are not entirely homogeneous, especially in the length and in the rate (fixed or renegotiable), these differences do not appear to justify a marked non-substitutability.

3.4.3 Norway

We find lack of evidence of a credit channel.

Figure 4.A shows total loans and housing loans by depository banks[21] in response

[20]The denominator includes therefore, besides mortgages from the two mentioned institutions, mortgages from commercial, savings, regional banks and from credit cooperatives. The definition of housing loans includes mortgages secured by real estate (about 90% of the aggregate) and a residual category of "other" housing loans (for redevelopment etc.).

[21]This specification includes four cointegrating vectors. The identification restrictions imposed on the monetary shock are similar to all other cases. The only difference is that the monetary shock cannot affect house prices in the impact period.

to a monetary shock, using data from 1988:3 to 1999:4. Loans and real house prices fall significantly.

The response of the Spread between the mortgage rate[22] and the 5-year government bond yield provides very weak evidence for the credit channel hypothesis. The Spread (Figure 4.B) is not significantly affected by a monetary contraction. Further evidence comes from the analysis of the Mix (Figure 1, bottom row). Over the sample period, Government Lending Institutions have originated an important fraction of mortgages. At the end of the 1990s, commercial and savings banks' share in the market had risen to around 80%. Finally, finance and credit companies that fund themselves mainly through the wholesale market cover a minor share. We construct the Mix as the sum of loans from state and non-depository financial institutions over total housing loans.[23] Figure 4.C shows its response to a negative monetary shock. The response appears insignificantly different from zero.

This result could reflect the deepening of the market for bank funding in the Norwegian housing finance system. According to Lea, Welter and Dubel (1997), the access to the wholesale market has improved for depository institutions over the 1990's, reducing the banks' dependence on retail deposits (even if deposits represent the main source of funding, with an approximate share of about 60% of banks liabilities). The EMF (2000) maintains that banks have increasingly enjoyed easy access to wholesale general funding (in the form of bank bonds, loans from other monetary financial institutions and other general funding).[24] Quite interestingly instead, arguments related to the average size of Norwegian banks are not of help. In fact, concentration in the banking system is quite low with the strong presence of a myriad of small savings banks alongside a few medium-sized commercial banks.

[22]Interest rates on mortgage loans from banks were available for Norway starting only in 1995. Before that date, we used the interest rate on long and medium term loans. The bulk of mortgage loans in Norway have reviewable rates, but a non marginal fraction have renegotiable rates. For this reason, and for the likely pooling with loans with medium-long term fixed rates, we opted for a medium term rate as benchmark.

[23]As shown in Figure 1, because of the declining importance of public funding the Mix exhibits a strong decline over the whole sample passing from 45% in late 1980's to a value of little more than 15% at the end of the 1990's.

[24]The EMF also reports that "from 1995 until 1998 Norwegian banks have faced a much faster growth in lending than in deposits and have increasingly relied on funding from other sources..." (2000, page 29)

3.4.4 The United Kingdom

The evidence supports the existence of a bank-lending channel and leaves room for a balance-sheet channel.

The first VAR runs from 1978:1 to 1999:4. Tight money reduces on impact mortgages of depository institutions. Total loans decline only slightly and with some lag (Figure 5.A). Real house prices react with the expected negative sign.

The response of the Spread between the average mortgage rate on building societies mortgages and the 3-months Treasury bill rate (Figure 5.B) offers some evidence of a broad credit channel.[25] The Spread stays marginally positive for about 3 years.

We construct the Mix as housing loans of non-depository financial institutions, insurance companies, pension funds and the State (excluding banks and building societies) over total housing loans by all institutions. After the Corset abolition in 1980 and especially from the late 1980's, real estate agents and centralised mortgage lenders have competed with building societies and banks in mortgage provision. The bulk of funds of these non-depository institutions (and of insurance companies) come from the wholesale market, shielding them from fluctuations in retail deposits. The Mix increases following a negative monetary innovation (Figure 5.C), showing evidence of a crunch in bank and building societies mortgage supply stronger than the crunch in the mortgage supply of non-depository institutions. In turn, a positive innovation in the Mix reduces significantly real house prices that are well below the baseline around 6 quarters after the shock (Figure 5.D). Hence, the hypothesis of a bank-lending channel appears supported. On the one hand, the causality from monetary actions to the Mix shows that monetary policy can affect the composition of mortgage supply. On the other, the good marginal explanatory power of the Mix hints at the relevance of the composition of external finance for housing demand.[26]

The relevance of monetary policy for the Mix would appear controversial. As

[25] Here the VAR runs from 1985:1 to 1999:3 (a period that extends after the UK housing finance system reforms of the 1980's including the 1986 Building Societies Act). We choose a three-month rate as benchmark because the majority of mortgages in UK have a rate reviewable at the discretion of the lender.

[26] Moreover, unlike in the Finnish system, the homogeneity in the mortgage products is also associated with substantial homogeneity in the range of beneficiaries of mortgage loans across institutions. This implies that the change in the Mix cannot be explained by changes in the composition of demand.

Diamond and Lea (1992) report, the UK funding market stands for one "of the most fully integrated and developed funding markets, almost as far as the United States" (page 221). Banks have relatively easy access to the wholesale market and the constraint imposed on Building Societies wholesale funding is not binding. Diamond and Lea report the limit imposed to issuance of unsecured debt by Building Societies as a major inefficiency. In such a fluid and liberalised context it would have been equally plausible to find a weak link between monetary policy and the composition of finance.

The effect of the Mix on house prices is instead in line with reasonable expectations. Having aggressively entered the mortgage market in the 1980's, non-depository institutions have seen their market share declining in the 1990's (Figure 1, bottom row[27]).[28] With a market share of less than 10%, they probably represent too tiny a buffer to effectively shield households from a reduction in mortgages from banks and building societies. As suggested by Kashyap and Stein (1994), in the presence of non-negligible costs from switching from one lender to the other the argument of the "marginal" lender could fail, and the relative sizes of the bank and non bank intermediary sectors could matter.[29]

3.5 Conclusions

We have analysed and tested the presence of a bank-lending channel and more generally of a credit channel in four European housing markets featuring different institutional frameworks and different levels of efficiency in the funding and mortgage systems. Table 3 summarises the econometric evidence. While robust evidence of a bank lending channel emerges for Finland and the UK, we find at most evidence of a balance sheet channel for Germany, and lack of evidence of a credit channel for Norway. The results suggest that, despite the process of integration, residual

[27]The figure also includes a negligible, declining market share of the Government.

[28]According to Lea, Welter and Dubel (1997), following the sharp rise of market rates in 1988, centralised lenders were hit both financially and in originations with heavy pre-payments as they had to adjust their rates when the funding rate index (Libor) changed. Banks and building societies could avoid this adjustment because retail savings rates sluggishly responded to market rates.

[29]It would seem therefore that neither the increased freedom of entry in the market for housing finance nor the relaxation of funding restrictions and liberalisation of market rates have led to a full flexibility of the UK system.

heterogeneity characterises European housing markets and eventually, the transmission mechanism of monetary policy. The results for Finland, Norway and Germany are in line with the analyses by Diamond and Lea (1992), Booth et al. (1994), Lea, Welter and Dubel (1997) and EMF (2000). The Finnish housing finance system, despite financial liberalisation, is affected by frictions: banks heavily rely on retail deposit funding and have a predominant role in mortgage origination. At the opposite extreme, Norway has enjoyed a clear improvement in the funding mechanisms of housing finance institutions and greater competition among mortgage financiers (EMF, 2000). Finally, the rigidity of the German markets, marginally affected by deregulation, explains the evidence of a balance sheet channel suggested by the behaviour of the Spread; the lack of a bank-lending channel could be the by-product of the historical richness of non-depository mortgage providers. The evidence for the UK is partially at odds with the studies mentioned, instead. While in the UK the funding market for depository institutions is considered to be well developed (Diamond and Lea, 1992), we find that a monetary policy shock affects the Mix "mortages from depository institutions/ mortgages from all mortgage providers". The result that in turn the Mix affects housing demand is instead consistent with households' heavy reliance on depository institutions for mortage provision.

Throughout the chapter we have avoided quantitative comparisons across countries, limiting our analysis to qualitative differences in the sign, shape and significance level of the VAR impulse responses. We think that, in order to address the transmission of monetary policy, this approach is relatively safe even if our conclusions should still be treated with caution.

The normative implications of the analysis for the conduct of monetary policy are relevant. In a framework with a single monetary policy (which is the case for Germany and Finland and in perspective for the UK), the choice of the appropriate intermediate targets can encounter relevant difficulties with strongly asymmetric transmission channels. The question then becomes whether the process of integration or phenomena like the diffusion of mortgage securitization will progressively sweep these asymmetries away.

The second conclusion is methodological. Recent studies (Maclennan, Muellbauer and Stephens, 1998) have strongly questioned the usefulness of VARs for

analysing asymmetries in housing finance systems. The consistency of our results with the descriptive evidence by Diamond and Lea (1992) and the other mentioned studies suggests that, at least if restrained to qualitative inference, VARs can surely represent a useful technique.

Appendix to Chapter 3

Table 4.1: Structural features of housing finance systems

Country	Institutional framework	Efficiency		
		Funding Market	Mortgage market	Risk-bearing
Finland	Banking and state system Strong role of banks State funding restricted in scope and beneficiaries	Strong reliance of banks on retail deposits and limited use of general wholesale funding (like bank bonds) Limited use of mortgage bonds; no use of mortgage backed securities (EMF)	Limited possibility of diversifying away from banks State funding limited to particular types of mortgages/borrowers (BGMR)	LTV ratios around 70-80%
UK	Banking system Strong role of depository institutions (banks and building societies)	Competitive (DL) Good access of depository institutions to wholesale general funding Building societies can issue mortgage backed securities Sources of inefficiency: limits on building societies unsecured debt capital requirements unfavourable to issuing mortgage-backed securities (DL and EMF)	Weak role of non-depository mortgage lenders Integrated and competitive system No restrictions on contracts (DL)	LTV ratios up to 80% (without insurance) and 100% with insurance
Germany	Banking and mortgage bond system Low concentration in banking system	Segmented (DL) strong reliance of banks on retail deposits (mortgage backed securities issued at a very small rate) Sources of inefficiency -Deposit rates sluggish below market rates -Banks cannot issue mortgage bonds -Only Bausparkassen can issue contract savings -Limits on insurers favour mortgage bonds (DL and EMF)	Strongly competitive Well diversified range of alternative mortgage-lenders Commercial and savings banks have overcome the funding segmentation through ownership of the specialised institutional funding sources (DL)	LTV ratios> 80% restricted only to repeat buyers Regulator constrains LTV ratio below 80% for mortgage bank and Bausparkassen mortgages
Norway	Banking and state system	Good access of commercial and savings banks to wholesale market (bank bonds and other general funding) (EMF)	Strong and increasing competition in market for mortgage loans (LWD)	LTV ratios around 80%

Note: DL refers to Diamond and Lea (1992); LWD refers to Lea, Welter and Dubel (1997); BGMR refers to Booth et al. (1994), EMF refers to European Mortgage Federation (2000).

Table 4.2: Overview of the econometric Specifications

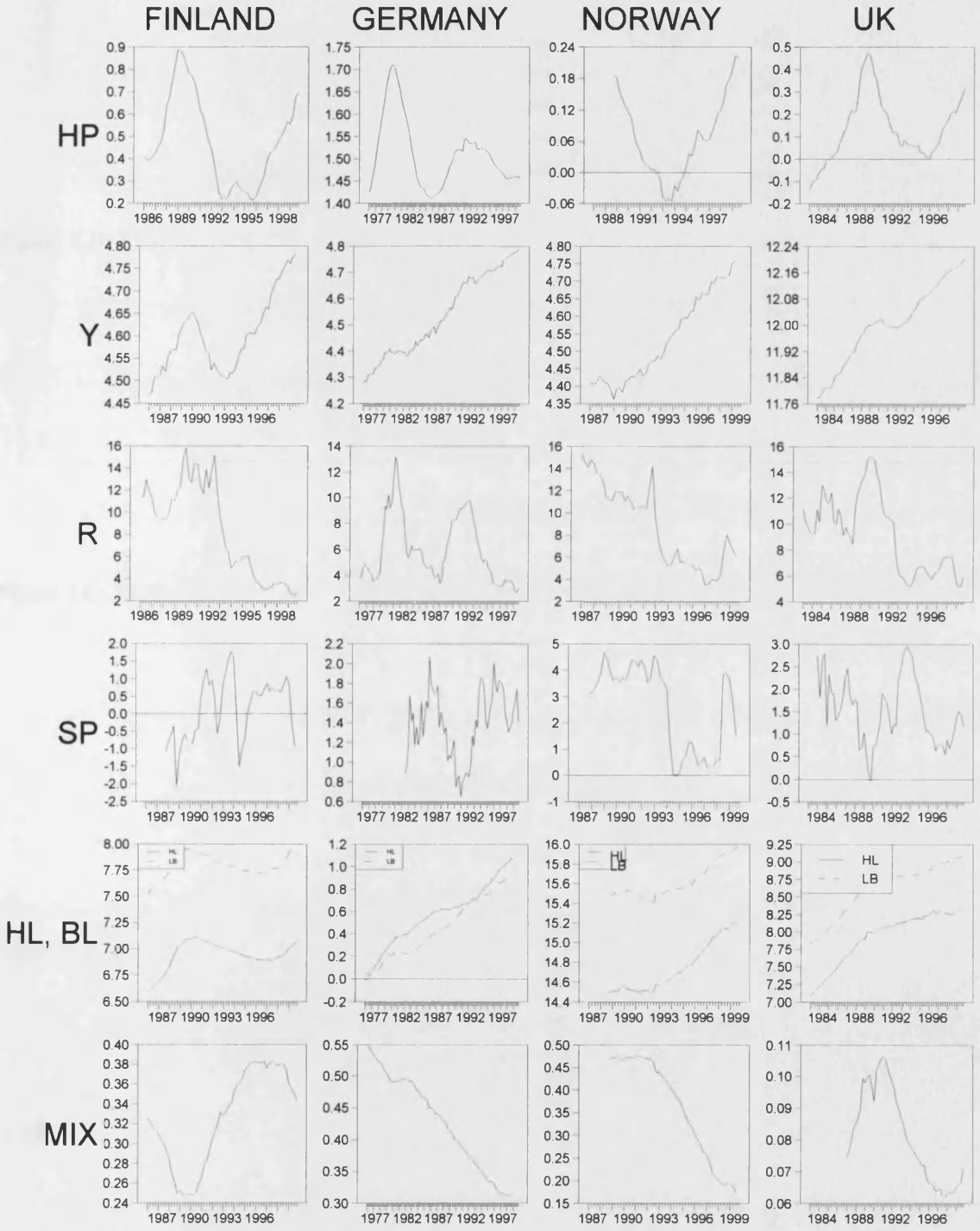
VAR	VARIABLES ()	IDENTIFICATION OF	IDENTIFICATION SCHEME
1	Y, DP, R, HP, HL, TL (Loans)	MONETARY POLICY SHOCK	Combinations of short and long run restrictions; monetary shock does not affect contemporaneously Y and DP and has zero impact on all the variables in the long run.
2	Y, DP, R, HP, SPREAD (Spread)		
3	Y, DP, R, HP, MIX (Mix)		
4	Y, DP, MIX, HP	MIX SHOCK	Recursive. The MIX shock does not affect contemporaneously Y and DP

Variables: Y (real GDP), DP (consumer price inflation), R (money market rate), HP (real house prices), HL (real housing loans from all institutions), TL (total loans from all institutions), SPREAD (mortgage rate, RM, *minus* benchmark safe rate, RL), MIX (ratio of housing loans from "non-banks" to total housing loans).

