BANCA D'ITALIA

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Temi di Discussione

(Working Papers)

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September 2017

Number 1134

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ISSN 1594-7939 (print)
ISSN 2281-3950 (online)

Printed by the Printing and Publishing Division of the Bank of Italy

CREDIT DEMAND AND SUPPLY: A TWO-WAY FEEDBACK RELATION

by Ugo Albertazzi* and Lucia Esposito*

Abstract

The model developed in this paper extends the framework of self-fulfilling credit market freezes proposed by Bebchuk and Goldstein (2011) by endogenizing firms' investments decisions. The existence of an aggregate investment threshold below which individual investment projects are unsuccessful creates a coordination failure not only among banks but also among firms and, crucially, between the two sides of the market. Because of the resulting strategic complementarities between firms and banks, low credit demand expectations reduce credit supply and viceversa. This two-way feedback loop explains why a severe slump in aggregate demand may be associated with a disruption in lending caused by a financial crisis. Replies to the euro area Bank Lending Survey by individual Italian banks provide support to the model's conclusions.

JEL Classification: D25, D82, E51, G21.
Keywords: credit crunch, investment, strategic complementarities, global games.

Contents

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1 Introduction[1]

The global financial crisis and the euro-area sovereign debt crisis have revived a strong interest in understanding the role of money and credit fluctuations in the macroeconomy and their importance in the creation, propagation and amplification of shocks. In this paper we investigate to what extent a malfunctioning in the financial sector and tensions in bank credit may result in strong and persistent deviations of output from its long-run trend, akin to what happened to the major advanced economies after the collapse of Lehman Brothers. Figure 1 highlights the increasingly diverging trend in Italian real GDP between the periods 1998-2008 and 2008-2017. The figure would look similar for other non-core euro-area countries. The drop in economic activity has mainly affected the investment component. As highlighted by Giordano, Marinucci and Silvestrini (2016), Italy experienced a large fall in gross fixed capital formation, both in the global financial crisis and the sovereign debt crisis. Total real investment suffered a loss of around 30 per cent since the pre-crisis peak in 2007, reverting to its lowest level since the mid-1990s. The exceptional fall in investment concerned all institutional sectors.[2]

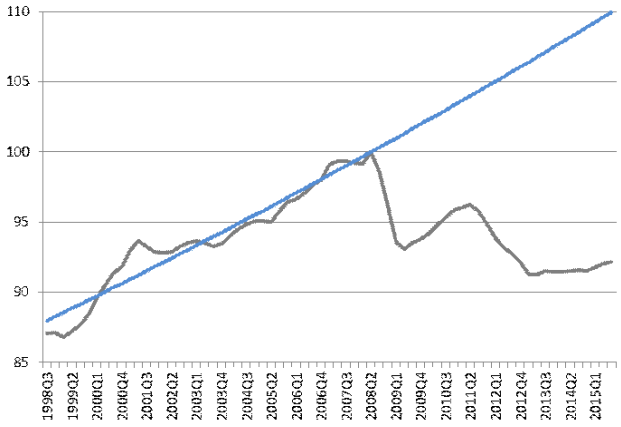

Figure 1. Real GDP in Italy (2008Q2 = 100)

The difficulties faced by the banking sector are believed to have ignited the crisis. As for the Italian economy, however, available empirical studies suggest

[1] We thank for useful comments Taneli Mäkinen, Stefano Neri, Stefano Siviero, an anonymous referee and participants at the Bank of Italy 2017 internal workshop on Secular Stagnation and Financial Cycles and at the VIII Workshop on Institutions, Individual Behavior and Economic Outcomes, at the University of Sassari.

[2] Besides investments, the consumption component of aggregate demand also fell considerably. Rodano and Rondinelli (2014) show that while in the first recession consumption decreased less than output (suggesting consumption smoothing), in the second recession consumption fell more than output and this extraordinary drop can be explained by the perception of a persistent fall in Italian household income.

that at most a portion of the observed slowdown in credit growth and loss in output can be explained by the deterioration of credit *supply* conditions (see, among others, Albertazzi and Marchetti, 2010; Caivano, Rodano and Siviero, 2011; Barone, De Blasio and Mocetti, 2016, Cingano et al., 2016).[3] Interestingly, Caivano, Rodano and Siviero (2011) estimate that confidence, a factor that may at least partly capture the mechanisms we want to highlight in this paper, contributed to the drop in Italian GDP in the years 2009-10 even more than financing constraints.

In this paper we ask the following questions. First, to what extent can the strong and persistent drop in credit demand for investment purposes be attributed to the credit supply restrictions per se? The nature of credit supply shocks is well understood in economic literature which illustrates how fragility and self-fulfilling crises are inherent to the banking sector due the sector's maturity mismatch, as in Diamond and Dybvig's (1983) classical framework, or the lack of coordination among lenders which may lead to an increase in firms' credit risk, as in Bebchuck and Goldstein (2011). As credit demand fell concomitantly with the drop in credit supply, this naturally begged the question whether the latter was itself the igniting factor for the former. It is important to highlight that we are not referring to the impact of a credit supply shock on equilibrium quantities of credit or investment, but instead to the impact on the credit demand schedule. In other words, we are asking if a shift in the credit supply schedule leads to a shift in the demand curve in the same direction, with an amplification of the effects on equilibrium quantities of the initial shock. Second, is it plausible that the causal relationship also works in the opposite direction, meaning a fall in aggregate demand reduces credit supply, thus establishing a two-way feedback loop? Third, what are the implications of this feedback loop for countries that are financially integrated? Finally, is this potential vicious circle exacerbated if the firms demanding credit are already heavily indebted?

Our paper investigates these issues by developing a model built upon two key but realistic assumptions: i) a project's return is positive only if a critical mass of investment is reached, i.e. if enough other firms invest as well (*coordination motive*); ii) firms can invest only if they receive funding from a bank (*bank-based economy*). The assumption of a coordination motive in firms' decision-making process means that firms, or at least a significant fraction of them, benefit from the success of other firms in the economy, and their returns increase if other firms invest.[4] As a result of this interdependence, under common knowledge

[3] The estimated effect of the credit crunch on economic activity provided by these papers differ due to data, methodology and sample period. The largest figure is found by Cingano et al. (2016) who argue that, had the interbank market not collapsed in 2007, the per-year investment expenditure in the four subsequent years would have been more than 5% higher than the observed amount which, while certainly not negligible, represents a small share of the actual drop in investments. At any rate, ten years after the beginning of the crisis, limited credit access is of minimal importance in explaining the persistent weakness of investments, as suggested by surveys of both firms and banks.

[4] This interdependence can be generated by multiple channels. A firm's success depends on the success of firms that use its products, of those which supply its inputs, and of those whose employees buy its products.

of macroeconomic fundamentals, the economy is prone to multiple equilibria. A bad equilibrium may arise in which aggregate investment is inefficiently low (Cooper and John, 1988). Furthermore, in a bank based-economy, a firm's decision to invest depends not only on the firm's assessment of whether other firms will be willing to invest but also on their ability to obtain bank financing. This implies that *expectations of tighter credit supply reduce credit demand* and investments, and increase the probability that an inefficient equilibrium characterized by low credit and low investment will materialize. At the same time, bank's decision to lend to a firm does not depend solely on the bank's expectations of whether other intermediaries will grant credit but also on the bank's assessment of whether firms are willing to invest. This implies that *low credit demand expectations reduce credit supply.* A negative feedback loop arises in which expectations of a low credit supply reduce credit demand (and investments) and expectations of a low credit demand (and investments) reduce credit supply.

Existing literature. The existing literature has extensively addressed the role of intra-group strategic complementarities among firms in shaping investment dynamics (Cooper and John 1988, Chamley 1999). The role of intra-group strategic complementarities among banks for credit supply has been analyzed by Bebchuk and Goldstein (2011). To the best of our knowledge, our paper is the first to assess the role of both intra-group strategic complementarities (among firms and among banks, respectively) and inter-groups strategic complementarities (between firms and banks' decisions) in shaping credit demand and supply.[5]

The literature has shown that when there are strategic complementarities, the equilibria and outcomes of the individual interactions differ considerably depending on the assumptions made regarding the information structure. As highlighted in the seminal paper by Cooper and John (1988), under common knowledge of macroeconomic fundamentals, the coordination game among firms may lead to multiple equilibria. There are ranges of macroeconomic fundamentals in which firms have a dominant strategy, irrespective of what other firms are expected to do. More specifically, when the fundamentals are *very good*, a firm will prefer to invest no matter what it believes other firms will do, as in this range the return on investment is guaranteed to be high enough. Symmetrically, when the fundamentals are *very bad*, the firm will not invest, even if it believes that all the other firms will invest. For fundamentals in the intermediate range, the optimal decision depends on the expectations of the actions of other firms. In this range, strategic uncertainty leads to two equilibria: an inefficient one with no investment and an efficient one where firms coordinate and realize positive net investment returns. A similar logic holds for models looking at strategic complementarities in banks' lending decisions, as in Bebchuk and Goldstein (2011). Carlsson and van Damme (1991) and Morris and Shin (1998) have shown that by introducing the realistic assumption of incomplete infor-

[5] Goldstein (2005) was the first paper to address the relevance of strategic complementarities across two groups of agents in the context of the simultaneous occurrence of banking and currency crises.

mation about the macroeconomic fundamentals, it is possible to eliminate the indeterminacy typical of coordination games. If private information is precise enough compared to public information, there is a threshold for fundamentals below and above which firms always coordinate on not investing or investing, respectively. Such threshold is larger than the levels of fundamentals for which, under common knowledge, not investing is a dominant strategy. This implies that there is a range of fundamentals characterized by an inefficient lack of investment where positive returns would be realized if agents could coordinate. Again, a similar argument can be put forward for coordination among banks.