Table 4.3: Summary of the Empirical Findings

Country	Response to a negative monetary shock			Response to Mix increase	Credit channel?	
	Bank loans and housing loans	Spread = bank mortgage - benchmark rate	Mix (Housing loans non bank / Total Housing loans)	Real House Prices	Balance sheet	Bank lending
Finland	BL $\Downarrow$ HL $\Downarrow$	SPREAD $\Uparrow$	MIX $\Uparrow$	HP $\Downarrow$	Possible	Yes
Germany	BL $\Downarrow$ HL $\Leftrightarrow$	SPREAD $\Uparrow$	MIX $\Uparrow$	HP $\Leftrightarrow$	Yes	No
Norway	BL $\Downarrow$ HL $\Downarrow$	SPREAD $\Leftrightarrow$	MIX $\Leftrightarrow$		No	No
UK	BL $\Leftrightarrow\Downarrow$ HL$\Downarrow$	SPREAD $\Leftrightarrow\Uparrow$	MIX $\Uparrow$	HP $\Downarrow$	Possible	Yes

Figure 1: The data used. HP and Y indicate (log of) real house prices and GDP. Third row shows the money market rate (R). Fourth row plots the Spread (SP) between mortgage rate and a safe rate of same maturity (interest rates are expressed in basis points). Fifth row shows log of real loans from banks for housing (HL) and all other purposes (BL). Sixth row shows the MIX variables, constructed as the ratio between housing loans from State and non-depository institutions versus total housing loans.



Impulse responses of the VAR in the countries analysed. For each country, Figure A shows response of total real bank loans, bank housing loans and other macro variables to a monetary contraction. Figure B shows responses of the Spread mortgage rate/long term safe rate of equal maturity to a monetary contraction. Figure C shows the response of Mix (housing loans from non-banks over total housing loans) to a monetary contraction. Figure D shows the response of the macro variables to a positive innovation in the MIX.

Figure 2.A: FINLAND: RESPONSES +1S.E. BANDS TO A MONETARY SHOCK, LOANS

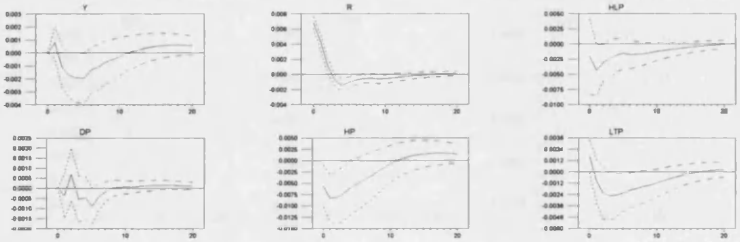


Figure 2.B: FINLAND: RESPONSES +1S.E. BANDS TO A MONETARY SHOCK, SPREAD

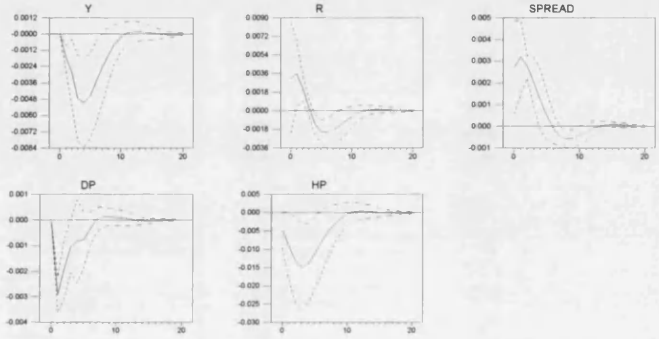


Figure 2.C: FINLAND: RESPONSES +1 S.E. BANDS TO A MONETARY SHOCK, MIX

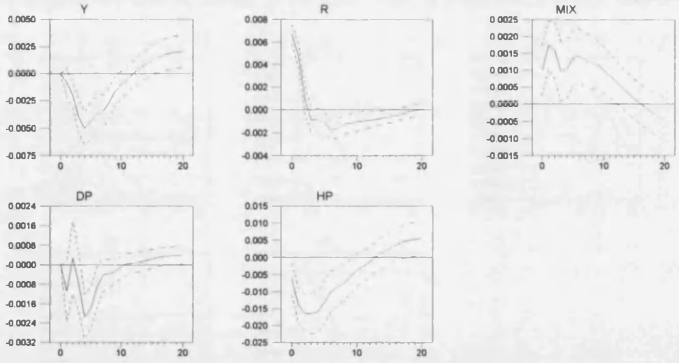


Figure 2.D: FINLAND: RESPONSES +1 S.E. BANDS TO A SHOCK IN THE MIX VARIABLE

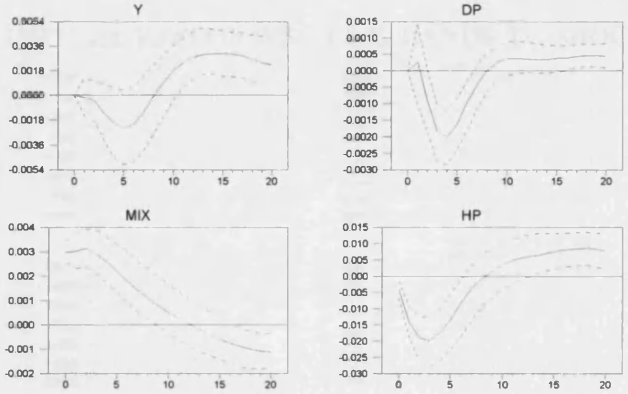


Figure 3.A: GERMANY: RESPONSE +1S.E. BANDS TO A MONETARY SHOCK, LOANS

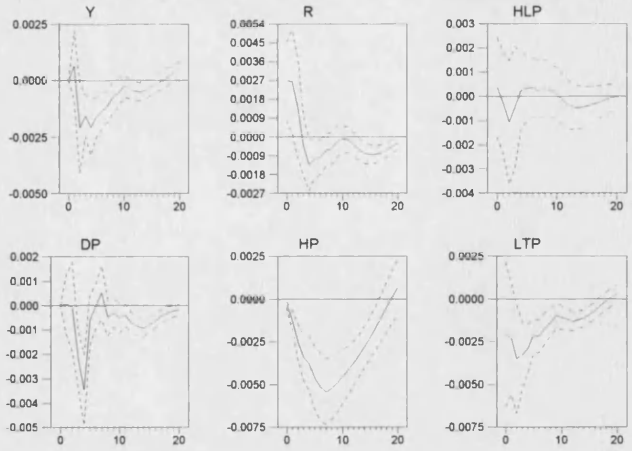


Figure 3.B: GERMANY: RESPONSE +1S.E. BANDS TO A MONETARY SHOCK, SPREAD

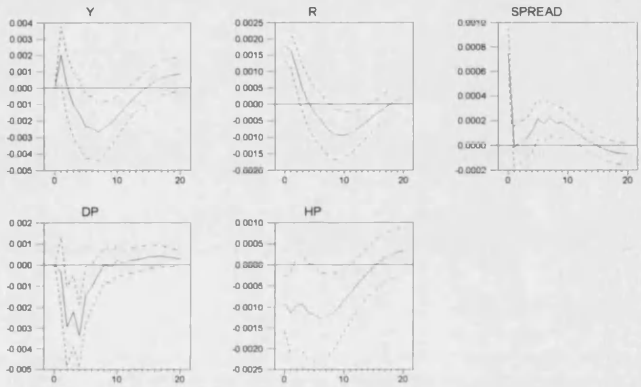


Figure 3.C: GERMANY: RESPONSE +1S.E. BANDS TO A MONETARY SHOCK, MIX

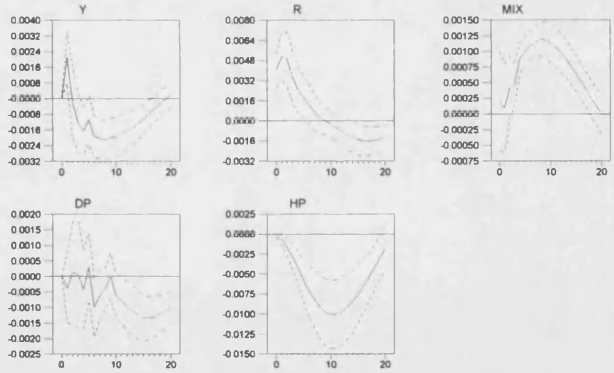


Figure 3.D: GERMANY: IMPULSE RESPONSES +1 S.E. BANDS TO SHOCK, MIX VARIABLE

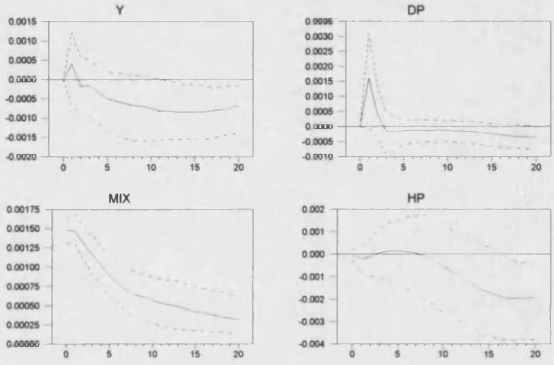


Figure 4.A: NORWAY: RESPONSE +1S.E. BANDS TO A MONETARY SHOCK, LOANS

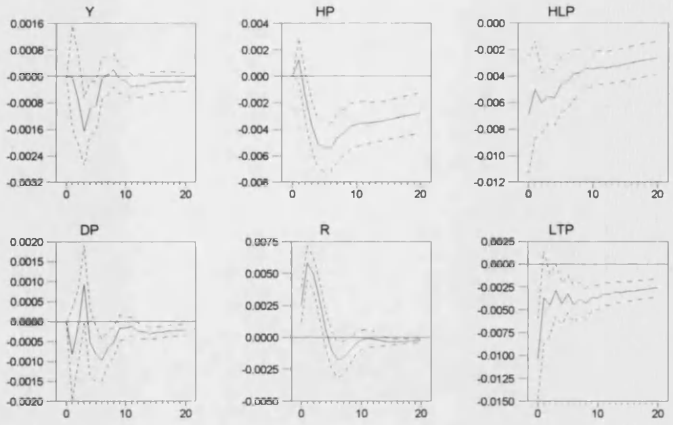


Figure 4.B: NORWAY: RESPONSE +1 S.E. BANDS TO A MONETARY SHOCK, SPREAD

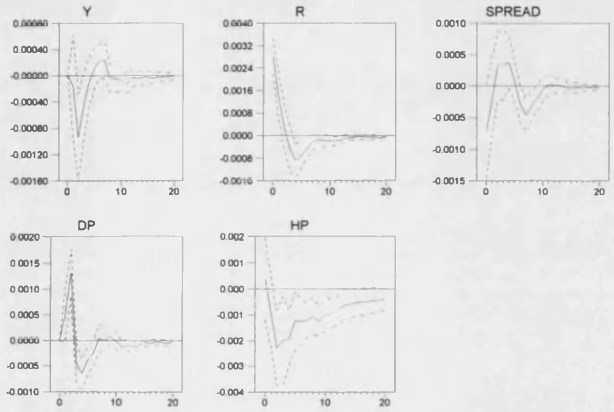


Figure 4.C: NORWAY: RESPONSES +1 S.E. BANDS TO A MONETARY SHOCK, MIX

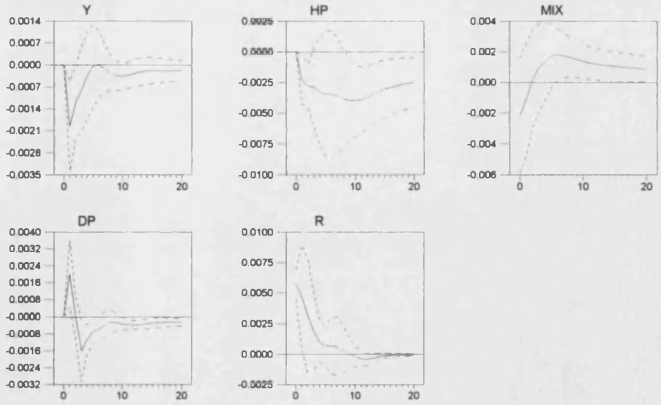


Figure 5.A: UK: RESPONSE +1S.E. BANDS TO A MONETARY SHOCK, LOANS

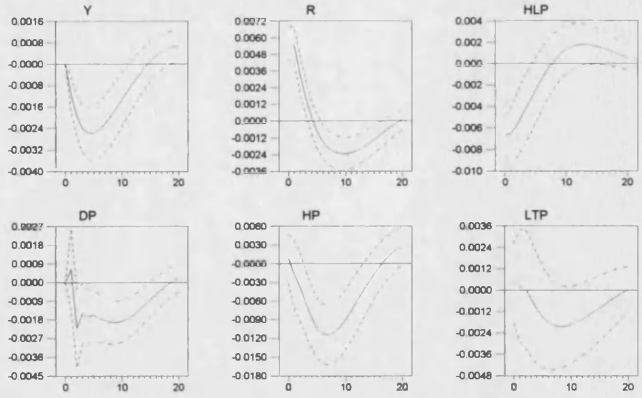


Figure 5.B: UK: RESPONSE +1S.E. BANDS TO A MONETARY SHOCK, SPREAD

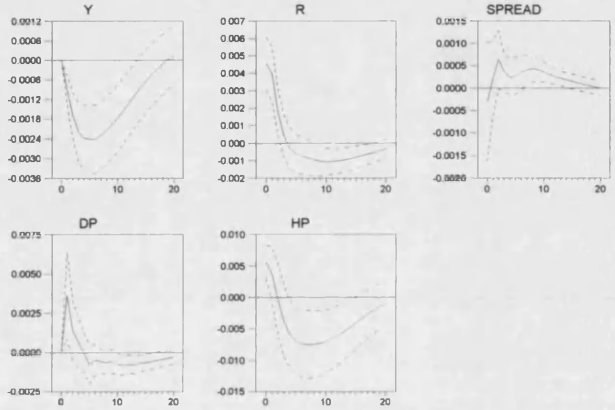


Figure 5.C: UK: RESPONSE +1S.E. BANDS TO A MONETARY SHOCK, MIX

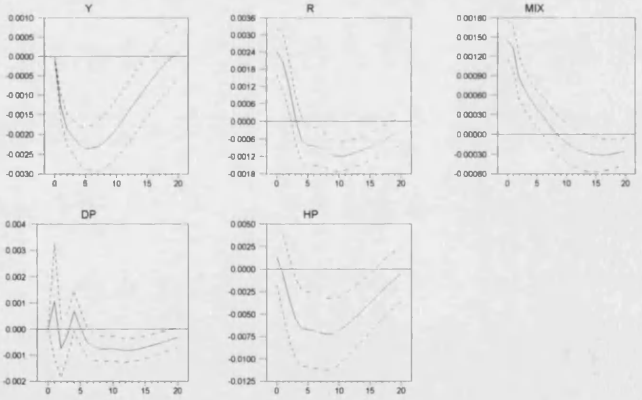
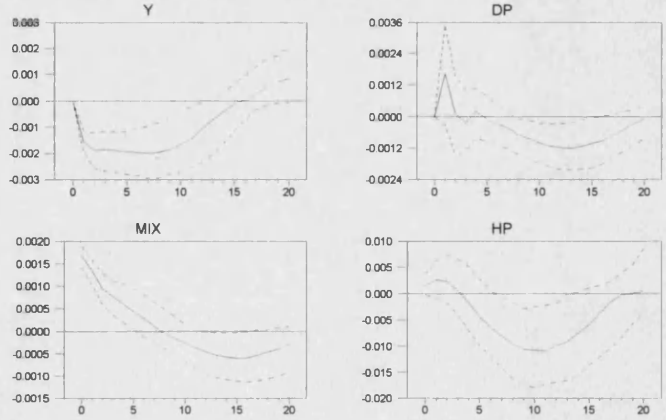


Figure 5.D: UK: IMPULSE RESPONSES +1 S.E. BANDS TO A SHOCK IN THE MIX



Annex 1: Structural features of the housing markets

Institutional framework

Main mortgage lenders and percent recent market share

Finland:	Deposit banks and Bank of Finland (68), State and other specialist lenders (32) (source: Statistics Finland)
UK:	Banks (68.6), building societies (24.9), other specialist lenders (6.5) (source: Lea, Welter and Dubel, 1997).
Norway:	Savings banks (40.8), commercial banks (33), mortgage institutions (1.5), State banks (16.1), insurance companies (8.2), other (0.4) (source: Lea, Welter and Dubel, 1997).
Germany:	Private commercial banks (21), mortgage banks (16), credit co-operatives (14), savings banks (25), Bausparkassen (11), regional banks (13) (source: Lea, Welter and Dubel, 1997)

Funding methods (depository institutions)

Sources of funding for banks and other depository institutions (retail deposits include accounts and savings deposits; wholesale general funding includes bank bonds, loans from other monetary institutions and other minor techniques)

Finland:	*banks*: retail deposits (90%), wholesale general funding (10%) (source: EMF 2000)
UK:	*banks* (exact figures not available); *building societies*: retail deposits (75%), wholesale general funding (25%) (source: EMF 2000)
Norway:	*commercial banks*: retail deposits (50%), wholesale general funding (47%); *savings banks*: retail deposits (61%), wholesale general funding (37%); (source: EMF 2000)
Germany:	Mortgage bonds, mortgage backed securities, deposits (exact figures not available)

Loan to value ratios

Finland	70% (source: Maclennan, Muellbauer and Stephens, 1998)
UK	95% (source: Maclennan, Muellbauer and Stephens, 1998)
Norway	80% (source: Maclennan, Muellbauer and Stephens, 1998)
Germany	65% (source: European Mortgage federation, 2000)

Degree of liberalisation

Set 1: Ceilings on deposit and lending interest rates; funding restrictions

Finland:	Abolition of ceilings on loan rates in 1987
UK:	End of collusive interest rate cartel with the abolition of the corset in 1980; relaxation of constraints on funding of Building Societies in 1986 (Building Societies Act)
Norway:	Abolition of ceilings on bank lending rates in 1985
Germany:	Abolition of "the regulation on interest rate adjustment (Zinsverordnung)" in 1967. Persisting collusive mortgage rates

Set 2: Entry and portfolio restrictions

UK:	Abolition of the Corset in 1980.

Annex 2: Data description

Summary tables of time periods and variables used in the s (source in brackets).

Loans s

Country	Years	Variables
Finland	78:4 – 99:3	HP = Residential Property Prices *(source: BIS)* R = Money Market Rate*(Datastream (DS))* HL = Banks' Outstanding Housing Loans *(Statistics Finland)* TL = Banks' Lending Outstanding *(Statistics Finland)*
Germany	74:2 – 98:4	HP = Residential Real House Price Index *(Aufina/ERA; the original annual series was made quarterly through interpolation assuming an ARIMA(0,2,0) in the original series))* R = 3 months Money Market Lending Rate *(DS)* HL = Private Commercial Banks Housing Loans *(DS)* TL = Private Commercial Banks Total Loans *(DS)*
Norway	88:3 – 99:4	HP = New Detached Houses, Price Index *(DS)* R = 3months Forward Rate*(DS)* HL = Housing Loans Commercial Bank + Savings Banks *(Statistics Norway)* TL = Total Loans Commercial Bank + Savings Banks *(Statistics Norway)*
UK	78:1 – 99:4	HP = Nationwide East Anglia House Price Index *(DS)* R = Inter-bank 3 months interest rate *(DS)* HL = Building Societies Loans For House Purchase + Bank Lending Secured On Dwellings *(DS)* TL = Total Loans, Banks And Building Societies *(DS)*

Spread (RM-RL) *s*

Country	Years	Variables
Finland	88:1 – 99:3	RM = Interest Rate On Banks New Housing Loans*(Bank of Finland)* RL = Long Benchmarking Interest Rate, 3 Years*(Bank of Finland)*
German y	82:4 – 99:4	*Industrial Production And Producer Price Inflation used instead of Y And DP* RM = Mortgage Rate, 10 year Fixed Average *(DS)* RL = 10 year Government Bond Yield *(DS)*
Norway	88:3 – 98:4	RM = Interest Rate On Long Term And Medium Term Loans Until 95:4; Interest Rate On Mortgage Loans From Banks From 96:1 (*Statistics Norway)* RL = Interest Rate On 5 Year Bonds *(Statistics Norway)*
UK	85:1 – 00:2	RM = Building Societies, Mortgage Average Rate *(DS)* RL = Treasury Bill Rate (Office for National Statistics)

Mix s

Country	Years	Variables
Finland	87:1 – 99:3	MIX = Housing Loans from all other lenders / (Housing loans from all other lenders + Housing Loans from Depository Banks and Central Bank)
Germany	74:2 – 98:3	MIX = Housing loans from Bausparkassen and Mortgage Banks / Total housing loans from all the financial institutions
Norway	88:3 – 99:4	MIX = Housing loans from state and non-depository fin. institutions / Total housing loans
UK	87:1 – 00:2	MIX = General Govt + Insurance Companies and Pension Funds + Other Financial Intermediaries Loans Secured on Dwellings / Total Loans Secured on Dwellings

Annex 3: Unit root and cointegration tests

Augmented Dickey-Fuller tests for unit root

Country	Variables	Unit root test statistic	Sample period
Finland	Y	-0.84	78:4 – 99:3
	DP	-2.14	78:4 – 99:3
	R	-1.84	78:4 – 99:3
	HP	-1.58	78:4 – 99:3
	HL	-2.40	78:4 – 99:3
	TL	-1.36	78:4 – 99:3
	SP	-3.48**	88:1 – 99:3
	MIX	-0.33	87:1 – 99:3
Germany	Y	-0.45	74:2 – 98:3
	DP	-4.94**	74:2 – 98:3
	R	-3.17*	72:2 – 98:3
	HP	-4.74**	72:2 – 98:3
	HL	-0.84	74:2 – 98:3
	TL	-0.30	74:2 – 98:3
	SP	-1.72	82:4 – 98:3
	MIX	-0.84	74:2 – 98:3
Norway	Y	0.579	88:3 – 99:4
	DP	-4.248**	88:3 – 99:4
	R	-1.88	88:3 – 99:4
	HP	-0.12	88:3 – 99:4
	HL	2.66	88:3 – 99:4
	TL	1.306	88:3 – 99:4
	SP	-2.44*	88:3 – 99:4
	MIX	2.43	88:3 – 99:4
United Kingdom	Y	-0.94	63:2 – 99:3
	DP	-2.24	63:2 – 99:3
	R	-2.846	63:2 – 99:3
	HP	-1.486	63:2 – 99:3
	HL	-0.29	63:2 – 99:3
	TL	-0.287	63:2 – 99:3
	SP	-0.834	86:1 – 99:3
	MIX	-2.98*	86:1 – 99:3

Note: */** indicates rejection of the unit root null hypothesis at 5/1% significance level.

Cointegration tests (sample periods as in the Appendix 1)

Countries	Model with	Suggested Cointegration rank (at 90% confidence level)* Lambda-max	Trace
Finland	Y, DP, R, HP, HL, TL	3	3
	Y, DP, R, HP, SP	3	3
	Y, DP, R, HP, MIX	2	2
Germany	Y, DP, R, HP, HL, TL	3	3
	Y, DP, R, HP, SP	4	3
	Y, DP, R, HP, MIX	3	2
Norway	Y, DP, R, HP, HL, TL	4	3
	Y, DP, R, HP, SP	4	3
	Y, DP, R, HP, MIX	4	4
United Kingdom	Y, DP, R, HP, HL, TL	3	2
	Y, DP, R, HP, SP	4	2
	Y, DP, R, HP, MIX	3	3

* To save space, the corresponding test statistics are not included. They are available from the authors upon request.

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Chapter 4

Diversified Banking and the Costs of Financial Distress

Abstract

We construct a model in which, by borrowing simultaneously from relationship and from transactional banks ("diversified funding"), a firm prevents its banks from restructuring opportunistically bad projects with the only only of seizing assets during the reorganisation. Transactional banks veto the continuation of a bad firm that relationship banks would continue only to seize assets during the restructuring. They do so, because, having less information than relationship banks, they expect to be "losers" in the seizure of assets. At the same time, because of this asymmetry in the information between relationship and transactional banks, diversified funding reduces the probability that banks succesfully reorganise a good project. We characterise the conditions under which a firm prefers diversified funding.

4.1 Introduction

Firms appear to diversify their links with banks, funding their activity both through relationship and transaction loans. Even in Germany and Japan, in which relationship banking is widespread, firms-banks links range from a tight long-term relationship with the *haus*-main bank to the transactional funding provided by arm's length ones (Aoki and Patrick, 1994; Edwards and Fisher, 1994).[1] The target of this chapter is to rationalise this fact analysing how the costs of financial distress affect a firm's debt structure, meant in our framework as the nature of the links established by a firm with its banks (relationship or transactional).

[1] An independent bank in Germany or Japan with no managers on the board of the funded firm could be an example of transactional bank. Note that in the paper a bank could be broadly interpreted as any non-atomistic lender.

Our analysis fits economies in which most firm restructurings occur outside courts, through a plan devised by the banks (and occasionally other major creditors) of the firm. During these private reorganisations, regardless of the original priority, the restructuring of claims follows a bargaining process in which the power of each party is determined also by her information on the firm and the sector in which the firm operates. We show that diversified funding, i.e. borrowing both from relationship and from transactional banks, minimizes the risk that banks opportunistically restructure bad projects with the only intent of seizing assets during the reorganisation. However, with respect to borrowing only from relationship banks, diversified funding reduces the probability that banks succesfully reorganise a good project. The firm's choice of the debt structure trades off this benefit and cost.

The intuition for this result is as follows. Consider a distressed firm with uncertain prospects. The firm can be a "lemon", whose assets will have necessarily to be liquidated sooner or later, or a good firm worth restructuring. We compare two scenarios. In the first scenario the firm has built relationships with all its banks ("pure relationship funding"); in the second scenario the firm has borrowed also from transactional banks ("diversified funding").[2] Let us start from the case in which the firm is a "lemon" and has built relationships with all its banks. Relationship banks could push for private restructuring of the firm to avoid immediate in-court liquidation and use their superior information and bargaining power to seize collateral during the reorganisation (or simply increase the value of their collateral).[3] On the other hand, dispersed stakeholders, (public bond-holders, small trade creditors, workers or shareholders), would have no interest in the costly restructuring of this bad firm. This would result in the firm's assets being seized by better informed banks and the firm eventually being liquidated with no residual for claimants that are passive

[2]In our framework the third scenario, in which the firm borrows only through transaction loans, is always dominated. Borrowing only through transaction loans implies that the probability that the restructuring of a good firm is successful is lower than with a diversified funding strategy. Moreover, to avoid the opportunistic continuation of bad projects at date 1, the entrepreneur can rely on a diversified funding, generating a conflict on their continuation between relationship and transactional banks.

[3]For Japan Sheard (1994) mentions the cases in which the main bank *"[...]intervenes but then forces the firm into bankruptcy after having secured its own claims. Sometimes main banks have forced firms into bankruptcy after a period of intervention*[...]".

in the restructuring. However, since they are passive players and receive only information filtered by the restructuring pool, dispersed stakeholders will not be able to distinguish a lemon from a good firm. Hence, dispersed stakeholders will either let the firm go ahead, or, when possible, require a costly signalling from the banks to be convinced that the firm is worth restructuring.

Consider what happens, instead, if the firm is a lemon and has borrowed both from relationship and from transactional banks. Unlike dispersed stakeholders, non-atomistic transactional banks are active players in the reorganisation and, even though with some noise, can assess the quality of the projects from the direct analysis of the firm's documents.[4] Unlike relationship banks, transactional banks have lower quality information on the firm. Because of this limited information transactional banks have less bargaining power than relationship banks and expect to be losers in the seizure of assets that will occur during the opportunistic restructuring of the bad firm. Hence, diversified funding, by creating an asymmetry between their bargaining powers, can induce a conflict between relationship and transactional banks that prevents the opportunistic continuation of the bad firm.