Paper contribution. Our contribution to the literature is to propose a unified framework for credit supply and demand decisions under the assumption of incomplete information about macroeconomic fundamentals. The model also encompasses moral hazard problems on the part of both firms and banks. To preserve enough skin in the game for both groups of agents, the interest margin applied to loans must neither be too large and nor too small. We show that at the market clearing margin firms and banks coordinate on investing and lending in correspondence of the same region of fundamentals (they invest or lend only if their signal is higher than a common threshold). Nevertheless because of binding incentive compatibility constraints the equilibrium margin may be lower or higher than the market clearing one. If the equilibrium margin is lower, there is a region of fundamentals in which firms would coordinate on investing but they don't because in that region banks do not coordinate on lending (Figure 2, scarce supply regime). Symmetrically, if the equilibrium margin is higher there is a region of fundamentals in which banks would coordinate on lending but they don't because in that region firms do not coordinate on investing (Figure 2, scarce demand regime). This implies that the interaction between the coordination failure among banks and firms creates additional inefficiencies with respect to the case where the two problems are considered in isolation. De facto, when the variance of the private information is vanishingly small, credit and investment freezes always happen together and the incidence of this event is led by the side of the credit market in which the incentive compatibility constraint is binding.[6]

[6] For example, suppose that the market clearing margin m^* is higher than the threshold margin for firms' incentive compatibility m_F. In order to satisfy firms' incentive compatibility, the equilibrium margin of the model has to be at most equal to m_F but when $m = m_F < m^*$ credit supply is smaller than demand. In order to fulfill firms' incentive compatibility, credit supply becomes relatively scarce. At this point the inter-group strategic complementarities come into play and the equilibrium displays a region of fundamentals in which firms would coordinate on investing but they don't because in that region banks do not coordinate on lending, as shown in Figure 2.

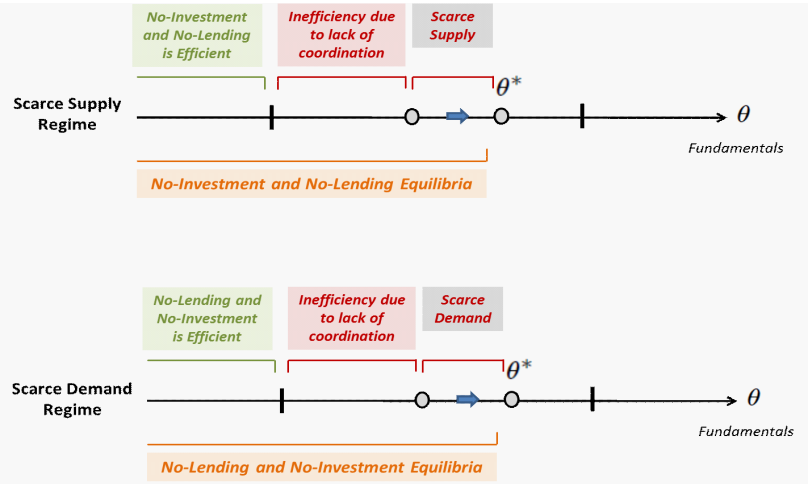

Figure 2. Coordination under incomplete information

Interestingly, the policy implications depend on the regime materializing in equilibrium. The broad message is indeed that the existence of scarce demand and scarce supply regimes imply that the stimulus is effective only if directed towards the short-side of the market. This is not a trivial message as in a standard demand and supply framework stimulating one side of the market, say the supply side, always leads to expansionary effects even if the weak side of the market is demand. With regard to monetary policy, in the model a more accommodative stance is always effective in reducing coordination problems, irrespective of the prevailing regime, because a reduction of the risk-free rate always shrinks the inefficient region.[7] This holds because monetary policy is the main driver of the profitability of the outside option (the risk free asset) for both banks and firms.

In the second part of the paper we develop two extensions of the baseline model, in order to tackle two important related issues, i.e. financial integration and debt. In the first extension, we consider two economies characterized by different levels of productivity and sharing the same interest rates and whose firms are financed by an integrated banking sector that can costlessly allocate funds in either region. Under some simplifying assumptions and parameter restrictions, the model admits two self-fulfilling equilibria, despite the presence of private information. In one equilibrium banks coordinate on financing only the high-productivity economy; in the other, only the low-productivity region. The main message of this exercise is that the equilibrium in which the low-productivity region receives credit exists only if the productivity differential is small enough. Despite the high level of stylization, we take these findings as suggesting that financial flows across regions could be detrimental to financial stability (self-

[7] For the equilibrium with endogenous margin determination, the finding that monetary policy stimulus always eases coordination-related inefficiencies relies on the assumption that the profitability of investment projects is high enough compared to the alternative risk-free asset.

fulfilling equilibria) and that, in this context, productivity differentials, if too harsh, may lead to low-productivity traps.[8]

We also study the role of (an exogenously given level of) debt in this economy. We assume that firms pay back their outstanding debt only when they can get a new loan to finance the investment project and the latter is successful, in all other cases they do not meet their obligations and suffer a penalty cost. In this context, debt rises inefficiency in a scarce demand regime but does not affect it in the scarce supply regime. We interpret this extension of the model as showing how debt-overhang episodes may arise via coordination failure on the demand side and not merely on the credit supply side, as in the classical framework dating back to the seminal contribution by Myers (1977).

Finally, using the replies of individual banks participating to the euro area Bank Lending Survey (BLS), we provide empirical evidence suggesting that both banks' loan supply and firms' loan demand decisions display an intra-group coordination motive. We also investigate inter-group coordination motives showing that coordination among firms is influenced by credit supply conditions; the evidence of possible spillover of demand conditions on coordination among banks is instead weaker.

The paper will be developed as follows: Section 2 presents the baseline model, Section 3 addresses the implications of the two-way feedback loop in a financially integrated two-region context, Section 4 takes firms' outstanding debt into account and Section 5 presents the empirical analysis.

2 The Model

This model entails two periods, $t = 1, 2$. There is a continuum $[0, F]$ of identical (non-financial) firms. In the first period, firms have access to projects that require an investment of €1 but have only own resources equal to €$E < 1$ and they need to rely on bank credit for the remaining necessary funds. Indeed, in the same period a continuum $[0, K]$ of identical banks can provide loans to firms. Banks are endowed with the liquidity necessary to finance the firm's project but if they do so a proportion k needs to be financed through bank capital, whose equity premium is exogenously set on international financial markets to ρ. Alternatively, banks can choose to invest their capital in government bonds that generates $1+r$ next period. We assume for simplicity that $F = K/(1-E)$ so that if all firms would invest and all bank would lend demand and supply would perfectly match.

As in Bebchuk and Goldstein (2011), firms' investment projects generate a gross return of $1 + \tilde{R}$ when a sufficient number of firms actually undertake the investment project. This complementarity could be due, for example, to the fact that the consumers of each firm's final output are employees of the other firms. If aggregate investment is too low, so will be wages and the demand for final goods. In particular, the return on the project is:

[8] Needless to say that the model is very partial in conducting this analysis as it fully neglects all possible benefits of financial integration.

$1+\tilde{R}$	$if\ aL^*+\theta \geq b$
0	$if\ aL^*+\theta < b$

(1)

In expression (1), θ is a random variable capturing macroeconomic conditions (for instance, consumers' demand and the cost of imported oil) and L^* is the mass of firms that want to invest and can actually do so as they manage to find credit to finance their project; a is a parameter capturing the importance of complementarities versus fundamentals in making projects profitable and b is a parameter capturing firms' (average) productivity, so that the lower b the more likely condition $aL^*+\theta \geq b$ is met.

Due to the presence of agency frictions, outlined below, our model allows for the possibility of equilibria with rationing, or more broadly speaking without market clearing. This leads us to define L^* based on the principle of the short side of the market and so we have:

$$L^* = \min\left\{L^S, L^D\right\}$$

where L^S represents lending supply, that is the proportion of banks that decide to lend to firms; L^D represents the mass of firms that are willing to invest, conditional on obtaining a loan. A related crucial difference with respect to Bebchuk and Goldstein (2011), where demand is always in excess and exogenously given, is that we relax the assumption that firms always invest if credit is available. Specifically, in our model demand is endogenous and can in principle be higher or lower than lending supply[9].

The payoff structure governing banks and firms actions is summarized in the following table, reporting the unitary (gross) return that can be obtained by both banks and firms, in the two possible states as implied by the regime change condition (1), for each of the two possible actions available.[10]

	$Coord.success$	$Coord.failure$
Banks		
$Credit$	$(1+r+m)-(1+r+\rho)\,k$	0
$Gov\ Bonds$	$(1+r)$	$(1+r)$
Firms		
$Invest$	$\left(\left(1+\tilde{R}\right)-(1+r+m)\,(1-E)\right)/E$	0
$Not\ Invest$	$(1+r)$	$(1+r)$

(2)

Banks' (firms') payoff of lending (investing), conditional on a successful coordination, is increasing (decreasing) in m which denotes the interest margin applied on bank loans. Note also that we assume that both firms and banks default on

[9] Note also that while there is complementarity between credit demand and credit supply in determining gross returns, L^* and θ are substitutes in expression (1).

[10] For simplicity of the exposition we label the two actions available to the firm as "invest" and "not invest". Clearly, these labels do not take into account that actual investment is conditional on being able to obtain funds.

their obligations in case of coordination failure. All agents are risk-neutral and maximize the expected value of their payoffs, taking into account what other agents do. An additional realistic feature of the model is represented by the presence of a moral hazard problem at the firm level. Conditional on coordination being successful, in the second period firms need to exert an adequate level of effort in order for their own project to be remunerative. Precisely, the return $\tilde{R}$ depends on the level of effort the firm exerts, which for simplicity is assumed to take two possible values. A low level of effort entails private benefits B_F for the firm but produces project return $\tilde{R} = 0$; a high level of effort entails no private benefits but produces high returns $\tilde{R} = R$.

$$\begin{array}{rcl} high\ effort & | & investing \rightarrow \left((1+R) - (1+r+m)(1-E)\right)/E \\ low\ effort & | & investing \rightarrow B_F \end{array}$$

The incentive compatibility for the firm requires:

$$\frac{(1+R) - (1+r+m)(1-E)}{E} \geq B_F \tag{3}$$

Expression (3) simply requires that conditional on coordination being successful the benefits accruing to the firm from undertaking the project and choosing a high level of effort are larger than those from exerting low effort. This essentially imposes a constraint on the level of the interest margin m which, if too large, is incompatible with adequate incentive provision on the side of firms. A similar moral hazard problem exists also on the side of banks who can choose a high or a low level of effort in the second period. If bank's effort is low, it enjoys private benefits equal to B_B but the return on their loans is nil (this is meant to represent the situation where a bank not adequately monitoring its borrowers is unable to enforce repayment). If instead bank's effort is high, it enjoys no private benefits but the borrower is enforced to meet his debt obligations.[11]

$$\begin{array}{rcl} high\ effort & | & lending \rightarrow (1+r+m) - (1+r+\rho)\,k \\ low\ effort & | & lending \rightarrow B_B \end{array}$$

The incentive compatibility for the bank requires:

$$(1+r+m) - (1+r+\rho)\,k \geq B_B \tag{4}$$

A final building block of the model concerns the information structure, which is that typical of the global game literature. Banks and firms choose their actions conditional on their information set. The fundamental θ is not publicly known. The initial common prior on θ is an improper uniform over $\mathbb{R}$. Agents observe

[11] One could think of a situation where banks' activity is characterized by the presence of a moral-hazard issue between shareholders and managers, as in a standard Jensen and Meckling (1976) framework. Bank managers should be made residual claimants for them to be adequately incentivized and this requires that m, the total payoff for the bank remunerating both banks' owners and managers, shuold be large enough in case of "success".

private signal $x_i = \theta + \sigma\varepsilon_i$, where the ε_i are i.i.d. independent of θ and $\frac{1}{\sigma}$ is the precision of private information.