Now let us assume that the firm is a good one worth restructuring. While in the first scenario the reorganisation will be managed only by well informed banks, in the second scenario informed, relationship banks will have to coordinate with less informed, transactional banks. Therefore, the probability that the banks implement with success the reorganisation of this good firm will be lower with diversified funding.[5]

We show that, if the advantage of relationship banks in information gathering is neither too big nor too small, the benefit of diversified funding will prevail on its cost. In fact, in this case diversified funding will imply enough asymmetry between the information and bargaining power of transactional and of relationship banks to induce a conflict on the continuation of a bad project. At the same time diversified funding will induce a small reduction in the probability that banks succesfully coordinate the restructuring of a good project. Such a result holds irrespective of

[4] Analysing corporate restructurings in Germany, Brunnen and Krahnen (2000) write: "[...] *once distress has become public every lender will collect more information about the borrower in order to prepare a future possible workout. In particular, if a creditor pool has been formed, the informational advantage of the housebank is shared by the pool*[...]"

[5] We ignore any loss of coordination due simply to the presence of multiple creditors.

whether or not we allow for screening on projects' quality. However, we show that the impact of other characteristics of the firm on the choice of funding depends on whether screening is feasible or not. The most interesting result pertains to the redeployability of the assets of the firm: we show that, when no screening mechanism is available, higher redeployability makes the choice of diversified funding less likely but the converse is true when screening is feasible.

The results of the analysis hinge on the *dual* role that we attribute to information. On the one hand, information facilitates the contribution of a bank to the success of a restructuring and especially "shared" information facilitates coordination among banks. This is the traditional, positive role of information that has been emphasised by the literature on banking.On the other, information contributes to determine the bargaining power, i.e. the "seizing ability", of a bank during a restructuring. The legal literature (e.g. Levmore, 1982) has suggested that information acquisition can lead to "creditor misbehaviour", that is the possibility of using information to seize assets at the expense of other creditors or the debtor. In 2.3 we analyse two ways in which information can affect the ability of a bank to seize assets during a reorganisation. First, when the assets of the firm have heterogeneous redeployability, an informed bank could have better knowledge on the redeployability of the different assets and "cherry-pick" the most generic ones, leaving assets less generic and saleable to other stakeholders.[6] Second, an informed bank could have early knowledge on the prospective failure of the firm and manage to obtain additional security on its outstanding loans at the expense of "unaware" stakeholders.

The analysis is at the intersection of two strands of the literature. The first develops alternative explanations of the coexistence of bank and public (arm' s length) debt. Holmstrom and Tirole (1997) and Besanko and Kanatas (1993) construct a trade-off based on the possibility for banks of monitoring to prevent entrepreneurs' moral hazard and on the lower cost of arm's length financing. Diamond (1991) obtains sequential substitution showing that initially firms borrow from banks, be-

[6]Similar assumption are in Diamond and Rajan (2001) and in Welch (1997). Diamond and Rajan (2001) argue that a bank is more efficient than dispersed investors in selling assets. Welch (1997) argues that during formal reorganisations, thanks to information and control over the day-to-day liquidity of the firm, banks can pressure the court more effectively.

fore moving to cheaper public debt when they have built enough reputation. The closest paper in this strand is Rajan (1992). Rajan (1992) shows that borrowing from arm's length financiers reduces the rents that a close bank can extract from a firm but also reduces the probability of efficient liquidation by limiting the control rights of the close bank in liquidation. Unlike these studies, besides the different explanation we offer, we rationalise the mix transactional/relationship bank debt rather than the mix bank debt/public debt. The second strand of the literature analyses how the costs of financial distress affect the firm's debt structure. Bolton and Sharfstein (1996) show that the number of banks can reduce the risk of strategic default by entrepreneurs. Diamond (1992) and Bergloef and Von-Thadden (1994) show that borrowing from two banks and diversifying the priority and maturity of debt can achieve the same goal. None of these papers examine how the costs of financial distress affect the nature of the links established by a firm with its multiple creditors.[7]While we are silent about the costs and benefits of single versus multiple relationships or of single versus multiple transactional banks, our contribution is to show how the dual role that creditors' information has in a reorganisation, simultaneously affecting their effectiveness in the reorganisation and their ability in seizing collateral, can rationalise firms' choice of diversified multiple banking.

The chapter is organised as follows: section 2 contains the basic model. In section 3 we extend the model to allow for screening on projects' quality. Section 4 concludes. All the proofs are in the Appendix.

4.2 The Model

4.2.1 Setup

Environment The economy lasts for three dates (t=0,1,2) and can be in two states of nature, "good" or "bad", respectively with probability ℓ and 1-ℓ. The state of nature realises and is common knowledge at date 1.

[7]Another group of studies derives the mix debt-equity that incentivates the party in control to take the efficient liquidation decisions (Dewatripont and Tirole, 1994; Admati and Pfleiderer, 1994; Berlin, John and Saunders, 1996). Focusing on ex-ante decisions of the entrepreneur rather than ex-post decisions in distress, Dewatripont and Maskin (1995) and Huang and Xu (2000) show that multiple banking can prevent entrepreneurs from choosing bad projects by reducing the probability that they are refinanced at intermediate stages.

There are one entrepreneur and two bankers. The entrepreneur and the bankers are risk neutral and consume on date 2. There is initially only the final good.

Technology At date 0, besides storage (accessible also by banks), the entrepreneur can activate one indivisible project requiring I units of final good. The project can be of high quality with probability π_h or low quality with probability 1- π_h. No one observes quality at date 0.

At date 1, if the good state realises, the project, whatever its quality, returns A units of verifiable, consumable assets plus Y units of non-verifiable, consumable final good accruing privately to the entrepreneur. If, instead, the bad state realises the project incurs distress and the entrepreneur and the banker(s) that have funded the project must decide whether to continue in order to reorganise it at date 2 or to liquidate. The returns in the bad state are as follows. If the project is not continued at date 1 or is continued but at date 2 restructuring fails it yields 0. If the project is successfully restructured and is of good quality it still returns $A + Y$ at date 2. If the project is successfully restructured but is of low quality at date 2 it yields no final good and the assets have to be redeployed outside the firm with a return of λA units of final good (λ <1).[8]

At date 1, if the project is continued, the entrepreneur and the bankers bear (enjoy) non-monetary restructuring costs (benefits). The entrepreneur bears a cost $L' > 0$ whatever the project's quality; each banker bears a cost $L^B > 0$ if the project is bad; if the project is good each banker enjoys a no matter how small benefit $L_G > 0$. The assumption that a lender enjoys a benefit from restructuring a good project allows to simplify the analysis and could be dispensed with. L_G can proxy, for instance, for the ex-post gain in reputation that a lender could derive from the continuation of a good project.[9]

At date 1, after the state of nature becomes common knowledge, banks can monitor. Monitoring determines the probability of success of the restructuring.

[8]The assumption that λ <1 captures the fact that assets are generally worth more inside than outside a firm.

[9]Edwards and Fisher (1994) write that in their interviews with German banks a consideration frequently mentioned "[...] *as affecting the decision whether to reorganise a firm in financial distress was the effect on bank's image* ". Such image-effects had a positive impact on banks' willingness to reorganise rather than liquidate. We think reasonable that these image-effects are present especially when ex-post the restructured projects turn out to be good.

Precisely, if p_T is the total monitoring of the bank(s), the probability of success will be p_T, whatever the project's quality. Thanks to its familiarity with the firm, a relationship bank finds monitoring easier. In particular, if p_J is the monitoring effort of a bank of type J, the disutility of monitoring is $p_J^2 c_J/2$ with $J = B$ (relationship bank), A (arm's length or transactional bank) and $c_A > c_B$. Without implications for the results and to simplify the analysis later on (2.3), we let p_J take values in the interval $\left[0, \frac{1}{2}\right]$.

We introduce restrictions on the parameters:

Assumption 1

$$A\ell > I$$

Assumption 2

$$L' < \pi_h^2 Y A \frac{1}{c_A}$$

Assumption 3

$$K = \frac{\pi_h A}{c_B}\lambda A - L^B > 0$$

Assumption 1 will guarantee the feasibility of lending at date 0. Assumption 2 will guarantee that, if uncertain on the quality of the project, the entrepreneur wants to continue it at date 1. Assumption 3 will guarantee that a relationship bank always wants to continue a bad project at date 1.

Endowments and Preferences At date 0 the entrepreneur has no final good; each banker has $I/2$ units of final good. We assume away interbank lending so that this assumption on endowments implies that two banks are needed to fund the project (multiple banking). In 3.3 we will show that in our framework, even allowing for single banking, this would be dominated by multiple banking. For simplicity we focus directly on multiple banking.

Entrepreneur and bankers derive a utility from consumption of $u(C_2) = C_2$ where C_2 are the units of final good or assets consumed at date 2.

Information At date 1, after the state of nature becomes common knowledge and the bankers choose their monitoring, the bankers privately observe the quality of the project and their restructuring cost (benefit) of continuation. The assumption that

transactional and relationship banks have equal information on the quality of the project proxies for the fact that among the active participants in a restructuring the informational asymmetry on the reorganised project tends to vanish (Brunnen and Krahnen, 2000). In fact banks' representatives work together in the reorganisation, attend meetings, analyse documents of the firm and so on. As to the entrepreneur's lack of information on the quality of the project this could be rationalised by interpreting the entrepreneur more as an uninformed owner or as a "representative" of the dispersed stakeholders of the firm (shareholders, public-debt holders, trade-creditors etc.) than as an informed entrepreneur-manager. Playing only a passive role during reorganisations, dispersed stakeholders have no access to firms' documents, relying on the parties active in the restructuring to obtain information. However, even interpreting the entrepreneur as an entrepreneur-manager we think reasonable that she has less information on the prospects of a restructuring than on the prospects of the firm in "normal times".

The monitoring realised by a banker at date 1 is observable both by the other banker funding the project and by the entrepreneur but is not verifiable and therefore non-contractible.

Except for the above, everything else is common knowledge.

Contracts and Bargaining At date 0, after choosing the number of relationships, the entrepreneur contracts with the banks. Since the endowments of the two banks must be lent in full to activate the project, the contract specifies only the allocation of the contractible returns (assets). The date 0 contract can be renegotiated at dates 1 and 2 if the bad state realises. We analyse explicitly a simple bargaining only for the restructuring time (t=2). For any bargaining occurring at date 0 or at date 1, we assume that the entrepreneur has 0 bargaining power and the two banks have the same bargaining power. The allocation of the bargaining power out of restructurings is not crucial for the results.

These assumptions allow us to concentrate on the bargaining in the date 2 reorganisation. Each party active in the reorganisation, i.e. each bank, carries a necessary expertise for the reorganisation and, by threatening to withhold such

expertise, can force renegotiation.[10] The bargaining power of the parties in the renegotiation is related to the information they have gathered on the firm (i.e. their date 1 monitoring). In 2.3 we will analyse two ways in which the information of a banker can affect her power in bargaining over resources (assets) during a restructuring. In particular, we will consider the case in which an informed bank has early warnings on the distress of the firm and the case in which, when the assets of the firm have heterogeneous redeployability, an informed bank has better knowledge on the redeployability of the single assets. Till then, we take the link between the information of a banker and her bargaining power during a reorganisation as a primitive assumption, focusing on its implications.

Summary

Date 0:

- (*Funding strategy*) The entrepreneur chooses the number of relationships, i.e. pure relationship banking (two relationships), diversified funding (one relationship) or pure transactional banking (no relationships).
- (*Date 0 contract*) The entrepreneur contracts with the two bankers.[11]The bankers lend their endowments and the project starts.

Date 1:

- (*Monitoring*) The state of nature is publicly revealed and each banker chooses her monitoring.
- (*Continuation*) The banks observe the quality of the project. Entrepreneur and banks decide simultaneously whether to continue. If and only if they

[10]These "forced renegotiations" have been extensively used by the literature on banking since Rajan (1992). In these renegotiations one or more parties carry out an action necessary for the project. By threatening to withold this action, the party can force a renegotiation of the original contract and trigger a reallocation of the surplus. In our case each bank is necessary for the implementation of the restructuring and can threaten to withold her contribution to the restructuring.

[11]The entrepreneur first decides how many relationships to establish and only in a second stage contracts with the banks. A rationale for this two-stage approach is that establishing a relationship with a bank requires time, especially when a relationship involves the presence of bank representatives on the board of the firm (as in Germany or in Japan).

all choose continuation the project is continued and they bear (enjoy) their restructuring cost (benefit).[12]

Date 2:

- (*Restructuring*) Restructuring fails or succeeds. If it succeeds, entrepreneur and bankers bargain over the returns and consume.

In Figure 1 we summarise the game with the net returns at each date:

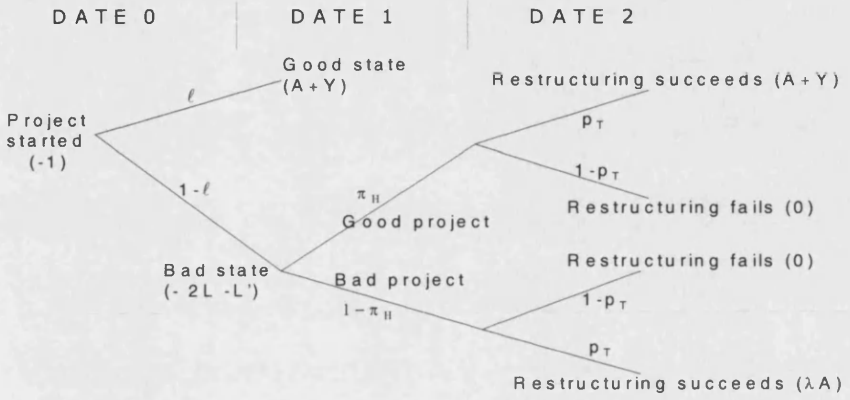

Figure 1. Game Tree

4.2.2 Equilibrium

At date 0, in choosing the funding strategy, the entrepreneur maximises her expected return.[13]

At date 1, in the good state, the entrepreneur and the banks are allocated the assets according to the date 0 contract and the entrepreneur gets the non-verifiable final good Y. In the bad state, for each of the three possible funding strategies (pure relationship banking, diversified banking and pure transactional banking), we solve the model by backward induction. First, we analyse the bargaining at date 2

[12]The restructuring game between entrepreneur and bankers is a simultaneous moves game of incomplete information and the resulting equilibrium a Bayesian-Nash equilibrium.

[13]Even if the entrepreneur proxied for the dispersed stakeholders of the firm, it would be reasonable to include shareholders among the dispersed stakeholders and implicitly assume that the management chooses the debt structure to maximise shareholders' returns. Moreover, senior diffuse stakeholders could influence the financial decisions of the management, too.

conditional on the project being continued at date 1 and on its restructuring being successful. Then we determine the continuation decision at date 1. Then we derive banks' monitoring at date 1 and after that we solve for the optimal contract at date 0. Finally, having solved the model separately for the different funding strategies, we derive the entrepreneur' choice of funding at date 0.

Both in this section and in section 3 we rule out equilibria in which agents play weakly dominated strategies.[14]

Pure Relationship Banking

In this subsection we analyse the case in which the entrepreneur chooses to enter relationships with both banks.

Restructuring At date 2, conditional on the reorganisation being successful, each bank, threatening to withdraw her expertise from the reorganisation, can trigger a renegotiation of the contract and bargain over the contractible surplus (assets). The total contractible surplus S is equal to A if the project is good and λA if it is bad (the restructuring costs and benefits are sunk at this stage). The bargaining power of each player in the renegotiation is related to her monitoring at date 1. In particular, if p_{Bi} is the information gathered by relationship bank i (i=1,2) and $p_T = p_{B1} + p_{B2}$ is the total information gathered by the two banks, the bargaining power of bank i is $p_{Bi}/(p_{B1}+p_{B2})$ (remember that the entrepreneur does not monitor). Assuming, for instance, a Nash bargaining game of the form $\max(S)^{\frac{p_{B1}}{p_T}}(S)^{\frac{p_{B2}}{p_T}}$, each relationship bank obtains an amount of assets A_{Bi} with

$$A_{Bi} = \frac{p_{Bi}}{p_{B1}+p_{B2}}\lambda A$$

if the project is bad and

$$A_{Bi} = \frac{p_{Bi}}{p_{B1}+p_{B2}}A$$

if the project is good. The entrepreneur gets Y if and only if the project is

[14] We can adopt a tremblig-hand refinement of the equilibrium to rule out such equilibria.

good.[15]

Continuation At date 1, in deciding whether to continue, each agent needs to evaluate only her net expected return if the project is continued (continuing if it is positive). For a bank this is given by

$$\frac{p_{Bi}}{p_{B1}+p_{B2}}(p_{B1}+p_{B2})\lambda A - L^B = p_{Bi}\lambda A - L^B$$

if the project is bad and analogously by $p_{Bi}A + L^G$ if the project is good. As to the entrepreneur her net expected return if the project is continued is $\pi_h^s(p_{B1} + p_{B2})Y - L'$, where π_h^s stands for the entrepreneur's subjective probability that the project is good if continued and $p_{B1} + p_{B2}$ is the probability of success of the restructuring.

Lemma 1 *At date 1, with pure relationship banking, all the agents will choose to continue the project regardless of its quality.*

Lemma 1 shows that with pure relationship banking also bad projects, i.e. projects that the entrepreneur, if she were able to disentangle them, would liquidate, will be continued. Relationship banks, having good information on the firm, know that their seizing ability will be high during the reorganisation and opportunistically continue a bad project to seize assets during the reorganisation.

Monitoring At date 1, in choosing monitoring p_{Bi}, each bank takes into account the equilibrium in the following stages. Thoughout the analysis we consider the case in which banks' optimal monitoring is always an interior solution, i.e. lower than their monitoring capacity $\frac{1}{2}$.[16] We will consider corner solutions only in 2.3, when

[15]The weights $\frac{p_{Bi}}{p_{B1}+p_{B2}}$ could also derive from an exogenous allocation function of the type assumed in conflict theory (Welch 1997; Hirshleifer 1995). Welch (1997) focuses on in court reorganisations and the crucial variable that determines the bargaining power of the banks is the expenses on lobbying (lawyers etc.). We focus mainly on out-of-court reorganisations and in this framework information is likely to play a crucial role. In particular Welch (1997) defines the shares of resources α accruing to the parties in conflict as $\alpha_s(L_s, L_j) = nL_j/(mL_s + nL_j)$ where L_s and L_j stand for the bargaining power of the two parties during the legal bankruptcy and could be proxied by the number of lawyers. In our case the $L's$ correspond to the $p's$ (levels of information) and could be proxied, for instance, by the number of representatives on the board. Also in our case the parameters m and n are set equal to 1.

[16]It will become clear that a necessary and sufficient condition for this to happen is $\frac{A[\pi_h+(1-\pi_h)\lambda]}{c_B} < \frac{1}{2}$.

this will allow to simplify the analysis. Therefore

$$p_{Bi}^* = \arg\max \left[p_{Bi} A \left(\pi_h + (1-\pi_h)\lambda \right) - (1-\pi_h) L^B + \pi_h L^G - \frac{c_B}{2} p_{Bi}^2 \right]$$

The sum of the first three terms gives the bank' s net expected return from the project and $p^2 c_B/2$ is the disutility of monitoring. The solution is

$$p_{Bi}^* = \overline{p}_B^* = \frac{A\left[\pi_h + (1-\pi_h)\lambda\right]}{c_B} \qquad i = 1, 2$$

Date 0 Contract Since the initial contract can always be renegotiated if the bad state obtains, the only relevant contractible variable is the assets allocated to the bankers if the good state obtains (let it be R_{Bi} for $i = 1, 2$). The bankers have the same power out of restructurings. Since in this scenario the banks are symmetric in the bad state, the assets A will be splitted equally in the good state. Hence, $R_{Bi} = A/2$ for $i = 1, 2$. Since, from Assumption 1, $\ell A/2 > I/2$ this guarantees that each bank will find convenient to lend $I/2$ at date 0.

Diversified Funding

We now analyse the case in which the entrepreneur enters a relationship with one bank only and borrows through a transaction loan from the other. When the discussion overlaps with the previous subsection we do not elaborate.

Restructuring For the relationship bank it is easy to see that, if the reorganisation is successful, the return from the bargaining is the same as with pure relationship banking. For the transactional bank the return is:

$$\begin{aligned} A_A &= \frac{p_A}{p_B + p_A} \lambda A \text{ (bad project);} \\ A_A &= \frac{p_A}{p_B + p_A} A \text{ (good project)} \end{aligned}$$

Continuation For the relationship bank the net expected returns if a bad (good) project is continued are as with pure relationship banking. For the transactional bank the net expected return if a bad project is continued is $p_A \lambda A - L^B$ ($p_A A + L^G$ if a good project is continued). Proposition 1 shows that the transactional bank

will never choose to continue a bad project if her informational disadvantage is not too small.

Proposition 1 *At date 1, with diversified funding, if its informational disadvantage ($c_A - c_B$) is not too small, the transactional bank will always liquidate a bad project. The project will be continued if and only if good.*

In the Appendix we provide a sufficient condition on $c_A - c_B$.

The result in Proposition 1 arises from the different information of the two banks that implies different abilities in seizing collateral (assets) during the restructuring. Since the transactional banker knows that, because of her lower quality information, her bargaining power in the reorganisation will be low, she prefers liquidating and saving the restructuring cost.

Henceforth, we assume that the condition set in Proposition 1 is satisfied and that with diversified funding a bad project is never continued at date 1.

Monitoring Taking into account that at date 1 a bad project will always be liquidated, the relationship bank and the transactional bank choose monitoring solving

$$p_J^* = \arg\max \left[\pi_h(p_J A + L^G) - \frac{c_J}{2}p_J^2\right] \qquad J = A, B$$

The monitoring decisions are respectively

$$p_B^* = \frac{\pi_h A}{c_B}, \quad p_A^* = \frac{\pi_h A}{c_A}$$

Date 0 Contract Unlike with pure relationship banking, at date 0 the relationship bank expects a higher return than the transactional bank in the bad state. Hence the transactional bank will be allocated more assets than the relationship bank in the good state. Formally, let R_B be the return of the relationship bank in the good state. R_B can be derived equating the total expected returns of the two banks after substituting for their rationally expected monitoring levels and then solving the obtained equation, i.e., after simple algebraic manipulations,

$$(1-\ell)\pi_h A(p_B^* - p_A^*) + \ell(2R_B - A) + \frac{1}{2}(c_A p_A^{*2} - c_B p_B^{*2}) = 0$$

Since R_B does not affect the following decisions of the banks or the entrepreneur we do not need to solve for it explicitly.

Pure Transactional Banking

The last strategy of the entrepreneur is to have two transactional banks. Lemma 2 shows that, under the condition set in Proposition 1, this strategy is always dominated.

Lemma 2 *The entrepreneur never chooses to borrow only through transaction loans.*

In our framework borrowing only through transaction loans implies that the probability that the restructuring of a good firm is successful is lower than with diversified funding. This is the standard result that relationships are beneficial because they facilitate information gathering. Moreover, in order to avoid the opportunistic continuation of a bad project at date 1, the entrepreneur can choose diversified funding, inducing a conflict on the continuation of a bad project between the relationship and the transactional bank. Therefore pure transactional banking is certainly suboptimal.

Choice of Funding

We now analyse the entrepreneur's choice of funding at date 0. On the one hand, pure relationship banking implies a higher probability of success of restructurings because it allows both banks to gather better information on the firm. However, pure relationship banking increases the risk that a bad project is opportunistically continued. On the other hand, diversified funding hampers the information acquisition of the transactional bank. However, by inducing a conflict between the transactional and the relationship bank, the entrepreneur avoids the temporary continuation of a bad project. Proposition 2 summarises the first result.

Proposition 2 *Assume that the condition in Proposition 1 is satisfied. The entrepreneur will strictly prefer diversified funding if and only if*

$$\pi_h(\frac{1}{c_B} - \frac{1}{c_A}) + \frac{2\lambda(1-\pi_h)}{c_B} < \frac{L'(1-\pi_h)}{AY\pi_h}$$

Propositions 1 and 2 together show that, if the informational gap between a relationship and a transactional bank ($c_A - c_B$) is not too big and not too small, diversified funding will be preferred. If the informational advantage of a relationship bank is not too small, a transactional bank co-funding the firm will expect to be a "poor fighter" during the date 2 private reorganisation and will not find convenient to continue a bad project. On the other hand, if the informational gap is not too big, by adopting diversified funding the firm will suffer only from a moderate reduction in the probability of success of restructurings.

The trade-off relationship-diversified funding can also be related to the other parameters. We provide details on Y, L' and λ (for the other parameters analogous considerations hold). A lower Y and a higher L' increase unambiguously the scope for diversified funding. In fact, Y and L' do not affect the expected return of the transactional bank if a bad project is continued and, hence, the condition that guarantees that with diversified funding a bad project is liquidated at date 1 (see the proof of Proposition 1). At the same time a lower Y implies a smaller loss from the informational deficit of diversified funding and a higher L' implies a higher cost for the entrepreneur from the continuation of a bad project. As to λ, that can be interpreted as the average redeployability of the firm's assets, Proposition 2 shows that, *ceteris paribus*, a lower λ increases the scope for diversified funding. This happens because with pure relationship banking lower asset redeployability reduces the incentive of relationship banks to monitor at date 1.

In the next section we explore which of these implications still hold if we allow for mechanisms for screening the quality of the project.

4.2.3 Information as "Seizing" Ability

Up to now we have taken the link between the information of a bank and its seizing and restructuring abilities during a reorganisation as exogenous. We now analyse two ways in which information can affect banks' ability in seizing assets during a reorganisation. For simplicity, and since this feature of the model is less novel, we still keep exogenous the positive impact of information on banks' restructuring ability.

A first way of linking information to seizing ability is allowing for an heteroge-

neous redeployability of the assets of the firm, with some assets being more generic and some others being more specific. A relationship bank could have better information on the redeployability of the different assets and, during a reorganisation, "cherry-pick" the most generic ones, i.e. the assets that can be redeployed at the highest price. We formalise this idea using our framework.

We assume that the assets A of the firm consist of N tools, each of size A/N. $N/2$ tools are generic and, if redeployed, return $\lambda^H A/N$ units of final good with $\lambda^H < 1$ while $N/2$ have a low redeployability $\lambda^L < \lambda^H$. λ can then be reinterpreted as the asset average redeployability, i.e. $\lambda = (\lambda^H + \lambda^L)/2$. We assume also that during the restructuring the two banks can claim an equal amount $\frac{A}{2}$ of assets and their claims cannot be contingent on the redeployability of the assets.[17] Moreover, if both banks claim (do not claim) any fraction of a tool, each will get half of the return from its redeployment. Finally, we assume there is imperfect information on asset redeployability. In particular, a bank of type J ($J = A,\ B$ respectively for a transactional and for a relationship bank) observes a noisy signal $\psi_i(p_J^*)$ on the redeployability of any tool i ($i = 1, ..., N$), with the noise of the signal depending on the date 1 monitoring p_J^* of the bank. $\psi_i(p_J^*)$ can take two values: ψ_i^H and ψ_i^L. At date 1, conditional on ψ_i taking value ψ_i^H, the redeployability of a tool will be high with probability $2p_J^* + (1 - 2p_J^*)/2$ and low with probability $(1 - 2p_J^*)/2$ (and conversely if ψ_i takes value ψ_i^L). For any p_J^* the unconditional probabilities of ψ_i^H and ψ_i^L are $1/2$. Finally, for simplicity, we consider the polar case in which a relationship bank suffers no disutility from monitoring ($c_B = 0$) so that it will trivially choose $p_B^* = \frac{1}{2}$ (its monitoring capacity). The rest of the framework is unaltered.