The perfect information benchmark of this model without moral hazard problems, has properties that are crucial for being able to select a unique equilibrium under incomplete information. In particular, when the fundamental θ is above b, a bank (firm) will prefer to lend (invest) no matter what it believes other banks and firms will do (i.e. even if $L^* = 0$), as in this range the gross return on lending is guaranteed to be $1 + R$. Similarly, when the fundamental is below $b - aK$, the bank (firm) will not give credit (invest), even if it believes that all the other banks will lend and firms will invest (i.e. even if $L^* = K$). When the fundamental is in the intermediate range, their optimal decision depends on their expectations on other banks and firms' actions and multiple self-fulfilling equilibria are possible. This indeterminacy is resolved in global games thanks to the introduction of incomplete information where agents takes action only after having observed a private signal about fundamentals θ. We restrict to symmetric equilibria in monotone strategies characterized by two thresholds values of the private signal which solve banks' and firms' indifference conditions. For the sake of the results illustration, we first analyze the game where m is exogenously fixed and moral hazard is ignored. Then we analyze the model in which m is endogenously determined, taking into account both market clearing and incentive compatibility constraints.

2.1 Exogenous margin

Definition (1) *The equilibrium of the model with exogenous margin m is characterized by the following set of thresholds:*

$$\{x_F^*, x_B^*, \theta^*\}$$

where x_B^* is the signal threshold for banks; x_F^* is the signal threshold for firms; θ^* is the value of θ which makes the regime change possible. In particular, for any $x_i \geq x_B^*$ bank i gives credit; for any $x_i \geq x_F^*$ firm i invests; for any $\theta \geq \theta^*$ the aggregate investment is remunerative. The two incentive compatibility constraints are assumed to be satisfied.

In this equilibrium, given the threshold θ^*, the signal thresholds x_B^* and x_F^* are such that banks' and firms' indifference conditions are satisfied.

$$\begin{aligned}
&\textit{Banks' indifference condition} \quad : \\
&\Pr\left(\theta \geq \theta^* \mid x_B^*\right) \quad = \quad \pi_B\left(m\right) \equiv \frac{1+r}{\left(1+r+m\right) - \left(1+r+\rho\right)k} \\
&\textit{Firms' indifference condition} \quad : \\
&\Pr\left(\theta \geq \theta^* \mid x_F^*\right) \quad = \quad \pi_F\left(m\right) \equiv \frac{\left(1+r\right)E}{\left(1+R\right) - \left(1+r+m\right)\left(1-E\right)}
\end{aligned}$$

Also, given the signal thresholds x_B^* and x_F^*, the fundamental threshold θ^*

satisfies the regime change condition

$$\textit{Regime change condition: } a\min\left\{L^S, L^D\right\} + \theta^* = b$$

where $L^S = \left[1 - \Phi\left(\frac{x_B^* - \theta^*}{\sigma}\right)\right] K$ and $L^D = \left[1 - \Phi\left(\frac{x_F^* - \theta^*}{\sigma}\right)\right] K$. The critical level of the conditional probability of coordination success $\pi_B(m)$ and $\pi_F(m)$ required by banks and firms respectively in order to lend and invest depends, besides other parameters, on the interest margin m applied on bank loans. Specifically, for banks $\pi_B(m)$ is decreasing in the margin m applied on loans while for firms $\pi_F(m)$ is increasing in m. Hence we can pin down a level of the margin m^* such that $\pi_B(m^*) = \pi_F(m^*) = \pi^*$; in turn we have $\pi_B(m) > \pi^* > \pi_F(m)$ when $m < m^*$ and $\pi_F(m) > \pi^* > \pi_B(m)$ when $m > m^*$. As shown in the technical Appendix, the equilibrium of this model is as described in the following Proposition.

Proposition 1 *For any $\sigma > 0$, the model with exogenous margin m admits a unique equilibrium. Let $m^* \equiv R - r + Ek(1 + r + \rho)$.*
When $m = m^*$ credit market clears and the equilibrium thresholds are

$$\theta^* = b - aK + aK\{\pi^*\}$$

$$x_B^* = x_F^* = x^* = \theta^* + \sigma\Phi^{-1}(\pi^*)$$

where $\pi^* = \frac{1+r}{1+R-k(1+r+\rho)(1-E)}$
When $m < m^*$ credit supply is scarce and the equilibrium thresholds are

$$\begin{aligned} \theta^* &= b - aK + aK\{\pi_B(m)\} \\ x_B^* &= \theta^* + \sigma\Phi^{-1}(\pi_B(m)) \\ x_F^* &= \theta^* + \sigma\Phi^{-1}(\pi_F(m)) \end{aligned}$$

where $\pi_B(m) = \frac{1+r}{(1+r+m)-(1+r+\rho)k} > \pi^* > \pi_F(m)$.
When $m > m^*$ credit demand is scarce and the equilibrium thresholds are

$$\begin{aligned} \theta^* &= b - aK + aK\{\pi_F(m)\} \\ x_B^* &= \theta^* + \sigma\Phi^{-1}(\pi_B(m)) \\ x_F^* &= \theta^* + \sigma\Phi^{-1}(\pi_F(m)) \end{aligned}$$

where $\pi_F(m) = \frac{(1+r)E}{(1+R)-(1+r+m)(1-E)} > \pi^* > \pi_B(m)$. In the limit as $\sigma \to 0$, the signal thresholds x_B^* and x_F^* converge to the fundamental threshold θ^*, $\forall m$.

$$\begin{aligned} x_B^* &\to \theta^* \\ x_F^* &\to \theta^* \end{aligned}$$

The amount of investments actually undertaken will be enough for not having a coordination failure whenever the fundamental θ is above a threshold θ^*. Such threshold is such that $\theta^* > b - aK$, implying that there is a region of realizations

of fundamentals θ for which (at least some of the) agents do not invest or lend despite it would be efficient to do so. As intuition would suggest, θ^* is smaller the higher the economy's productivity (i.e. the smaller b), the smaller the relative importance of coordination for the success of investments (i.e. the higher a), the larger the return on investment R, the smaller ρ, the bank-capital related cost of lending and the smaller k. It is interesting to note that in all the three cases considered, a more accommodative monetary policy stance (a smaller risk-free rate r) is associated with a reduction in θ^* which is intuitive considering that r represents in essence the opportunity cost of both investing and lending. When credit market clears, an increase in E leads to a smaller θ^*: larger own funds make firms more inclined to invest as they allow saving on the external financing premium (m). The impact of an increase in E is nil in a scarce supply regime and ambiguous in a scarce demand regime. The effect of the margin m on the threshold θ^* depends on whether there is scarce demand or scarce supply. In the scarce demand regime, the threshold θ^* is increasing in m while when supply is the short-side of the market the threshold θ^* is decreasing in m.[12].

A crucial result of this model is represented by the interdependencies between loan supply and demand stemming from inter-group strategic complementarities and coordination issues. This can be seen by looking at the signal equilibrium thresholds $x_F^* = \theta^* + \sigma\Phi^{-1}(\pi_F(m))$, $x_B^* = \theta^* + \sigma\Phi^{-1}(\pi_B(m))$ and their intercept $\theta^* = b - a\left[1 - \Phi\left(\frac{\max(x_B^*, x_F^*) - \theta}{\sigma}\right)\right]K$. Consider for example an exogenous decrease in R the return on investment. This exogenous change has a negative direct impact on demand. However, if the weak side of the market is the demand itself, this reduction in R exerts also an adverse indirect impact on banks' loan supply via θ^*. This indirect effect is more important the smaller is σ as shown in the Proposition (1). Similar considerations apply to loan demand for any exogenous shift of the supply schedule in a scarce supply regime.

Finally, it is interesting to point out that as $\sigma \to 0$, $x_B^* \to \theta^*$ and $x_F^* \to \theta^*$. As the precision of the signal increases, the nature of the equilibrium converges to a bang-bang solution where for any θ above θ^*, every firm invests and every bank is willing to lend. If instead θ is below such threshold, no firm wants to invest and no bank would be willing to lend, even if this is inefficient.

2.2 Equilibrium margin

We now abandon the assumption that m is exogenously fixed and make the hypothesis that it endogenously adjusts to a level which equalizes the demand and the supply of loans. Furthermore, we also consider the realistic assumption that both sides of the market are concerned by moral hazard issues as described above.

Definition (2) *The equilibrium of the model with endogenous margin is*

[12] The negative impact of a larger size of the economy K on the threshold θ^* is fully related to the fact that the regime change condition is expressed in absolute terms. If that was not the case, the size of the economy would not necessarily be relevant for θ^*.

characterized by the following set of quantities:

$$\left\{\tilde{x}_F, \tilde{x}_B, \tilde{\theta}, \tilde{m}\right\}$$

where $\tilde{x}_B$ is the signal threshold for banks; $\tilde{x}_F$ is the signal threshold for firms; $\tilde{\theta}$ is the value of θ which makes the regime change possible. In particular, for any $x_i \geq \tilde{x}_B$ bank i gives credit; for any $x_i \geq \tilde{x}_F$ firm i invests; for any $\theta \geq \tilde{\theta}$ the aggregate investment is remunerative. $\tilde{m}$ is such that loan demand and loan supply clears ($\tilde{m} = m^*$) unless this violates one of the two incentive compatibility constraints. In the latter case, $\tilde{m}$ is such that such constraint is satisfied with equality.