It is straightforward that the probability of success of a reorganisation will be $2p_{Bi}^* = 2\overline{p}_B^* = 1$ with pure relationship banking and $\frac{1}{2} + p_A^*$ with diversified funding. Then, we derive the returns to a relationship and to a transactional bank conditional on a project being continued at date 1 and being succesfully restructured. If the project is good, both with pure relationship banking and with diversified funding the return of each bank will be $\frac{A}{2}$. If a project is bad, observing a

[17] For instance, the banks could vote and manage to get approved a restructuring plan that assigns $\frac{A}{2}$ units of assets to each bank.

noiseless signal on asset redeployability, a relationship bank will always claim the tools with the high redeployability. Hence, with pure relationship banking, each relationship bank will get $A_{Bi} = \frac{\lambda A}{2}$. With diversified funding, the transactional bank will always claim the tools for which the observed value of ψ_i is ψ_i^H. It is easy to show that the return of the transactional bank if a bad project is successfully restructured will be $A_A^* = \frac{1}{2}A\left[(2p_A^* + (1-2p_A^*)\frac{1}{2})\lambda + (1-2p_A^*)\frac{1}{2}\lambda^L\right]$, hence lower than the one of the relationship bank $(A - A_A^*)$ and increasing in p_A^*. In fact, for each tool i the transactional bank expects to observe ψ_i^H (or ψ_i^L) with probability $\frac{1}{2}$. The probability that the redeployability of tool i, conditional on $\psi_i = \psi_i^H$, is actually high (λ^H) is $2p_A^* + (1-2p_A^*)\frac{1}{2}$, while the probability that is low (λ^L) is $(1-2p_A^*)\frac{1}{2}$. Moreover, the transactional bank knows that if a tool is highly redeployable, it will be claimed also by the relationship bank and the two banks will get $\lambda^H A/2N$ each; if, instead, it has low redeployability it will not be claimed by the relationship bank and the transactional bank will get $\lambda^L A/N$. Finally, each tool that is not claimed by the transactional bank will not be claimed by the relationship bank if and only if it has actually low redeployability. This happens with probability $2p_A^* + (1-2p_A^*)\frac{1}{2}$ and in this case each bank will get $\frac{A}{2N}\lambda^L$ from its redeployment. Combining these steps, the gross expected return of a transactional bank is $A_A^* = \frac{A}{2}\left\{\left[(2p_A^* + (1-2p_A^*)\frac{1}{2})\frac{1}{2}\lambda^H + (1-2p_A^*)\frac{1}{2}\lambda^L\right] + \left[(2p_A^* + (1-2p_A^*)\frac{1}{2})\frac{1}{2}\lambda^L\right]\right\} =$
$= \frac{A}{2}\left[(2p_A^* + (1-2p_A^*)\frac{1}{2})\lambda + (1-2p_A^*)\frac{1}{2}\lambda^L\right]$.

In this slightly modified framework, the results of Proposition 1 and 2 hold with minor changes in the numerical conditions.[18]

A second way of linking information to seizing ability is introducing uncertainty on the prospects of the firm. If such an uncertainty exists, an informed bank could have earlier signals on the prospective failure of the firm and exploit these timely information to gain additional security on its loans at the expense of other, "unaware" stakeholders. Analysing the behaviour of the First National Bank of St. Paul (FNB) before the American Lumber Company (ALC) bankruptcy, Welch (1997) writes "[...] having reasonable certainty that the corporation was insolvent

[18] In practice, given the simplifying assumption that $c_B = 0$, now Propositions 1 and 2 impose restrictions only on c_A. For example, it can easily be shown that the condition in Proposition 2 becomes $\frac{1}{2} - \frac{\pi_h A}{c_A} < \frac{L'(1-\pi_h)}{Y\pi_h}$.

the bank sought to gain an additional security interest in the inventory and equipment of ALC. ALC attempted to deny the interest but ultimately the bank was in a position of control [...]". This could have been facilitated by the fact that "[...] outside formal bankruptcy other (i.e. non-bank) creditors need not even be informed of the reallocation of claims caused by side payments or additional security given to an outstanding loan [...]". Analogously, Edwards and Fisher (1994) recognise the possibility for well informed German banks of obtaining additional collateral as soon as they have detected the distress of the firm. They report the results of a survey among receivers conducted in Germany by Hesselmann and Stefan (1990). According to this survey, in receivers' opinion, in Germany "obtaining additional collateral" is the most frequent measure taken by a bank after early detection of distress. According to Sheard (1990) in Japan such a practice of main banks "[...]is more likely to be possible for smaller unlisted firms than for larger public ones". Sheard's argument is that other creditors will probably detect this behaviour of a main bank, preventing it. This argument appears consistent with our analysis since the "other creditors" are likely to be centralised lenders (proxied in our model by the transactional bank) that have frequent contacts with the main bank.

4.3 Screening

4.3.1 Setup

In Section 2 we ruled out screening on the quality of the project. To analyse screening we now assume that at the continuation stage a relationship bank, thanks to its familiarity with the firm, can implement an unproductive, extra-restructuring effort $\widehat{L}$. We allow the disutility of this effort $\widehat{L}(\widetilde{\epsilon})$ to be a continous random variable with $\widehat{L}(\widetilde{\epsilon}) = \widehat{L} + \widetilde{\epsilon}$, $\widetilde{\epsilon} \in [\underline{\epsilon}, \overline{\epsilon}]$, $E(\widetilde{\epsilon}) = 0$ and $\overline{\epsilon} - \underline{\epsilon} < L^B$. The realisation of $\widetilde{\epsilon}$ becomes known at the continuation time. To avoid issues of free-riding or delegation we assume that at date 1 only one relationship bank can implement $\widehat{L}$ and that, if two relationship banks have funded the firm at date 0, at date 1 "nature" randomly chooses the bank that can implement $\widehat{L}$. Ex-ante each of the two relationship banks has probability 1/2 of being able to implement $\widehat{L}$.

Contracts and Bargaining A contract between the entrepreneur and the bankers specifies now the allocation of the assets and the extra-restructuring effort $\widehat{L}$ that the bankers have to sustain at date 1 if the project is continued. As before a contract can always be renegotiated. In particular, we now assume that the entrepreneur can always force a renegotiation at date 1 and that in any date 1 renegotiation she has all the bargaining power so that the date 1 contract maximises her expected return. We also assume that, if the entrepreneur is indifferent among contracts, the parties will agree on the one with the lowest $\widehat{L}$, i.e. the one that brings the lowest expected disutility to the bank that can implement $\widehat{L}$.

Assumptions 2 and 3 are modified as follows:

Assumption 2b

$$L' < \pi_h AY \min\left[\frac{1}{c_A}, \frac{1-\frac{1}{2}\lambda}{c_B}\right]$$

Assumption 3b

$$K' = \frac{\pi_h A(1-\frac{1}{2}\lambda)}{c_B}\lambda A - L^B > 0$$

Assumption 2b will guarantee that at date 1 the entrepreneur always wants to continue if she is sure that, if continued, the project will be good. Assumption 3b will guarantee that, if screening is not implemented, a relationship bank always wants to continue a bad project at date 1.

4.3.2 Equilibrium

Diversified Funding

It is straightforward that, also under Assumptions 2b and 3b, Proposition 1 will hold, guaranteeing the liquidation of a bad project with diversified funding. Hence, no screening mechanism will be implemented at date 1 and the analysis is as in section 2.

Pure Relationship Banking

The analysis for the restructuring stage at date 2 is unaffected. Hence, we can start from the date 1 continuation decision.

Continuation At date 1, for a relationship bank the net expected return if a bad project is continued will be

$$\frac{p_{Bi}}{p_{B1}+p_{B2}}(p_{B1}+p_{B2})\lambda A - L^B - \widehat{L}^*(\epsilon) = p_{Bi}\lambda A - L^B - \widehat{L}^*(\epsilon)$$

and $p_{Bi}A + L^G - \widehat{L}^*(\epsilon)$ if a good project is continued. In the expressions $\widehat{L}^*(\epsilon)$ stands for the disutility of the extra-restructuring $\widehat{L}^*$ that the relationship bank has to implement if the project is continued.

Before the continuation decision the entrepreneur contracts on $\widehat{L}^*$ with the bank that can implement it. Lemma 3 solves for the contract:

Lemma 3 *With pure relationship banking, if screening is feasible, in the bad state the contract specifies* $\widehat{L}^* = p_{Bi}\lambda A - L^B - \underline{\epsilon}$ *for the bank that can implement the additional restructuring. The project will be continued if and only if it is good.*

Lemma 3 shows that, when screening is feasible, also with pure relationship banking the entrepreneur can prevent the continuation of a bad project. Moreover, the size of the extra-restructuring effort $p^*_{Bi}\lambda A - L^B - \underline{\epsilon}$ that is realised by one relationship bank is positively related to its monitoring.[19]

Monitoring In choosing monitoring p^*_{Bi} each banker rationally takes into account the equilibrium in the following stages. Therefore

$$p^*_{Bi} = \arg\max\left\{\pi_h\left[p_{Bi}A + L^G - \frac{1}{2}(p_{Bi}\lambda A - L^B - \underline{\epsilon})\right] - \frac{c_B}{2}p^2_{Bi}\right\}$$

The term in square brackets is the return to the bank if the project turns out to be good net of the expected disutility from the extra restructuring (a bad project has 0 net expected return because it is always liquidated). The solution is

$$p^*_{Bi} = \overline{p}^*_B = \frac{\pi_h A(1-\frac{1}{2}\lambda)}{c_B} \qquad i = 1,2$$

[19]Screening has two costs. The direct one, i.e. the disutility of the extra-restructuring effort, is borne entirely by the bank that implements $\widehat{L}$. The indirect one, affecting both the relationship banks and the entrepreneur, is the distortion in the level of monitoring (see further on in the analysis).

Note that with screening, since banks know that the size of the extra-restructuring effort they could be asked to implement is positively related to their monitoring, banks' monitoring is distorted downwards. In particular, $\overline{\overline{p}}_B^*$ is below the monitoring p_B^* realised by the relationship bank with diversified funding.

Choice of Funding

If screening is feasible, both pure relationship banking and diversified funding lead to the continuation of good projects only. Therefore it is sufficient to compare p_T^*, i.e. the probability of success of the restructuring of good projects, in the two types of funding. With diversified funding the transactional bank is naturally hindered in its monitoring; with pure relationship banking both banks have high ability in monitoring but their monitoring gets distorted downwards by the expectation of having to implement $\widehat{L}$.

Proposition 3 *Assume that the condition set in Proposition 1 is satisfied. If screening is feasible, the entrepreneur will strictly prefer "diversified" funding if and only if*

$$\frac{c_A - c_B}{c_A} < \lambda$$

Propositions 1 and 3 together show that, also with screening, there exists an intermediate range of informational gaps for which diversified funding prevails. Unlike without screening, the choice of funding is instead unrelated to Y and L', since a bad project is always liquidated at date 1, regardless of the funding strategy. Hence, the restructuring cost L' is now ininfluential and Y becomes a scale variable that does affect only the size but not the sign of the gap between the entrepreneur's expected return with pure relationship banking and with diversified funding. More interestingly, unlike without screening, the higher is the redeployability λ of the firm's assets, the easier will be that diversified funding dominates pure relationship banking. In fact, a high λ implies that the gain for the relationship banks from continuing a bad project is high. As a result also the downward distortion of monitoring induced by screening will be high.

4.3.3 Single and Multiple Banking

We now allow for single banking. We assume that, before the funding choice, the firm can set up its activity in one location, where it can borrow from two banks as in the previous analysis, or in a second location where there is a third bank that has I units of final good at date 0 and can therefore perform single banking. Analogously to the two banks in the model, this third bank has all the bargaining power vis-a-vis the entrepreneur at dates 0 and 1 and, during the reorganisation, has bargaining power equal to the relatively share of its monitoring, i.e. 1. Analogously to the two alternative banks, this third bank can run monitoring p_J $(0 \leq p_J \leq \frac{1}{2})$, with the disutility of monitoring being $p_J^2 c_J/2$ (respectively $J = B$ if the bank becomes a relationship one and A if it becomes a transactional one) and $c_A > c_B$.In the Appendix we show that in our framework, single banking (i.e. having one transactional or one relationship bank instead of two) is always be sub-optimal. We develop the case with screening but the extension to the case without screening is straightforward. The sub-optimality of single banking is a by-product of the chosen monitoring technology rather than having a "deep" economic meaning. However, by now a number of explanations exist on the trade-off between multiple and single banking (for an overview see Ongena and Smith, 2000) and this trade-off is outside the scope of the analysis.

4.4 Conclusion

We have presented a model that rationalises the choice of a firm to borrow simultaneously from relationship and from transactional banks. The analysis relates the choice of a diversified funding to the informational gap between relationship and transactional banks and to a number of characteristics of the firm.

We identify at least one extension. In the chapter we have carried out the analysis in a regulatory and legal *vacuum*. Introducing the regulatory and legal system explicitly would affect our results. For instance, a straightforward implication of the model is that a bankruptcy law tough in protecting small stakeholders from the "abuses" of big creditors would reduce the frequency of diversified debt structures and increase the frequency of relationship banking. Further research is clearly

needed to relate the nature of the firm-bank links prevailing in a financial system with the ruling bankruptcy law.

4.5 Appendix to Chapter 4

Proof of Lemma 1

Assumption 2 implies that the entrepreneur never liquidates a project. From Assumption 2 we know that, even if uncertain on the quality of the project and if only a transactional bank had monitored at the level maximising her expected return from a good project ($p_A^* = \frac{\pi_h A}{c_A}$), the entrepreneur would continue. Hence we can focus on the two relationship banks. No bank ever liquidates a good project. In fact, continuing a good project returns L^G at least. Therefore, the lowest level of monitoring of each is $p_B^* = \frac{\pi_h A}{c_B}$, i.e. the monitoring the bank would realise if it expected a liquidation of the bad project by the other bank. However no bank would liquidate a bad project at this monitoring level since her expected return from its continuation would be $\frac{\pi_h A}{c_B}\lambda A - L^B$ (> 0 from Assumption 3).

Proof of Proposition 1

From Lemma 1 we know that the relationship bank and the entrepreneur will always choose to continue a project. Hence we can restrict the attention to the transactional bank. Having defined K in assumption A3, a sufficient condition for the transactional bank never being willing to continue a bad project is

$$\lambda A^2 \left[\pi_h\left(\frac{1}{c_B} - \frac{1}{c_A}\right) - \frac{(1-\pi_h)\lambda}{c_A}\right] > K$$

In fact in this case $p_A^*\lambda\ A < L^B$ and the transactional bank will always choose liquidation.

Proof of Lemma 2

Follow the case of diversified funding assuming however that both banks behave like the transactional bank analysed in that case. Both with pure transactional funding and with diversified funding a bad project will always be liquidated (see Proposition 1). Hence we can focus on the case in which the project is good. The total monitoring of the two transactional banks will be $2p_A^*$ with

$$2p_A^* = \frac{2\pi_h A}{c_A} < p_B^* + p_A^* = \frac{\pi_h A}{c_B} + \frac{\pi_h A}{c_A}$$

In the above expression $p_B^* + p_A^*$ is the total monitoring when diversified funding is chosen. Thus the probability of success of the restructuring of a good project will be lower with a pure transactional banking than with diversified funding and pure transactional banking will always be dominated.