Considering the two incentives compatibility constraints, the admissible region for the equilibrium margin $\tilde{m}$ is given by:

$$B_B + (1 + r + \rho)\, k - (1 + r) \equiv m_B \leq \tilde{m} \leq m_F \equiv \frac{(1 + R) - B_F}{(1 - E)} - (1 + r)$$

This expression highlights that the margin must be not too small for the banks and not too large for the firms in order for them to choose an high level effort in the second period. Hence whenever the market clearing margin m^* does not belong to this region of parameters, the equilibrium with market clearing is not feasible and the unique equilibrium of the model is characterized by either scarce demand or scarce supply. In fact, if $m^* < m_B$, then banks' incentive compatibility creates a scarce demand regime. If $m^* > m_F$, firms' incentive compatibility imposes a scarce supply regime. These considerations leads to the following proposition.

Proposition 2 *For any $\sigma > 0$, the model with endogenous margin m admits a unique equilibrium.*
When $m^* \in [m_B, m_F]$ credit market clears and the equilibrium thresholds are

$$\begin{aligned} \tilde{m} &= m^* \\ \tilde{\theta} &= b - aK + aK\left\{\pi^*\right\} \\ \tilde{x}_B &= \tilde{x}_F = x^* = \tilde{\theta} + \sigma\Phi^{-1}\left(\pi^*\right) \end{aligned}$$

where m^* and π^* are defined as in Proposition (1).
When $m^* < m_B$ credit demand is scarce and the equilibrium thresholds are

$$\begin{aligned} \tilde{m} &= m_B \\ \tilde{\theta} &= b - aK + aK\left\{\pi_F\left(m_B\right)\right\} \\ \tilde{x}_B &= \tilde{\theta} + \sigma\Phi^{-1}\left(\pi_B\left(m_B\right)\right) \\ \tilde{x}_F &= \tilde{\theta} + \sigma\Phi^{-1}\left(\pi_F\left(m_B\right)\right) \end{aligned}$$

where $\pi_F\left(m_B\right) = \frac{(1+r)E}{(1+R)-(B_B+(1+r+\rho)k)(1-E)} > \pi^* > \pi_B\left(m_B\right)$.

When $m^* > m_F$ credit supply is scarce and the equilibrium thresholds are

$$\begin{aligned} \tilde{m} &= m_F \\ \tilde{\theta} &= b - aK + aK\left\{\pi_B\left(m_F\right)\right\} \\ \tilde{x}_B &= \tilde{\theta} + \sigma\Phi^{-1}\left(\pi_B\left(m_F\right)\right) \\ \tilde{x}_F &= \tilde{\theta} + \sigma\Phi^{-1}\left(\pi_F\left(m_F\right)\right) \end{aligned}$$

where $\pi_B\left(m_F\right) = \frac{1+r}{\frac{(1+R)-B_F}{(1-E)} - (1+r+\rho)k} > \pi^* > \pi_F\left(m_F\right)$. *In the limit as* $\sigma \to 0$, *the signal thresholds* x_B^* *and* x_F^* *converge to the fundamental threshold* θ^*, $\forall m$.

$$\begin{aligned} \tilde{x}_B &\to \tilde{\theta} \\ \tilde{x}_F &\to \tilde{\theta} \end{aligned}$$

As in the model with exogenous m, the amount of investments actually undertaken will be enough for not having a coordination failure whenever the fundamental θ is above a threshold $\tilde{\theta}$. As in Proposition (1), the regime change threshold is such that $\tilde{\theta} > b - aK$, implying that there is a region of realizations of fundamentals θ for which (at least some of the) agents do not invest or lend despite it would be efficient to do so. Similarly to what seen above, $\tilde{\theta}$ is smaller the larger a and R, the smaller b, ρ and k. Interestingly, in this context changes in E are relevant for the equilibrium $\tilde{\theta}$ also in a scarce loan supply regime. This because a large E implies that firms' incentive compatibility constraint is less likely to be binding (skin in the game), allowing banks to apply a larger margin m.

Crucially, also with endogenous m the model provides an interdependence between loan supply and demand stemming from inter-group strategic complementarities which becomes prominent as $\sigma \to 0$.

In this model the market clearing margin m^* does not depend on the realization of θ and as such it provides no information on the fundamentals of the economy. This ensures that the information structure of the model, characterized by the presence of private information, is preserved guaranteeing equilibrium uniqueness. This also simplifies the analysis by preventing agents' inference about fundamentals from equilibrium prices as in Angeletos and Werning (2006).

3 Two-Region Model

The baseline model emphasizes how credit demand and supply interacts due to coordination issues so that a shock to credit supply may trigger a weakening of demand. At the same time, a growing literature is documenting how global banks actively use cross-border internal funding to provide insulation from local shocks, including monetary policy ones. It is therefore interesting to assess what are the implications in our context of the existence of international banks that can lend in multiple countries or regions, each one characterized by domestic coordination issues (e.g. workers in one economy are buyers of goods

produced mainly domestically). In order to focus on the role played by strategic complementarities, we maintain perfect symmetry among the different national economies but for the parameters driving the intensity of coordination issues. The assumption that all interest rates are identical among the regions allows the model to be thought of as a representation of a common currency area; the model, though, is conceived to be suited to highlight, more broadly, interactions between financial integration and coordination frictions in lending markets.

Specifically, we consider an extension of the model with exogenous margin m (and no moral hazard) in which there are two regions characterized by different levels of productivity, high and low ($i = H, L$). Firms are financed by an integrated banking sector that can costlessly allocate funds in either region. As in the benchmark model, in each region firms coordinate on investment opportunities under the following local regime change conditions:

$$a \min \left\{ L_L^S, L_L^D \right\} + \theta > b_L$$

$$a \min \left\{ L_H^S, L_H^D \right\} + \theta > b_H$$

where $b_L = \frac{1}{productivity_L} > \frac{1}{productivity_H} = b_H$. Firms' payoff, conditional on a given strategy and on coordination success or failure, is identical in the two countries (Table 5). The (international) banks have to decide if they want to finance firms in country H or in country L and the payoff, again conditional on coordination success or failure, is the same. Given our focus on allocation of funds between the two countries, in order to allow for the possibility that international banks invest all their funds into one economy only, it is assumed, as in the benchmark model, that there are a continuum $[0, K]$ of banks and a continuum $[0, F]$ of firms in each country with $F = K/(1 - E)$.

	$Coord.success$	$Coord.failure$
Banks		
Lend in H	$(1 + r + m) - (1 + r + \rho) k$	0
Lend in L	$(1 + r + m) - (1 + r + \rho) k$	0
Firms		
Invest (locally)	$((1 + R) - (1 + r + m)(1 - E))/E$	0
Not Invest	$(1 + r)$	$(1 + r)$

(5)

The equilibrium is characterized in the following proposition.[13] It is interesting to observe that banks' equilibrium strategies do not depend on the private signal x_i. In fact, in this model the fundamental θ does not differ across countries implying that the probability of coordination failure in country i is uniquely pinned down by supply and demand coordination, given b_i. If banks expect coordination being stronger in a given country they will lend to that country no matter what is their information on the fundamentals.

[13] This extension ignores the possibilty for banks to invest in a risk-free asset. We are therefore implicitly assuming that the return on the risk free asset is low enough to be dominated by investing in one of the two countries. This allows us to simplify the analysis and focus on coordination issues related to the cross border allocation of funds of international banks, which is what we want to focus on.

Proposition 3 *The model admits two self-fulfilling equilibria. In the first equilibrium* $\theta_L^* > \theta_H^*$ *and* $x_{L,F}^* > x_{H,F}^*$ *with:*

$$\begin{aligned} \theta_L^* &= b_L > b_H \\ \theta_H^* &= b_H - aK + aK\left(\pi_F\left(m\right)\right) \\ x_{L,F}^* &= \theta_L^* + \sigma\Phi^{-1}\left(\pi_F\left(m\right)\right) \\ x_{H,F}^* &= \theta_H^* + \sigma\Phi^{-1}\left(\pi_F\left(m\right)\right) \end{aligned}$$

In the second equilibrium $\theta_L^* < \theta_H^*$ *and* $x_{L,F}^* < x_{H,F}^*$ *with:*

$$\begin{aligned} \theta_L^* &= b_L - aK + aK\left(\pi_F\left(m\right)\right) \\ \theta_H^* &= b_H \\ x_{L,F}^* &= \theta_L^* + \sigma\Phi^{-1}\left(\pi_F\left(m\right)\right) \\ x_{H,F}^* &= \theta_H^* + \sigma\Phi^{-1}\left(\pi_F\left(m\right)\right) \end{aligned}$$

This equilibrium exists only if the productivity of country L *is not too low compared to the productivity of country* H*, i.e.* $b_L - b_H < aK\left[1 - \pi_F\left(m\right)\right]$*. In the limit as* $\sigma \to 0$*,* $x_{L,F}^* \to \theta_L^*$ *and* $x_{H,F}^* \to \theta_H^*$*, in both equilibria.*

Proposition (3) says that this economy is prone to multiple self-fulfilling equilibria, despite the presence of private information which in standard global games leads to equilibrium unicity. In one equilibrium the banking sector coordinates on financing only country H, in the other one only country L. In the first equilibrium country L inefficient region (with No-lending and No-Investment) is the widest possible; indeed, in the entire range of fundamentals where there would be multiplicity of equilibria under common knowledge, $[b_L - aK, b_L]$, firms and banks do not choose to invest and lend respectively, although this would be efficient (Figure 3). A symmetric considerations apply for country H in the second equilibrium.

In both equilibria the level of activity in the country receiving lending is pinned down by the demand side. Given that the equilibrium in which country L receives credit from the banking sector arises only when the difference in productivity between the two countries is not too big, we conclude that compared to the autarkic regime, whenever the productivity differential is large enough, country B is trapped in an inefficient low supply regime. We interpret these findings as showing how financial flows in a financially integrated set of economies could be detrimental to financial stability (self-fulfilling equilibria) and how in this context productivity differentials among regions, if too harsh, may lead to low-productivity traps.

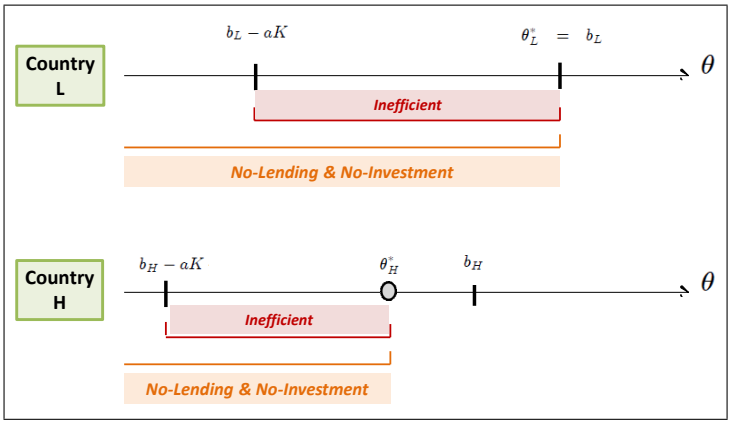

Figure 3. One of the equilibria of the two-region model

4 Model with firm's (outstanding) debt

From the seminal contribution by Myers (1977), the corporate finance literature has emphasized the crucial role of firms' degree of indebtedness or leverage in limiting their ability to access external finance in order to finance new projects even when profitable. We develop a simple extension of our baseline model incorporating this dimension and explore how outstanding debt interacts with the inefficiencies posed by lack of coordination in a framework of strategic complementarities.

Starting from the baseline model with exogenous margin (and no moral hazard), we assume that firms are burdened by previously contracted outstanding debt whose service implies an end-of-period disbursement equal to d. However, this payment takes place only when the firm is able to produce a high enough payoff that is only if it invests and the project is successful. If the project fails or investment does not take place, the firm does not meet its debt obligations and suffers a penalty cost p. If the firm does not invest in the project it can alternatively invest its own capital E in risk free assets; the cashflow from the risk free assets cannot be seized by outstanding creditors. Although ad hoc, this assumption is meant to represent the standard situation of debt overhang where a firm can (be forced to) pay back its own debt only if it invests in new (profitable) projects. The payoff for the bank making the (new) loan are unchanged

compared to the benchmark model (Table 6).

	$Coord.success$	$Coord.failure$
Banks		
$Credit$	$(1+r+m)-(1+r+\rho)k$	0
$Gov\ Bonds$	$1+r$	$1+r$
Firms		
$Invest$	$(1+R)-(1+r+m)(1-E)-d$	$-p$
$Not\ Invest$	$(1+r)E-p$	$(1+r)E-p$

(6)

Proposition 4 *For any $\sigma > 0$, the model with debt and exogenous margin m admits a unique equilibrium. Let $m^* \equiv R - r + p - d + kE(1+r+\rho)$.*
When $m = m^*$ credit market clears and the equilibrium thresholds are

$$\theta^* = b - aK + aK\{\pi^*\}$$

$$x_B^* = x_F^* = x^* = \theta^* + \sigma\Phi^{-1}(\pi^*)$$

where $\tilde{\pi}^* = \pi_B(m^*) = \tilde{\pi}_F(m^*) = \frac{1+r}{1+R+p-d-k(1+r+\rho)(1-E)}$.
When $m < m^*$ credit supply is scarce and the equilibrium thresholds are

$$\begin{aligned} \theta^* &= b - aK + aK\{\pi_B(m)\} \\ x_B^* &= \theta^* + \sigma\Phi^{-1}(\pi_B(m)) \\ x_F^* &= \theta^* + \sigma\Phi^{-1}(\tilde{\pi}_F(m)) \end{aligned}$$

where $\pi_B(m) = \frac{1+r}{(1+r+m)-(1+r+\rho)k} > \tilde{\pi}^* > \tilde{\pi}_F(m)$.
When $m > m^*$ credit demand is scarce and the equilibrium thresholds are

$$\begin{aligned} \theta^* &= b - aK + aK\{\tilde{\pi}_F(m)\} \\ x_B^* &= \theta^* + \sigma\Phi^{-1}(\pi_B(m)) \\ x_F^* &= \theta^* + \sigma\Phi^{-1}(\tilde{\pi}_F(m)) \end{aligned}$$

where $\tilde{\pi}_F(m) = \frac{(1+r)E}{(1+R)-(1+r+m)(1-E)-d+p} > \tilde{\pi}^* > \pi_B(m)$. In the limit as $\sigma \to 0$, the signal thresholds x_B^* and x_F^* converge to the fundamental threshold θ^*, $\forall m$.

$$\begin{aligned} x_B^* &\to \theta^* \\ x_F^* &\to \theta^* \end{aligned}$$

The main finding is that debt increases the size of the inefficiency in a scarce demand regime but does not affect the scarce supply regime inefficiency. We interpret this extension of the model as showing how debt-overhang episodes may arise via coordination failure on the demand side and not merely on the creditors side, as in standard corporate finance set up. It can easily be shown that the expected debt repayment in each regime as the product of the probability of success and the debt coupon d. In the first regime with scarce supply, the expected debt repayment is increasing in d while in the second regime it is non monotonic in d.

5 Empirical Evidence

In this Section we provide empirical evidence on the relevance of the strategic interactions at the basis of our theoretical model. Although the exercises conducted have no structural interpretation and can therefore provide only reduced form evidence, they represent a first attempt to empirically assess the presence of such strategic complementarities in lending markets. The findings suggest that indeed such mechanisms are potentially important, both in a statistical and economic sense.

Before doing so, it is important to recall the main testable model's predictions. First, the model shows that the presence of complementarities in the productive sector generates interdependences in banks' lending policies. If a bank expects other banks to tighten lending standards, making credit less accessible to other firms with negative spillover on the probability of success of its own perspective borrowers, then everything else equal it should be induced to tighten its own credit policies. This prediction is not specific to our model as it is also an implication of Bebchuk and Goldstein (2011) contribution. The second testable prediction is that if a bank expects credit demand to be low, then everything else equal it will be less willing to extend credit even to firms asking for credit. The reasoning is similar to that outlined for the first prediction. If a bank expects aggregate investment to be low, this will increase the risk on its own perspective borrowers because the probability of coordination success diminishes. In the end it does not really matter whether aggregate investment is low because other banks are tightening their lending policies or because their borrowers are demanding less credit.[14] Following a similar line of reasoning we formulate a third empirical prediction to be tested according to which also firms do not ask for credit if they expect other firms will not invest. This could be considered the main assumption of the model rather than a prediction; arguably, grasping its quantitative relevance is all the more crucial. A final and fourth testable implication is that credit demand depends on lending standards: if a firm expects tight credit policies it also expects low aggregate investment activities.

One potential difficulty in carrying out these tests is related to the need to identify the set of firms whose investments are strategic complements to those of the bank's own potential borrowers as well as the corresponding lenders. This is challenging because, as mentioned, there are in principle several channels creating interdependencies among firms, each one entailing a different set of firms related via strategic complementarity (suppliers, customer firms, employers of customers etc.). In what follows, also due to the type of data utilized, we will

[14] Interestingly, a similar mechanism is outlined in the analysis by Giannetti and Saidi (2017) who show that "lenders with a larger share of the loans outstanding in an industry are more likely to provide credit to industries in distress with less redeployable assets, in which fire sales are more likely to ensue." Their notion implicitly points to the presence of negative spillover of a firm's distress on the other firms of the same sector due to fire sales depressing the value of firms' assets and therefore their capitalisation and collateral availability. Their evidence suggests that a bank with a large exposure to such sector is more inclined to internalise these spillovers and keep lending to firms in case of distress.

adopt a broad perspective and assume that such interactions can be detected with the average firm operating in the economy (and the average bank exposed to it). So, for example, we will check if the lending standards of a bank are influenced by the lending standards of the other banks in the economy, which amount to assume that all other firms in the economy present, on average, some degree of complementarity with those borrowing from the bank under consideration. This broad perspective neglects more specific relations engendering possible complementarities: our estimates can therefore be considered as providing a lower bound of the relevance of strategic interdependencies.

The data utilized are the replies of individual banks participating to the euro area Bank Lending Survey (BLS). Data are available for the Italian component of the BLS sample, an unbalanced panel of all major Italian intermediaries, representing on average about two thirds of national outstanding total credit (this makes a total of 11 banks, including those not anymore in the sample). The BLS is conducted quarterly by the Eurosystem since 2003 and aims at measuring changes in lending policies and in credit demand conditions by directly surveying banks. The replies to the questionnaire provide, for each bank in each quarter, qualitative indicators of whether credit standards have been tightened and of the factors leading to such change, as well as indicators of whether credit demand has changed and which components. Del Giovane et al. (2011) shows that BLS credit supply and demand indicators can explain a large part of credit dynamics[15].

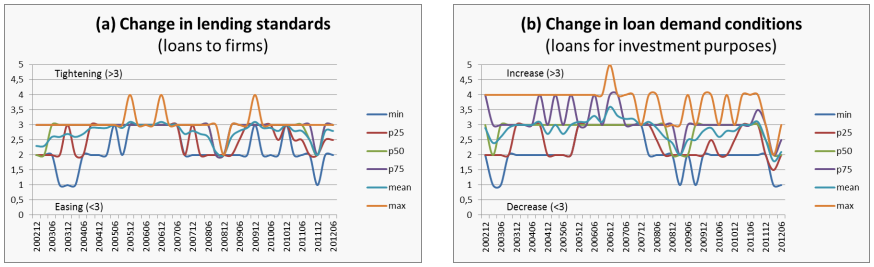

Fig. 3 Bank Lending Survey indicators of credit demand and supply in Italy[16]

Given the focus of our theoretical paper on strategic complementarities among different firms' investment projects, we will be focusing on the lending standards applied to loans to non-financial corporations and on the indicators of credit demand for investment purposes. As one can see from Figure 3, banks reported more restrictive lending standards during the first years of the survey. Lending policies were reported to be somewhat eased prior to the financial crisis in 2006 and then entered a new and prolonged tightening cycle since 2008, only

[15] The questionnaire and all the other details about the survey are available at https://www.ecb.europa.eu/stats/ecb_surveys/bank_lending_survey/html/index.en.html.

[16] Source: Banca d'Italia. Note: both charts report the replies to the corresponding question given by each Italian bank participating to the survey. In panel (a)/(b), respectively: 1= tightened/diminished considerably; 2= tightened/diminished moderatly; 3= unchanged; 4= eased/increased moderatly; 5=eased/increased considerably.

partially interrupted in 2010, before the Italian economy was directly involved in the euro area sovereign debt crisis. One thing worth noting is that banks almost only reported either unchanged lending standards (in 72% of the cases) or moderately tighter ones (26%). This simplifies our analysis as it allows us to analyze credit supply by looking at a dummy denoting (any) tightening, without a significant loss of information[17]. The same does not hold for the credit demand indicator (panel (b)) which takes all five possible values and, more importantly, indicates both expansion and contraction episodes. Demand indicators fluctuate more visibly, reflecting credit acceleration in the pre-crisis years, the abrupt slowdown occurred with the global financial crisis and the stagnation thereafter.