Proof of Proposition 2

At date 0 the entrepreneur will choose the funding that maximises her expected return. The entrepreneur's expected return from pure relationship banking (as of date 0) is

$$\ell Y + (1-\ell)(\pi_h 2\overline{p}_B^* Y - L')$$

The entrepreneur's expected return from diversified funding is

$$\ell Y + (1-\ell)\left[\pi_h(p_B^*+p_A^*)Y - L'\pi_h\right]$$

Note that the two expressions differ: i) in the probability of success of the restructuring p_T; ii) in the expected entrepreneur's restructuring cost that with pure relationship banking is $(1-\pi_h)L'$ higher because also bad projects are restructured. Comparing the two expressions and substituting the values of $\overline{p}_B^*, p_B^*$ and p_A^*, after simple algebraic manipulations, we obtain the result in Proposition 2.

Proof of Lemma 3

As proved in Lemma 1, the relationship bank that does not have to bear the additional restructuring will always choose continuation of a good project. We can then focus on the optimal $\widehat{L}$. The optimal contract maximises the entrepreneur's expected return if the good project is continued, i.e. $\pi_h^s(p_{B1}+p_{B2})Y - L'$, where, as before, π_h^s stands for the entrepreneur's subjective probability that the project is good if continued. Note that $\widehat{L}$ affects only π_h^s. In particular, in estimating the probability π_h^s that the project is good if continued, if $\widehat{L}^* < \max\left[p_{Bi}\lambda A - L^B - \underline{\epsilon}, 0\right]$ the entrepreneur will set π_h^s <1. In fact, in this case, with some positive probability the bank that has to implement $\widehat{L}^*$ will choose continuation also of a bad project. Otherwise the entrepreneur will set π_h^s =1. Moreover, from Assumption 2b, when π_h^s =1 the entrepreneur will always choose continuation. The best contract sets $\widehat{L}$ at the minimum level such that π_h^s =1, i.e. $\widehat{L}^* = p_{Bi}\lambda A - L^B - \underline{\epsilon}$. The bank that has to implement $\widehat{L}^*$ will always choose continuation if the project is good since it will expect a return of at least $p_{Bi}A + L^G - p_{Bi}\lambda A + L^B + \underline{\epsilon} - \overline{\epsilon} > 0$.

Proof of Proposition 3

The expected return of the entrepreneur (as of date 0) is

$$\ell Y + (1-\ell)\pi_h(p_T^* Y - L')$$

where $p_T^* = p_B^* + p_A^*$ with diversified funding and $p_T^* = 2\overline{p}_B^*$ with pure relationship banking. Therefore it is sufficient to compare p_T^* in the two types of funding, i.e.

$$p_B^* + p_A^* > 2\overline{p}_B^* \longleftrightarrow \frac{A}{c_B} + \frac{A}{c_A} \geq 2\frac{A - \frac{1}{2}\lambda A}{c_B} \longleftrightarrow \frac{1}{c_A} \geq \frac{1-\lambda}{c_B} \longleftrightarrow \frac{c_A - c_B}{c_A} \leq \lambda$$

Single and Multiple Banking

To prove that single banking is always sub-optimal it is sufficient to observe that, since the monitoring technology exhibits decreasing returns to scale, the amount of information produced by one bank is always less than the amount of information produced by two banks. For instance, take the case of one versus two relationship banks. Even if the single relationship bank had no signal to send, its level of monitoring p_B^* would be lower than the total one of two relationship banks. Formally

$$p_B^* = \frac{\pi_h A}{c_B} < \frac{2\pi_h A(1 - \frac{1}{2}\lambda)}{c_B} \leftrightarrow A < A(2 - \lambda)$$

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Chapter 5

Financial Distress, Asset Heterogeneity and the Optimal Nature of Creditors

Abstract

We construct a model that rationalises the choice of an entrepreneur to borrow both from relationship and from transactional banks ("diversified funding"). We derive endogenously the optimal degree of diversification as a function of the nature of the assets of the firm, especially their redeployability and their heterogeneity, and of the costs of restructuring the firm in distress. Having better information on asset redeployability and on the prospects of restructuring, relationship banks could have the incentive to continue a firm only to recover the most generic assets. By creating an asymmetry between the information of relationship banks and of transactional ones, diversified funding creates a conflict among banks that prevents the opportunistic continuation of bad projects. However, this informational asymmetry can lead to the premature liquidation of good projects.

5.1 Introduction

In the last two decades a growing literature has documented and analysed the redistributions of claims that can occur in the reorganisation of distressed firms. A typical finding of this literature is that shareholders receive value even when creditors are not paid in full, violating the absolute priority of claims (Weiss, 1990). More recently, based on the experience of countries in which many restructurings occur outside courts, some studies (e.g. Penati and Zingales, 1997) have stressed the possible appropriation of resources by big creditors active in restructurings at the

expense of small stakeholders that play a passive role in these reorganisations.[1]In this chapter we construct a model in which, by borrowing both from relationship and from transactional banks (diversified funding), a firm can discipline its banks during a private reorganisation, preventing them from extracting resources.[2]At the same time, diversified funding can be costly because it can induce the premature, inefficient liquidation of good projects. The model allows to derive endogenously the optimal degree of diversification of the links established by a firm with its banks and especially to relate this degree of diversification to observable characteristics of the firm.

The intuition of the analysis is as follows. In the model a relationship bank differs from a transactional bank for its better information on the firm. Banks' information plays a dual role during a reorganisation. On the one hand, an informed bank knows which assets of the firm are more easily redeployable and, hence, has a stronger ability in seizing assets during a reorganisation.[3]To make this dimension relevant we assume that the assets have different redeployability in the secondary market. On the other hand, an informed bank can disentangle a good project worth restructuring from a bad one worth liquidation more easily and, therefore, has a stronger restructuring ability. We show that relationship banks could choose to continue a bad firm temporarily with the only intent of seizing assets during its reorganisation. By creating an asymmetry between the information and the seizing ability of relationship banks and of transactional ones, diversified funding creates a conflict among banks that prevents the opportunistic continuation of bad projects. However, diversified funding hinders coordination in the restructuring of good projects, possibly leading to their premature liquidation.

The chapter builds on the model contained in chapter 4. By specialising and elaborating that more general framework, we are able to derive endogenously the

[1]Analysing the restructuring of the Italian Ferruzzi Group, Penati and Zingales (1997) finds evidence of a redistribution of claims from small stakeholders to the big banks active in the restructuring.

[2]Even in Germany and in Japan, in which bank-firm relationships are widespread, most firms establish different links, ranging from a tight long-term relationship with the haus-main bank to the transactional funding provided by arm's length ones (Aoki and Patrick, 1994; Edwards and Fisher, 1994).

[3]A comparable assumption is in Diamond and Rajan (2001), that argues that a bank is more efficient than dispersed investors in selling assets.

optimal degree of diversification of the firm-banks links as a function of characteristics of the firm such as the nature (redeployability and heterogeneity) of its assets and the costs of restructuring the firm in distress.[4] In related work (Guiso and Minetti, 2002) we are testing the empirical implications of the model using data from small US businesses.

Besides being linked with the mentioned literature on the redistribution of claims during reorganisations, the chapter is related to the analyses on the implications of the costs of financial distress for firms' choice of debt structure. In this strand the closest paper is Bolton and Sharfstein (1996), which endogenises the optimal number of creditors by showing that a higher number reduces entrepreneurs' incentive to make strategic default but increases the costs of liquidity defaults. Another related paper is Hart and Moore (1995) which derives the optimal distribution of priority of claims among creditors.[5] Hart and Moore (1995) show that, by combining classes of debt with different priority, a firm can commit not to overinvest (empire building) without incurring in debt-overhang.

The chapter is organised as follows: section 2 contains the model. Section 3 draws conclusions and empirical implications. All the proofs are in the Appendix.

5.2 The Model

5.2.1 Setup

Environment The economy lasts for three dates (t=0,1,2). At date 1 a "good" or a "distress" state realises, respectively with probability ℓ and $1-\ell$ ($\ell > \frac{1}{2}$). At date 2 the distress state can turn into "bad" with probability $(1-\ell)\gamma$ or "very bad" with probability $(1-\ell)(1-\gamma)$. The state of nature is common knowledge at each date.

There are one entrepreneur and two bankers. The entrepreneur and the bankers are risk neutral and consume on date 2. There is initially only the final good.

[4] Unlike in chapter 4, we also endogenise the positive aspect of banks' information during restructurings as banks' timely knowledge on the quality of the projects. However, the lower level of generality of the model in this chapter hinders the tratment of other issues, such as the implications of firm's screening on projects' quality for the choice of diversified funding.

[5] In a related vein see also Diamond (1993), Levmore (1982) and Rajan (1992).

Technology At date 0, besides storage (accessible also by banks), the entrepreneur can activate one indivisible project requiring I units of final good. The project can be of high quality with probability π_h or of low quality with probability $1-\pi_h$. No one observes quality at date 0.

At date 1, if the good state realises, the project, whatever its quality, returns A units of verifiable assets and Y units of non-verifiable final good accruing privately to the entrepreneur. If the distress state realises the entrepreneur and the banker(s) that have funded the project can liquidated or reorganise it over dates 1 and 2. We specify the sequence of events and the returns in distress below.

Henceforth we assume that the assets produced by the firm consist of N tools, each of size A/N. If the good state realises or the distress state realises but the project is reorganised over dates 1 and 2 and is of good quality, each tool can be fully consumed. If the distress state realises and the project is reorganised but is of bad quality all the produced tools must be redeployed outside the firm generating a lower level of consumption.[6] We assume that, while $\frac{N}{2}$ tools have a high redeployability $\lambda^H < 1$, i.e. if redeployed return $\lambda^H A/N$ units of final good, $\frac{N}{2}$ have a low redeployability $\lambda^L < \lambda^H$. Let λ denote the asset average redeployability, i.e. $\lambda = \frac{1}{2}(\lambda^H + \lambda^L)$.

Endowments and Preferences At date 0 the entrepreneur has no final good; each banker has $I/2$ units of final good. We assume away interbank lending so that this assumption on endowments implies that two banks are needed to fund the project (multiple banking).

The entrepreneur' s utility function is $u(C_2, L_1', L_2') = C_2 - L_1' - L_2'$ while bankers' utility function is $u(C_2, L_1, L_2) = C_2 - L_1 - L_2$. C_2 stands for the units of final good or assets consumed at date 2 and $L_t'(L_t)$ for any non-monetary restructuring cost that the entrepreneur (the bankers) bear at date 1 and 2. We allow any $L_t'(L_t)$ to be negative, i.e. to be a private benefit of continuation.

Timing and Information

[6] This assumption captures the fact that assets are generally worth more inside than outside a firm.

Date 0:

- (*Funding strategy*) The entrepreneur chooses pure relationship banking (two relationship banks) or diversified funding (one relationship and one transactional bank). In the analysis it will become clear that pure transactional banking (i.e. having two transactional banks) is always dominated. A relationship and a transactional bank differ for the information they have at date 1 and at date 2 (see below).

- (*Contract*) The entrepreneur contracts with the banks. The banks lend their endowment and the project starts.

Date 1:

- If the distress state realises, a relationship bank fully observes the quality of the project and asset redeployability. A transactional bank observes only noisy signals on these, with the noise of these signals chosen by the entrepreneur at date 0.

- (*Date 1 continuation*) Entrepreneur and banks decide simultaneously whether to continue. If and only if they all choose continuation the project is continued and they bear (enjoy) their restructuring cost (benefit).[7] The entrepreneur has a cost $L_1' = 0$ of continuation. Each bank has a cost L_1, where L_1 is the realisation observed by the bank at date 1 of a continuous random variable $\widetilde{L}_1 \sim f\left[\underline{L_1}, \overline{L}_1\right]$, with $\underline{L_1} < 0$ and $\overline{L}_1 > 0$.

Date 2:

- (*Date 2 continuation*) Both banks observe the quality of the project. Entrepreneur and banks decide simultaneously whether to continue. The entrepreneur (each bank) has a cost of continuation $L_2 > 0$ ($L_2' > 0$).

[7] The restructuring games between entrepreneur and bankers are simultaneous moves games of incomplete information and the resulting equilibrium a Bayesian-Nash equilibrium.

- (*Restructuring*)The returns from the restructuring realise and the agents consume.

In Figure 1 we summarise the game with the net returns at each stage:

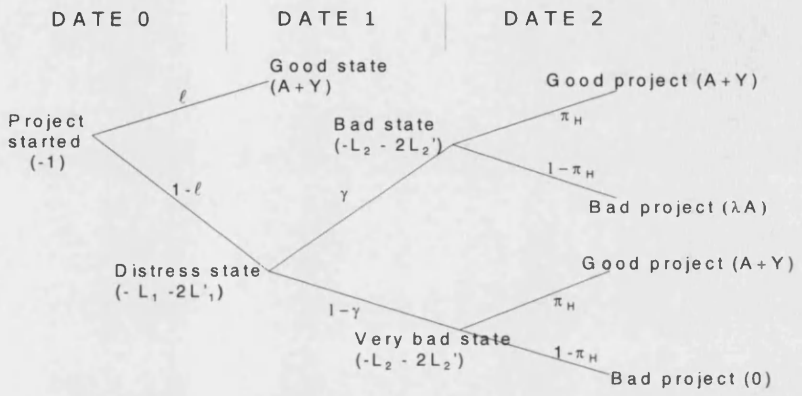

Figure 1. Game Tree

We introduce restrictions on the parameters:

Assumption 1

$$A\ell > I$$

Assumption 2

$$Y > L_2' > \frac{\pi_h}{\pi_h + F(0)^2(1-\pi_h)}Y$$

Assumption 3

$$\lambda\frac{A}{2} > L_2 > (\lambda^L + \lambda)\frac{A}{4}$$

Assumption 1 will guarantee the feasibility of lending at date 0. Assumption 2 implies that at date 2, in the bad state, the entrepreneur continues if and only if she is confident enough that the project is good if continued. Assumption 3 implies that at date 2, in the bad state, a bank continues a bad project if and only if it can recover enough generic assets.