The results of the regressions estimated to test the first and second empirical predictions are depicted in Table 1. The dependent variable is the dummy $Tightening(i,t)$, equal to 1 if bank i reports in quarter t a tightening in lending standards and 0 otherwise. The explanatory variables of interest are two. One is *Loan supply*$(-i,t-1)$, other banks' average credit policy indicators (namely the weighted average across all banks different from i of the indicator depicted in Fig. 3a, taken with a one quarter lag[18]). The second variable of interest is the indicator of demand conditions for the firms other than bank i borrowers, *Loan demand*$(-i,t-1)$. Given the dichotomic nature of the variable of interest, we proceed by estimating logit models. We test the robustness of the results to the adoption of alternative models, including probit and linear probability models. All regressions displayed in the following tables shows robust standards errors clustered at the bank-level.[19]

[17] The fact that in our sample banks only report unchanged or tightened credit policies may suggests the possible presence of a bias in banks' reporting behaviour, making them reluctant to indicate an easing of credit standards. In other words, it could be that the series reported is a downward shift of the one banks would report without such reporting bias. This is common to other similar surveys, such as those run by the FED and the Bank of England. More importantly, this is not a concern for us, as in a regression framework we are not concerned about the average level of the variable, but merely on its variation over time and across banks.

[18] A perfect correspondence between the theoretical model and the empirical analysis is not possible. The model is static and so by definition the interdependence occurs across contemporaneous lending policies. However, in real life lending policies are sluggish (in the sample each bank adjusts them about once a year on average). This means that banks can, with some lag, directly observe what competitors are doing and react accordingly. These considerations seem to advocate for the use in the regressions of other banks' lending standards with a (quarter) lag. If we used instead the contemporaneous indicator *Loan supply*$(-i,t)$ the main findings would be confirmed but the statistical significance would be somewhat weaker (not shown).

[19] The fact that the demand indicator utilised is derived from a survey of banks is not a limitation but instead it represents one of the advantages of using such data. Indeed, the demand indicators relevant when testing the impact on credit policies of strategic interdependence are those perceived by banks. By the same token, it would be more appropriate to utilise data derived from firm surveys when assessing the impact of strategic interdependence on loan demand. We leave this to future research.

Table 1

Dependent variable: Tightening(i,t)	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Loan supply(-i,t-1)	-1.813***		-1.727***	-2.125***	-1.340**	-1.576**	-1.672**
	(0.285)		(0.310)	(0.485)	(0.544)	(0.764)	(0.705)
Loan demand(-i,t-1)		-0.738**	-0.302	-0.0959	0.360	0.303	0.516
		(0.373)	(0.452)	(0.693)	(0.712)	(0.790)	(1.085)
Balance sheet constraints(i,t)					-2.087***	-1.543*	-1.322
					(0.667)	(0.806)	(0.974)
Risk(i,t)					-0.853**	-1.192***	-1.630***
					(0.424)	(0.427)	(0.483)
Constant	3.901***	1.149	4.561***	4.128*	0.127	0.853	-46.28***
	(0.606)	(1.143)	(1.205)	(2.416)	(2.704)	(4.290)	(10.92)
Observations	276	276	276	260	260	250	250
Bank FE	NO	NO	NO	YES	YES	YES	YES
MACRO controls	NO	NO	NO	NO	NO	YES	YES
Bank B.S. indicators	NO	NO	NO	NO	NO	NO	YES

Robust standard errors in parentheses, clustered at bank level. *** p<0.01, ** p<0.05, * p<0.1
Loan supply(-i,t-1) is the indicator for the change in lending standards, taking values from 1 (strong tightening) to 5 (strong easing) in quarter t-1. Average across all banks in the sample other than bank i, weighted by outstanding amount of total loans. Loan demand(-i,t-1) is the indicator for the change in investment component of loan demand, taking values from 1 (strong reduction) to 5 (strong increase) in quarter t-1. Average across all banks in the sample other than bank i, weighted by outstanding amount of total loans. Macro controls: growth rate of country-specific nominal GDP; change in EONIA; change in the yields paid by domestic 10-year governement bonds. Bank balance sheet indicators: log of total main assets, ratio of non-performing loans to total loans, total capital ratio, funding gap (share of loans not financed by retail deposits). See Table A1 for details on the variables definition.

Given the definition of the variables involved, a negative coefficient for *Loan supply*$(-i, t-1)$ is consistent with hypothesis of intra-group strategic complementarity among banks in lending standards (first prediction), which is the case based on the results shown in column (1) where *Loan supply*$(-i, t-1)$ is the unique explanatory variable considered. Column 2 shows the basic regressions testing the second empirical prediction outlined above. The probability of tightening is now regressed on the indicator of demand conditions for the firms other than bank i borrowers, *Loan demand*$(-i, t-1)$. The expected coefficient sign is again negative (bank i should be less likely to tighten credit standards with a stronger loan demand by firms other than its borrowers), which seems to be the case based on such estimation. However, by just considering the two regressors together, *Loan supply*$(-i, t-1)$ and *Loan demand*$(-i, t-1)$, we can see that only the coefficient of the former survives (column 3). So far the evidence does not support the presence of strategic interdependence from firms to banks while it is consistent with the presence of interdependence across banks. We now conduct some robustness checks of the latter result.

One obvious remark is that lending policies across banks may comove not in relation to strategic interdependence but instead because of the presence of common underlying factors influencing the credit supply of all banks. We tackle this issues by introducing a number of controls that should reasonably capture all factors relevant for their lending policies, other than strategic complementarities.[20] First, we add a set of bank fixed-effects (column 4), controlling for

[20] In our framework the introduction of time fixed effects in order to account for the presence of common underlying factors is not a viable option because these intercepts would be

the effect of all possible observable and unobservable time invariant (structural) bank features. We then enhance the set of controls by including the factors behind the change in lending standards as reported by each bank (column 5). These relate to the effect on lending policies of changes in the perception of credit risk as well as in banks' balance-sheet conditions (capital and liquidity position). In the absence of strategic interdependence, such factors should account for all the variation in lending policies. As the BLS replies may contain some noise, we further enrich the controls capturing credit risk and banks balance sheet constraints by adding macro controls (growth rate of country-specific nominal GDP, change in EONIA; change in the yields paid by domestic 10-year government bonds over the corresponding quarter) and a set of individual bank balance sheet indicators (log of total main assets, ratio of non-performing loans to total loans, total capital ratio, funding gap, defined as the share of loans not financed by retail deposits). The results are shown, respectively, in column 6 and 7. In all these specifications the coefficient for *Loan supply*$(-i, t-1)$ remains negative and statistically significant. The magnitude of this effect is also economically remarkable. Considering the specification of Table 1-column 5, the marginal effect corresponding to the regression coefficient of *Loan supply*$(-i, t-1)$ amounts to -0.21. A change in *Loan supply*$(-i, t-1)$ equal to its standard deviation (0.29) should then be expected to bring about a change in the the same direction of the probability of tightening equal to .07, corresponding to 26% of the dependent variable's sample average (.27), 16% of its standard deviation (0.44).

Table 2 shows the findings for the third and fourth empirical predictions, by looking at whether the indicator of the investment component of credit demand perceived by bank i is influenced by the corresponding figure reported, on average, by other lenders, *Loan demand*$(-i, t-1)$, as well as by *Loan supply*$(-i, t-1)$. As the dependent variable is categorical we estimate a multinomial logit and show the result for the two cases where bank i reports either an increase in loan demand (for investment purposes) or a reduction. Both cases are therefore compared with the baseline outcome of unchanged loan demand. As shown in panel 1 of Table 2, everything else equal, the probability of a bank reporting a decline in loan demand is smaller when other banks report stronger demand from their borrowers or easier credit conditions, although the statistical significance of the latter coefficient turns out to be just borderline (p-value 0.12). Symmetrically, the probability of a bank reporting an increase in loan demand is larger when other banks report easier credit conditions or stronger demand from their borrowers, although in this case none of the two coefficients turns out to be statistically significant (the p-value for Loan supply(-i) is again borderline, 0.11).

consistent estimates of the mean of the BLS indicator. This implies that all the indicators of the credit supply tighteness would be expressed relatively to the average. A relatively tighter lending policy is, by definition, associated with an average relatively easier lending policy for other banks; the introduction of time fixed-effects would therefore meccanically generate a positive coefficient for Loan supply(-i). This issue resonates the popular "reflection problem" put forward in the seminal paper by Mansky (1993).

Table 2

Dependent variable:	(1)		(2)	
prob (loan demand= down/up)	down	up	down	up
Loan supply(-i,t-1)	-1.293	2.875	-2.424***	2.129*
	(0.839)	(1.858)	(0.783)	(1.168)
Loan demand(-i,t-1)	-1.849***	0.0491	-1.823***	-0.111
	(0.584)	(1.509)	(0.491)	(1.000)
Constant	7.427**	-9.724	10.57***	-7.319
	(3.034)	(6.628)	(2.221)	(4.757)
Observations	265	265	276	276
Bank FE	YES	YES	YES	YES
MACRO controls	YES	YES	NO	NO

Robust standard errors in parentheses, clustered at bank level. *** p<0.01, ** p<0.05, * p<0.1
Loan supply(-i,t-1) is the indicator for the change in lending standards, taking values from 1 (strong tightening) to 5 (strong easing) in quarter t-1. Average across all banks in the sample other than bank i, weighted by outstanding amount of total loans. Loan demand(-i,t-1) is the indicator for the change in investment component of loan demand, taking values from 1 (strong reduction) to 5 (strong increase) in quarter t-1. Average across all banks in the sample other than bank i, weighted by outstanding amount of total loans. Macro controls: growth rate of country-specific nominal GDP; change in EONIA; change in the yields paid by domestic 10-year governement bonds. Bank balance sheet indicators: log of total main assets, ratio of non-performing loans to total loans, total capital ratio, funding gap (share of loans not financed by retail deposits). See Table A1 for details on the variables definition.

The controls utilized in this specification include bank fixed-effects and the set of macroeconomic controls. While potentially useful as additional controls of the determinants of loan demand fluctuations unrelated to strategic interdependence, it is not possible to include BLS controls for the factors underlying the reported changes in loan demand for investment purposes, as there is no such thing in the questionnaire. It is not clear whether it is appropriate to include bank balance-sheet conditions as controls, but their inclusion turns out to be immaterial for all main findings (not shown). It is also not clear whether one should control for macroeconomic indicators, as these may absorb part of the effects the main regressors are meant to capture. This is why we also show in panel 2 the results of a regression similar to the previous one but without such controls. In this specification Loan supply(-i) is statistically significant and with the expected sign.

To be conservative, we assess the magnitude of these mechanisms by looking only at panel 1 of Table 3. In the equation for the probability of a contraction of loan demand, the marginal effects turns out to be equal to -0.21* for *Loan supply*$(-i, t-1)$ and -0.25*** for *Loan demand*$(-i, t-1)$. Everything else given, a change in *Loan supply*$(-i, t-1)$ equal to its standard deviation (0.29) should be expected to be associated to a change in the probability of a loan demand contraction equal to 0.06, corresponding to 13% of the standard deviation of the dependent variable. A change in *Loan demand*$(-i, t-1)$ equal to its standard deviation (0.41) should be expected to be associated to a change in the probability of a loan demand contraction equal to 0.10, almost a fourth of the standard deviation of the dependent variable.

In the equation for the probability of an expansion of loan demand, the marginal effects of *Loan supply*$(-i, t-1)$ turns out to be equal to -0.20*. A change of this explanatory variable equal to its standard deviation (0.21) should

be expected to be associated to a change in the probability of a loan demand expansion equal to 0.04, corresponding to 10% of the standard deviation of the dependent variable.

Overall, the reduced form evidence presented above provides three main messages. First, the effects of the interdependence in explaining loan demand fluctuations is pronounced when modelling the probability of a contraction in loan demand, rather than the probability of an expansion (summing up the two effects, interdependencies seem to explain almost 40% of the variation of loan demand during downturns, while just 10% in expansions). This suggests that coordination motives could be an explanation of why aggregate demand conditions can rapidly deteriorate but, once in a recession, they may get out of it at a much slower pace. This asymmetry is more importantly due to the role of complementarities across firms ($Loan\ demand(-i, t-1)$); inter-group complementaries (the effect of $Loan\ supply(-i, t-1)$ on $Loan\ demand(-i, t-1)$) play a smaller role both in expansionary and contracting episodes. Second, complementarities are more relevant in explaining fluctuations of loan demand rather than loan supply (interdependencies are estimated to explain 16% of the variation in loan supply; it is not possible to provide a distinction between booms and busts as the sample only includes tightening episodes). In this case, the effects are fully explained by bank intra-group complementarities, as the effect of $Loan\ demand(-i, t-1)$ on loan supply is not significant. Third, during upturns loan demand is significantly boosted by favorable lending conditions as a consequence of a strong inter-group interdependence.

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Appendix

Proposition (1)

In equilibrium, given the threshold θ^*, the signal thresholds x_B^* and x_F^* are such that banks' and firms' indifference conditions are satisfied.

$$\begin{aligned} &\textit{Banks' indifference condition} \quad : && (1)\\ &\Pr\left(\theta \geq \theta^* \mid x_i\right) = \pi_B \equiv \frac{1+r}{(1+r+m)-(1+r+\rho)\,k} \\ &\textit{Firms' indifference condition} \quad : && (2)\\ &\Pr\left(\theta \geq \theta^* \mid x_i\right) = \pi_F \equiv \frac{(1+r)\,E}{(1+R)-(1+r+m)\,(1-E)} \end{aligned}$$

Also, given the signal thresholds x_B^* and x_F^*, the fundamental threshold θ^* satisfies the regime change condition

$$\textit{Regime change condition}\text{: } a\min\left\{L^S, L^D\right\} + \theta = b \tag{3}$$

Note that:

$$\begin{aligned} \Pr\left(\theta \geq \theta^* \mid x_i\right) &= \Pr\left(x_i - \sigma\varepsilon_i \geq \theta^*\right) = \Pr\left(x_i - \theta^* \geq \sigma\varepsilon_i\right) = \Phi\left(\frac{x_i - \theta^*}{\sigma}\right) \\ L^S\left(x_B^*, \theta\right) &= K\Pr\left(x_i \geq x_B^*\right) = K\Pr\left(\theta + \sigma\varepsilon_i \geq x_B^*\right) = K\left[1 - \Phi\left(\frac{x_B^* - \theta}{\sigma}\right)\right] \\ L^D\left(x_F^*, \theta\right) &= K\Pr\left(x_i \geq x_F^*\right) = K\Pr\left(\theta + \sigma\varepsilon_i \geq x_F^*\right) = K\left[1 - \Phi\left(\frac{x_F^* - \theta}{\sigma}\right)\right] \end{aligned}$$

Hence (1)-(3) can be written as follows

$$\begin{aligned} \Phi\left(\frac{x_B^* - \theta^*}{\sigma}\right) &= \pi_B \to x_B^* = \theta^* + \sigma\Phi^{-1}\left(\frac{1+r}{(1+r+m)-(1+r+\rho)\,k}\right) \\ \Phi\left(\frac{x_F^* - \theta^*}{\sigma}\right) &= \pi_F \to x_F^* = \theta^* + \sigma\Phi^{-1}\left(\frac{(1+r)\,E}{(1+R)-(1+r+m)\,(1-E)}\right) \end{aligned}$$

$$a\min\left\{\left[1 - \Phi\left(\frac{x_B^* - \theta^*}{\sigma}\right)\right]K, \left[1 - \Phi\left(\frac{x_F^* - \theta^*}{\sigma}\right)\right]K\right\} + \theta^* = b$$

We look for a solution $\{x_B^*, x_F^*, \theta^*\}$ to the system of equations (1)-(3). Since $\pi_F(m)$ is increasing in m and $\pi_B(m)$ is decreasing in m, we have $\pi_B(m) = \pi_F(m)$ when $m = m^* = R - r + Ek(1+r+\rho)$. Hence

$$\begin{aligned} m &= m^* \to x_B^* = x_F^* = x^* \to L^S\left(x^*, \theta\right) = L^D\left(x^*, \theta\right), \forall\theta \\ m &< m^* \to x_B^* > x_F^* \to L^S\left(x_B^*, \theta\right) < L^D\left(x_F^*, \theta\right), \forall\theta \\ m &> m^* \to x_B^* < x_F^* \to L^S\left(x_B^*, \theta\right) > L^D\left(x_F^*, \theta\right), \forall\theta \end{aligned}$$

Also

$$\begin{aligned} m &= m^* \to \pi_B(m^*) = \pi_F(m^*) = \pi^* \\ m &< m^* \to \pi_B(m) > \pi > \pi_F(m) \\ m &> m^* \to \pi_F(m) > \pi > \pi_B(m) \end{aligned}$$

where $\pi^* = \frac{1+r}{1+R-k(1+r+\rho)(1-E)}$. When $m = m^*$ the system (1)-(3) becomes

$$\Phi\left(\frac{x^* - \theta^*}{\sigma}\right) = \pi^* \to x^* = \theta^* + \sigma\Phi^{-1}(\pi^*)$$

$$\theta^* = b - aK\left[1 - \Phi\left(\frac{x^* - \theta^*}{\sigma}\right)\right]$$

and we can pin down the two equilibrium thresholds $\{x^*, \theta^*\}$

$$\begin{aligned} \theta^* &= b - aK + aK\{\pi^*\} \\ x^* &= \theta^* + \sigma\Phi^{-1}(\pi^*) \end{aligned}$$

When $m < m^*$ the system (1)-(3) becomes

$$\begin{aligned} x_B^* &= \theta^* + \sigma\Phi^{-1}\left(\frac{1+r}{(1+r+m) - (1+r+\rho)k}\right) \\ x_F^* &= \theta^* + \sigma\Phi^{-1}\left(\frac{(1+r)E}{(1+R) - (1+r+m)(1-E)}\right) \\ \theta^* &= b - aK\left[1 - \Phi\left(\frac{x_B^* - \theta^*}{\sigma}\right)\right] \end{aligned}$$

and we can pin down the three equilibrium thresholds $\{x_B^*, x_F^*, \theta^*\}$ substituting x_B^* into the regime change condition, we have

$$\begin{aligned} \theta^* &= b - aK + aK\{\pi_B(m)\} \\ x_B^* &= \theta^* + \sigma\Phi^{-1}(\pi_B(m)) \\ x_F^* &= \theta^* + \sigma\Phi^{-1}(\pi_F(m)) \end{aligned}$$

When $m > m^*$ the system (1)-(3) becomes

$$\begin{aligned} x_B^* &= \theta^* + \sigma\Phi^{-1}\left(\frac{1+r}{(1+r+m) - (1+r+\rho)k}\right) \\ x_F^* &= \theta^* + \sigma\Phi^{-1}\left(\frac{(1+r)E}{(1+R) - (1+r+m)(1-E)}\right) \\ \theta^* &= b - aK\left[1 - \Phi\left(\frac{x_F^* - \theta^*}{\sigma}\right)\right] \end{aligned}$$

and we can pin down the three equilibrium thresholds $\{x_B^*, x_F^*, \theta^*\}$ substituting x_F^* into the regime change condition

$$\begin{aligned} \theta^* &= b - aK + aK\{\pi_F(m)\} \\ x_B^* &= \theta^* + \sigma\Phi^{-1}(\pi_B(m)) \\ x_F^* &= \theta^* + \sigma\Phi^{-1}(\pi_F(m)) \end{aligned}$$

Proposition (2)
The incentive compatibility constraint for firms is

$$(1+R) - (1+r+m)(1-E) \geq B_F$$

The incentive compatibility constraint for banks is

$$(1+r+m) - (1+r+\rho)k \geq B_B$$

The two incentive compatibility constraints define a region for the admissible values of m

$$B_B + (1+r+\rho)k - (1+r) \equiv m_B \leq m < m_F \equiv \frac{(1+R) - B_F}{(1-E)} - (1+r)$$

This expression highlights that the margin must be not too small for the banks and not too large for the firms. Since the market clearing margin is equal to

$$m^* = (R-r) + kE(1+r+\rho)$$

If $m^* < m_B$, i.e. $B_B > (1+R) - k(1+r+\rho)(1-E)$, then banks' incentive compatibility impose a scarce demand regime with the equilibrium margin $\tilde{m} = m_B$. If $m^* > m_F$, i.e. $B_F > (1+R) - (1-E)((1+R) + kE(1+r+\rho))$, then firms' incentive compatibility impose a scarce supply regime with the equilibrium margin $\tilde{m} = m_F$. Only in the intermediate range m^* is admissible. The equilibrium thresholds corresponding to each regime (market clearing, scarce supply and scarce demand) are pinned down as in Proposition (1) taking into account which is the corresponding $\tilde{m}$.