Information Structure We now specify the information on the quality of the project and on asset redeployability observed by a transactional bank at date 1. A transactional bank observes a signal $\varphi(p^*)$ on the quality of the project and a signal $\psi_i(p^*)$ on the redeployability of tool i with $i = 1, ..., N$. As anticipated, the *common* noise p^* of these signals, i.e. the informational gap between the transactional and the relationship bank, is chosen by the entrepreneur at date 0. At date 1, conditional on φ taking value φ^G, the project will be good with probability $p^*+(1-p^*)\pi_h$ and bad with probability $(1-p^*)(1-\pi_h)$; conditional on φ taking value φ^B, the project will be good with probability $(1-p^*)\pi_h$ and bad with probability $p^*+(1-p^*)(1-\pi_h)$. For any p^* the unconditional probabilities of φ^G and φ^B are $\pi_h$and $(1-\pi_h)$. Analogously, conditional on ψ_i taking value ψ_i^H, the redeployability of tool i will be high with probability $p^*+(1-p^*)(1/2)$ and low with probability $(1-p^*)(1/2)$ (and conversely if ψ_i takes value ψ_i^L). For any p^* the unconditional probabilities of ψ_i^H and ψ_i^L are $1/2$.

Contract At date 0, since the endowments of the two banks must be lent in full to activate the project, the contract specifies only the allocation of the verifiable returns (assets). We assume that this allocation cannot be contingent on the state of nature, on the quality of the project or on the resale price of the assets. We assume that the entrepreneur has no bargaining power and the banks have the same bargaining power.

In what follows we consider an equilibrium in which both banks are allocated $A/2$ units of assets. In Lemma 2 we will prove that in equilibrium this is necessarily true and, therefore, the banks find convenient to lend at date 0 (in fact, from Assumption 1, $\ell A/2 > I/2$). If the assets must be redeployed and both banks claim (do not claim) any fraction of a tool, each bank will get half of the returns from its redeployment.

5.2.2 Equilibrium

We proceed by backward induction first determining banks' returns if the project is continued at date 2. Then we determine the continuation decision at date 2. Then we determine the continuation decision at date 1 and finally the entrepreneur' choice

of funding at date 0.

We rule out equilibria in which agents play weakly dominated strategies. We also assume for simplicity that, when an agent is indifferent between continuation and liquidation, she chooses liquidation.

Restructuring The only non-trivial case is when the project is bad and the state is bad. Since a relationship bank has perfect information on redeployability, it will always claim the tools with high redeployability in full. The transactional bank will always claim the tools for which the observed value of ψ_i is ψ_i^H in full.

Lemma 1

With diversified funding the expected return of the transactional bank A_A^* and of the relationship bank A_B^* if a bad project is continued in the bad state are respectively

$$\begin{aligned} A_A^* &= \frac{A}{2}\left[(p_A^* + (1-p_A^*)\frac{1}{2})\lambda + (1-p_A^*)\frac{1}{2}\lambda^L\right] \\ A_B^* &= A - A_A^* \end{aligned}$$

With pure relationship banking the expected return of both relationship banks if a bad project is continued in the bad state is $\frac{\lambda A}{2}$.

Lemma 1 shows that a transactional bank has less to gain from the continuation of a bad project in the bad state ($A_A^* < \frac{\lambda A}{2} < A - A_A^*$). Intuitively, the transactional bank, having noisy information on the redeployability of the single tools, expects to claim also tools with low redeployability and to leave some generic tools to the relationship bank.

Date 2 Continuation We now solve for the continuation decision at date 2

Lemma 2 *Let*

$$\widehat{p} = \frac{4L_2 - (\lambda + \lambda^L)A}{A(\lambda - \lambda^L)}$$

At date 2, in the bad state, if $p^* = 1$, i.e. with pure relationship banking, the project will always be liquidated. If $p^* = \widehat{p}$, the project will be liquidated if and only

if bad. In the very bad state, for any p^*, the project will be liquidated if and only if bad.[8]

Lemma 2 shows that at date 2 in the bad state, while with pure relationship banking a project will always be liquidated, with diversified funding, when $p^*=\widehat{p}$, a project will be liquidated if and only if bad. Intuitively, this happens because with diversified funding the entrepreneur knows that a bad project will always be liquidated by the transactional bank, since the transactional bank expects a low return A_A^* from its continuation and the following redeployment of the assets. Loosely speaking the entrepreneur expects that, with diversified funding, there will be no collusion within the restructuring pool.

Lemma 2 allows also to vindicate the claim that both banks are initially allocated $\frac{A}{2}$ units of assets. In fact, ex-post the only asymmetry in their returns could come from the continuation of a bad project in the bad state, but this is ruled out by Lemma 2.

Date 1 Continuation and Funding Strategy We now solve for the continuation decision at date 1 (Lemma 3) and for the entrepreneur's choice of funding at date 0 (Proposition 1).

Lemma 3 *Assume that*

$$(1-\widehat{p})\pi_h < \frac{\overline{L}_1}{\frac{A}{2}-L_2} < \min\left[1-\gamma,\ \widehat{p}+(1-\widehat{p})\pi_h\right]$$

Let $1-F(\widehat{p}) = Pr(\tilde{L}_1 > (1-\widehat{p})\pi_h(\frac{A}{2}-L_2))$. At date 1, if $p^*=1$, a good project will never be liquidated; if $p^*=\widehat{p}$ a good project will be liquidated with probability $(1-\widehat{p})\pi_h(1-F(\widehat{p}))$.

Lemma 3 shows that with diversified funding, when $p^*=\widehat{p}$, with some probability a good project will be prematurely liquidated at date 1. In fact, the transactional bank can observe a bad signal φ^B at date 1 even if the project is good and, if its restructuring cost L_1 is high, trigger liquidation. This possible premature liquidation

[8] It is easy to see that any $p^*<\hat{p}$ and any p^* between $\hat{p}$ and 1 are dominated.

of a good project arises from the poor information of the transactional bank and we interpret it as "lack of coordination" between the transactional and the relationship bank in the reorganisation of a good firm. Conversely, when $p^* = 1$, i.e. with pure relationship banking, no good project will be "prematurely" liquidated at date 1 because both banks will have full information on the quality of the project at this date.

Proposition 1 *At date 0 the entrepreneur will choose pure relationship banking, i.e.* $p^* = 1$, *if and only if* $(1 - \widehat{p})\pi_h(1 - F(\widehat{p})) < \gamma$. *Otherwise she will choose a "degree of diversification"* $\widehat{p}$.

Proposition 1 establishes the condition under which a firm prefers diversified funding. The entrepreneur will choose diversified funding if and only if the expected loss due to the certain date 2 liquidation of a good project in the bad state that realises with pure relationship banking (Lemma 2) ovewhelms the expected loss due to the date 1 possible premature liquidation of a good project that can realise with diversified funding (Lemma 3).

5.3 Conclusion and Empirical Implications

We have presented a model that rationalises the choice of a firm to borrow simultaneously from relationship and from transactional banks. We have shown that, by exploiting the worse information that transactional banks have on the redeployability of its assets, a firm can generate a conflict between transactional and relationship banks that prevents the strategic continuation of bad projects. However, by choosing diversified funding, a firm reduces the information that is shared by all the banks, possibly leading to the premature liquidation of good projects.

The model has straightforward empirical implications. In the model $\widehat{p}$ is a proxy for the (endogenous) degree of diversification of the firm-banks links. The closer is $\widehat{p}$ to 1 the less diversified are these links and the debt-structure close to pure-relationship banking. Looking at the expression for $\widehat{p}$ and at Proposition 1 we can relate this degree of diversification to a number of characteristics of the firm including: the average redeployability λ and the heterogeneity $\lambda - \lambda^L$ of its assets

and banks' restructuring cost L_2.

Asset average redeployability: $\widehat{p}$ is inversely related to the average asset redeployability. Intuitively, the higher is the average asset redeployability the higher is the diversification necessary to avoid collusion. In fact, the higher is the redeployability of the assets the higher will be banks' incentive to continue also a bad project to seize them.

Asset heterogeneity: $\widehat{p}$ is positively related to asset heterogeneity. A higher asset heterogeneity reduces the diversity in banks' information necessary to induce a conflict between the transactional and the relationship bank.

Restructuring costs: $\widehat{p}$ is positively related to banks' restructuring costs. In fact, a higher restructuring cost implies lower banks' incentives to continue a bad project with the only intent of seizing assets.

It should be kept in mind, however, that Proposition 1 predicts that beyond a threshold level of $\widehat{p}$ the required degree of diversification will become "too big", i.e. will imply a too big coordination loss, and pure relationship banking will be preferred.

We are currently verifying these empirical implications using micro data from banks and firms.

5.4 Appendix to Chapter 5

Proof of Lemma 1

For each tool i the transactional bank expects to observe ψ_i^H (or ψ_i^L) with probability $\frac{1}{2}$. The probability that the redeployability of tool i, conditional on $\psi_i = \psi_i^H$, is actually high (λ^H) is $p_A^* + (1-p_A^*)\frac{1}{2}$, while the probability that is low (λ^L) is $(1-p_A^*)\frac{1}{2}$. The transactional bank knows that if a tool is actually highly redeployable, it will be claimed also by the relationship bank and the two banks will get $\lambda^H A/2N$ each; if, instead, it has a low redeployability it will not be claimed by the relationship bank and the transactional bank will get $\lambda^L A/N$. Finally, each tool that is not claimed by the transactional bank will not be claimed by the relationship bank if and only if it has actually low redeployability. This happens with probability $p_A^* + (1-p_A^*)\frac{1}{2}$ and in this case each bank will get $\lambda^L \frac{A}{2N}$ from its redeplyment. Combining these steps the expected return of a transactional bank is

$$A_A^* = \frac{A}{2}\left\{\left[(p_A^* + (1-p_A^*)\tfrac{1}{2})\tfrac{1}{2}\lambda^H + (1-p_A^*)\tfrac{1}{2}\lambda^L\right] + \left[(p_A^* + (1-p_A^*)\tfrac{1}{2})\tfrac{1}{2}\lambda^L\right]\right\} =$$
$$= \frac{A}{2}\left[(p_A^* + (1-p_A^*)\tfrac{1}{2})\lambda + (1-p_A^*)\tfrac{1}{2}\lambda^L\right].$$

Proof of Lemma 2

1st case: $p^*=\widehat{p}$. Banks' decision.

At date 2: i) In the bad state a transactional bank will always choose to liquidate a bad project since $L_2 = \frac{A}{2}(\widehat{p}\lambda + (1-\widehat{p})\lambda^L)$; ii) In the bad state a relationship bank will always choose to continue a bad project since $L_2 < \lambda\frac{A}{2}$; iii) In the very bad state both banks will choose to liquidate a bad project since $L_2 > 0$; iv) In both states both banks will choose to continue a good project since, from A3c, $L_2 < \frac{A}{2}$.

Entrepreneur's decision

Unlike the banks, the entrepreneur does not know the quality of the project at date 2. However, she knows that with a positive probability the outstanding project is bad (see the proof of Lemma 3 for a vindication of this claim) but that the transactional bank will always liquidate a bad project. As before, since from A3c $L_2' < Y$, the entrepreneur will always continue the project.

2nd case: $p^*=1$. Banks' decision.

i) In the bad state both a relationship and a transactional bank will choose to continue a bad project since, from A3b, $L_2 < \lambda\frac{A}{2}$; ii) In the very bad state both banks will choose to liquidate a bad project since $L_2 > 0$; iii) In both states both banks will choose to continue a good project since, from A3c, $L_2 < \frac{A}{2}$.

Entrepreneur's decision.

In this case the entrepreneur knows that with probability greater than $\frac{\pi_h}{\pi_h+F(0)^2(1-\pi_h)}$ the oustanding project is bad (see again the proof of Lemma 3) and that the banks will want to continue a bad project. Since, from A3c $L_2' > \frac{\pi_h}{\pi_h+F(0)^2(1-\pi_h)}Y$, the entrepreneur will always liquidate the project.

Proof of Lemma 3

Entrepreneur' s decision

The entrepreneur will always choose to continue at this stage since her cost of continuing is 0.

Banks' decision. 1st case: $p^*=\widehat{p}$.

The project is good. For a relationship bank the return from continuing is

$$(\frac{A}{2} - L_2)\gamma + (\frac{A}{2} - L_2)(1-\gamma) = \frac{A}{2} - L_2 > \overline{L}_1$$

In fact the relationship bank expects that at date 2, in both states, only a good project will be continued with a return of $\frac{A}{2} - L_2$.

For a transactional bank that has observed φ^G the expected return is

$$(\frac{A}{2} - L_2)(\widehat{p} + (1-\widehat{p})\pi_h) > \overline{L}_1$$

Thus a transactional bank observing φ^G will always want to continue.

For a transactional bank that has observed φ^B the expected return is

$$(\frac{A}{2} - L_2)(1-\widehat{p})\pi_h < \overline{L}_1$$

If $L_1 > (1-\widehat{p})\pi_h(\frac{A}{2} - L_2)$ a transactional bank observing φ^B will liquidate. The probability that $\tilde{L}_1 > (1-\widehat{p})\pi_h(\frac{A}{2} - L_2)$ is $1 - F(\widehat{p})$. Conditional on the project being good the transactional bank will observe φ^G with probability $\hat{p} + (1-\hat{p})\pi_h$ and φ^B with probability $(1-\hat{p})\pi_h$. Hence, at date 1 a good project will be liquidated with probability $(1 - F(\widehat{p}))(1\text{-}\hat{p})\pi_h$.

The project is bad. Since for a relationship bank the net expected return from continuing a bad project is $0 - L_1$, with probability $F(0)$ a relationship bank will choose to continue. For a transactional bank the expected returns conditional on the value of the signal φ have already been described in the previous subsection. However now, conditional on the project being bad, the transactional bank will observe φ^G with probability $(1-\widehat{p})\pi_h$ and φ^B with probability $\widehat{p}+(1-\widehat{p})\pi_h$. Overall this implies that with probability greater than $F(0)^2$ a bad project will be continued vindicating the claim in Lemma 2.

Banks' decision. 2nd case: $p^*=1$

The project is good. In this case, at date 1, both banks share full information on the quality of the project. Moreover, they rationally expect that at date 2 in the bad state the entrepreneur will always liquidate. Hence both for the relationship and the transactional bank the return from continuing will be

$$(\frac{A}{2} - L_2)(1-\gamma) > \overline{L}_1$$

The project is bad. With probability $F(0)^2$ a bad project will be continued. In fact if both banks have $L_1<0$ the project will be continued.

Proof of Proposition 1

With pure relationship banking the entrepreneur expects that at date 2, in the bad state, a good project will always be liquidated with an expected loss of $(1\text{-}\ell)\gamma\pi_h(Y - L_2')$. With diversified funding the entrepreneur expects that with probabiltiy $(1\text{-}\hat{p})\pi_h(1 - F(\widehat{p}))$ a good project will be liquidated at date 1 with an expected loss of $(1\text{-}\ell)(1\text{-}\hat{p})\pi_h(1 - F(\widehat{p}))\pi_h(Y - L_2')$. Comparing the two losses we obtain the result of the Proposition.

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