Proposition (3)
In equilibrium, given the threshold θ_L^* and θ_H^*, the signal thresholds $x_{F,L}^*$ and $x_{F,H}^*$ are such that firms' indifference conditions are satisfied

Firms indifference condition for country L : (4)

$$\Pr((\theta \geq \theta_L^*) \mid x_i) = \pi_F(m) \equiv \frac{(1+r)E}{(1+R) - (1+r+m)(1-E)}$$

Firms indifference condition for country G : (5)

$$\Pr((\theta \geq \theta_H^*) \mid x_i) = \pi_F(m) \equiv \frac{(1+r)E}{(1+R) - (1+r+m)(1-E)}$$

Also banks' indifference condition must be satisfied given the threshold θ_L^* and θ_H^*

$$\begin{aligned} &\textit{Banks indifference condition} \quad : \\ &\Pr\left((\theta \geq \theta_L^*) \mid x_i\right) \quad = \quad \Pr\left((\theta \geq \theta_L^*) \mid x_i\right) \end{aligned} \tag{6}$$

Furthermore, given the signal thresholds $x_{F,L}^*$ and $x_{F,H}^*$ and the banks' equilibrium strategy, the fundamental threshold θ_L^* and θ_H^* must satisfy the regime change conditions

$$a \min\left\{L_L^S, L_L^D\right\} + \theta_L^* \quad > \quad b_L \tag{7}$$

$$a \min\left\{L_H^S, L_H^D\right\} + \theta_H^* \quad > \quad b_H \tag{8}$$

Note that

$$\Pr\left((\theta \geq \theta_L^*) \mid x_i\right) = \Pr\left(x_i - \sigma\varepsilon_i \geq \theta_L^*\right) = \Pr\left(x_i - \theta_L^* \geq \sigma\varepsilon_i\right) = \Phi\left(\frac{x_i - \theta_L^*}{\sigma}\right)$$

$$\Pr\left((\theta \geq \theta_H^*) \mid x_i\right) = \Pr\left(x_i - \sigma\varepsilon_i \geq \theta_H^*\right) = \Pr\left(x_i - \theta_H^* \geq \sigma\varepsilon_i\right) = \Phi\left(\frac{x_i - \theta_H^*}{\sigma}\right)$$

$$L_L^D = K \Pr\left(x_i \geq x_{F,L}^*\right) = K \Pr\left(\theta + \sigma\varepsilon_i \geq x_{F,L}^*\right) = K\left[1 - \Phi\left(\frac{x_{F,L}^* - \theta}{\sigma}\right)\right]$$

$$L_H^D = K \Pr\left(x_i \geq x_{F,H}^*\right) = K \Pr\left(\theta + \sigma\varepsilon_i \geq x_{F,H}^*\right) = K\left[1 - \Phi\left(\frac{x_{F,H}^* - \theta}{\sigma}\right)\right]$$

From banks' indifference condition $\Phi\left(\frac{x_i - \theta_L^*}{\sigma}\right) = \Phi\left(\frac{x_i - \theta_H^*}{\sigma}\right)$ we can see that

$$\begin{aligned} &\text{if } \theta_L^* \quad > \quad \theta_H^* \quad \rightarrow \forall x_i \text{ banks invest in country } H \rightarrow L_L^S = 0 \text{ and } L_H^S = K \\ &\text{if } \theta_L^* \quad < \quad \theta_H^* \quad \rightarrow \forall x_i \text{ banks invest in country } L \rightarrow L_L^S = K \text{ and } L_H^S = 0 \end{aligned}$$

Hence (4)-(5) and (7)-(8) can be written as follows

$$\begin{aligned} \Phi\left(\frac{x_{F,L}^* - \theta_L^*}{\sigma}\right) \quad &= \quad \pi_F(m) \rightarrow x_{F,L}^* = \theta_L^* + \sigma\Phi^{-1}(\pi_F) \\ \Phi\left(\frac{x_{F,H}^* - \theta_H^*}{\sigma}\right) \quad &= \quad \pi_F(m) \rightarrow x_{F,H}^* = \theta_H^* + \sigma\Phi^{-1}(\pi_F) \end{aligned}$$

$$\begin{aligned} a \min\left\{L_L^S, L_L^D\right\} + \theta_L^* \quad &> \quad b_L \\ a \min\left\{L_H^S, L_H^D\right\} + \theta_H^* \quad &> \quad b_H \end{aligned}$$

Now assume $\theta_L^* > \theta_H^* \rightarrow L_L^S = 0$, the regime change condition in country L becomes

$$a \min\left\{0, \left[1 - \Phi\left(\frac{x_{F,L}^* - \theta_L^*}{\sigma}\right)\right] K\right\} + \theta_L^* = b_L$$

and it is satisfied for $\theta_L^* = b_L > b_H$. The regime change condition in country H becomes

$$a \min\left\{K, \left[1 - \Phi\left(\frac{x_{F,H}^* - \theta_H^*}{\sigma}\right)\right] K\right\} + \theta_H^* = b_H$$

and it is satisfied for

$$\theta_H^* = b_H - aK\left[1 - \Phi\left(\frac{x_{F,H}^* - \theta_H^*}{\sigma}\right)\right]$$

substituting for $x_{F,H}^*$ we get $\theta_H^* = b_H - aK\left[1 - \pi_F(m)\right]$. Since b_L by assumption is greater than b_H our hypothesis $\theta_L^* > \theta_H^*$ is fulfilled hence we found the following equilibrium.

$$\begin{aligned} \theta_L^* &= b_L \\ x_{F,L}^* &= \theta_L^* + \sigma\Phi^{-1}\left(\pi_F(m)\right) \\ \theta_H^* &= b_H - aK + aK\left\{\pi_F(m)\right\} \\ x_{F,H}^* &= \theta_H^* + \sigma\Phi^{-1}\left(\pi_F(m)\right) \end{aligned}$$

Now assume $\theta_L^* < \theta_H^* \rightarrow L_H^S = 0$, the regime change condition in country H becomes

$$a \min\left\{0, \left[1 - \Phi\left(\frac{x_{F,H}^* - \theta_H^*}{\sigma}\right)\right] K\right\} + \theta_H^* = b_H$$

and it is satisfied for $\theta_H^* = b_H < b_L$. The regime change condition in country L becomes

$$a \min\left\{K, \left[1 - \Phi\left(\frac{x_{F,L}^* - \theta_L^*}{\sigma}\right)\right] K\right\} + \theta_L^* = b_L$$

and it is satisfied for

$$\theta_L^* = b_L - aK\left[1 - \Phi\left(\frac{x_{F,L}^* - \theta_L^*}{\sigma}\right)\right]$$

substituting for $x_{F,L}^*$ we get $\theta_L^* = b_L - aK\left[1 - \pi_F(m)\right]$. Our hypothesis $\theta_L^* < \theta_H^*$ is fulfilled if $b_L - b_H < aK\left[1 - \pi_F\right]$. Hence under this restriction we found the following equilibrium.

$$\begin{aligned} \theta_H^* &= b_H \\ x_{F,H}^* &= \theta_H^* + \sigma\Phi^{-1}\left(\pi_F(m)\right) \\ \theta_L^* &= b_L - aK + aK\left\{\pi_F(m)\right\} \\ x_{F,L}^* &= \theta_L^* + \sigma\Phi^{-1}\left(\pi_F(m)\right) \end{aligned}$$

Proposition (4)

The equilibrium of this model is pinned down following the same steps of the benchmark model in Proposition 1, substituting π_F with $\tilde{\pi}_F(m) = \frac{(1+r)E}{(1+R)-(1+r+m)(1-E)-d+p}$.

Table A1

tightening(i,t)	=1 if bank i indicates in quarter t a moderate or strong tightenig of lending standards applied to loans to firms; 0 otherwise.
loan demand (i,t)	=1 if bank i indicates in quarter t a moderate or strong increase of investment component of credit demand by firms; -1 with a moderate or strong reduction; 0 otherwise.
balance sheet constraints(i,t)	= average of the indicator for the contribution to the change in lending standards stemming from "bank's capital position" and that for "ability to access market financing" (each of them takes value from 1 -contributed to a strong tightening- to 5 - contributed to a strong easing-). The factor "liquidity position" is neglected as virtually always reported unchanged.
risk(i,t)	= average of the indicator for the contribution to the change in lending standards stemming from "expectations regarding general economic activity" and that for "industry or firm-specific outlook" (each of them takes value from 1 -contributed to a strong tightening- to 5 - contributed to a strong easing-). The factor "risk on the collateral demanded" is neglected as virtually always reported unchanged.
bank size(i,t)	= ln(bank i total assets -euro millions-), at the beginning of quarter t
bad debts(i,t)	= bad debts / total loans, for bank i at the beginning of quarter t (%)
capital ratio(i,t)	= total capital / total assets, for bank i at the beginning of quarter t (%)
funding gap(i,t)	= (total loans - total deposits) / total loans, for bank i at the beginning of quarter t (%)
GDP(t)	= growth rate of nominal GDP in Italy in quarter t (%)
change in EONIA(t)	= change in EONIA rate in quarter t (%)
change in 10y GB(t)	= change in 10-year Italian Government bond yields in quarter t (%)

Table A2

	mean	p25	p50	p75	sd	N
tightening(i,t)	0.3	0.0	0.0	1.0	0.4	287
loan demand (i,t)	-0.2	-1.0	0.0	0.0	0.6	287
balance sheet constraints(i,t)	-0.1	0.0	0.0	0.0	0.2	287
risk(i,t)	-0.4	-1.0	0.0	0.0	0.5	287
bank size(i,t)	12.1	11.3	12.1	12.6	0.8	287
bank NPL(i,t)	5.5	3.1	4.6	7.4	3.0	287
capital ratio(i,t)	7.7	6.2	7.7	9.2	1.8	287
funding gap(i,t)	38.7	34.6	38.6	44.2	7.6	287
GDP(t)	0.4	-0.0	0.5	1.1	0.9	287
change in EONIA(t)	-0.1	-0.2	0.0	0.2	0.4	287
change in 10y GB(t)	0.0	-0.2	-0.0	0.2	0.3	287

Source: Banca d'Italia

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