Flight to Quality or to Captivity? Information and Credit Allocation*

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Abstract

This paper analyzes how banks reallocate liquidity across borrowers when exogenous shocks force them to curtail credit. It shows that in addition to a "flight to quality" effect there may be a "flight to captivity effect". The superior nature of the information exchanged over the course of a lending relationship generates a bank-client specificity to the extent that such information cannot be communicated credibly to outsiders. Consequently, banks obtain higher profits from more captured borrowers than from borrowers that have other alternatives for obtaining financing; while, at the same time, they find it more difficult to liquidate captive assets at par. Then, as banks hang on to their most profitable clients during periods of curtailed lending, a negative shock will cause a reallocation of credit away from more transparent borrowers and towards more opaque, more captured borrowers. The paper applies these ideas to the analysis of bank behavior in transition economies and emerging markets after financial liberalization.

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1 Introduction

Asymmetric information makes bank credit special. The superior nature of the information exchanged over the course of a lending relationship generates a bank-client specificity, to the extent that such information cannot be communicated credibly to outsiders. This informational specificity is likely to vary across segments of the market and depends on borrowers' relative ability to signal their quality to outside lenders and banks' ability to gather special information about their clients.

A number of recent papers have examined how the character of the information flows between lenders and borrowers influences the way in which banks compete for clients[1] as well as the market structure of the banking industry.[2] In the present paper, we focus on an aspect largely overlooked in the previous literature. We analyze how informational specificity affects the way banks allocate credit across groups of borrowers.

The analysis of this issue is important for a number of reasons. Bank lending constitutes an important source of funding both for individuals as well as for smaller businesses. Likewise, large businesses make heavy use of bank borrowing as a form of short term financing. As such, the allocation of bank credit can have important real consequences for the economy. In particular, determining how the allocation of credit responds to exogenous shocks to the banking system may help us understand the channels by which the credit view of monetary policy works, and determine the relative impact of such policies across sectors of the economy. In addition, examining this issue may allow us to understand the allocative consequences of financial liberalization and cross-border deregulation policies.

To study this issue, we focus primarily on how borrowers characterized by different degrees of opaqueness are impacted when banks are hit by a negative shock and forced to curtail their lending, or, conversely, when banks are hit by a positive shock and choose to expand their lending. In other words, to the extent that borrower opaqueness generates a specificity that is an important driver of bank profitability, we believe that this might also be an important determinant of banks' credit allocation decisions.

[1] See Sharpe (1990), Rajan (1992), and von Thadden (1998).

[2] Dell'Ariccia, Friedman, and Marquez (1999).

The main finding of this paper is that, when forced to reduce lending, banks will reallocate their portfolio towards more opaque borrowers. This "*flight to captivity*" may coexist with the "*flight to quality*" where banks faced with increased market interest rates tend to reduce lending to lower quality borrowers.[3]

The "*flight to captivity*" effect is the result of a twofold implication of "informational specificity" which up to now has not been analyzed. First, banks should obtain higher profits from more captured (more opaque) borrowers than from borrowers that have other financing alternatives. Second, when faced with liquidity needs, banks should be able to sell more profitably those assets whose value can be more easily evaluated by outsiders (see Figure 1).[4] Consequently, if during periods of curtailed lending banks retain their most profitable clients and are forced to sell their most liquid assets, we should expect to see a relative reallocation of bank credit away from more transparent borrowers and towards more opaque, more captured borrowers. Similarly, if banks find it easier to attract less captive borrowers when expanding credit, we should expect a relative reallocation of bank credit away from more opaque borrowers when banks are hit by a positive shock.[5]

The intuition for this result is simple. A borrower's demand for credit from its inside bank is a function of that borrower's other financing possibilities, such as ease of access to public debt markets or to financing by other banks. Easier access to alternative forms of financing should translate directly into a more elastic demand curve for bank credit, as one would expect borrowers with other sources of financing to be more sensitive to increases in interest rates charged by their inside banks. Our argument is that access to credit should correlate with the amount of public information available about a borrower, so that creditworthy but more informationally opaque borrowers should have a less elastic demand curve for bank credit. Therefore, a bank forced to curtail lending will cut credit relatively more to those borrowers with the more elastic demand (the less opaque borrowers) and retain a greater fraction of the more opaque (higher margin) borrowers. In

[3]A large literature has examined this phenomenon. See, for example, Asea and Blomberg (1998), Lang and Nakamura (1995), or Bernanke, Gertler, and Gilchrist (1996) and the references therein.

[4]The variable on the axis refer to the model in the next section.

[5]In the case of a positive shock, the result is that the proportional expansion of bank credit will be greater in markets with more transparent borrowers, not that lending to opaque borrowers will be curtailed in order to lend to transparent borrowers.

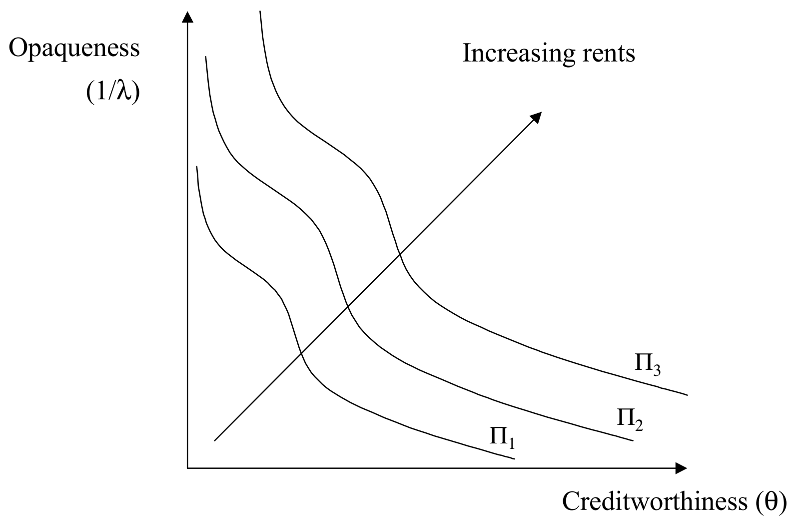

Figure 1: Two dimensions to loan profitability.

this paper we present two models of banking competition under asymmetric information that deliver this prediction.

We first build a model where a monopolist bank with an informational advantage competes with an entrant with a cost advantage, and examine how credit allocation reacts to changes in the relative cost of funds for the two banks. We apply this framework to the analysis of financial liberalizations such as those that have occurred recently in emerging markets and transition economies.

In that context, the model has strong predictions on which groups of borrowers will be retained by local banks and which groups will switch to the new entrants. The situation we have in mind is one where, relative to local banks, foreign banks enjoy the advantage of a lower cost of funding, while they suffer the disadvantage of having inferior information about local borrowers. Foreign banks will then be more effective at competing away from local banks the borrowers for whom the informational disadvantage is smaller, i.e., the borrowers that can effectively signal their quality to outside lenders (the less opaque borrowers). Conversely, local banks will retain a larger market share in segments where borrower quality is more opaque to external lenders.

In the second model, an informed bank with limited lending capacity competes with an uninformed arm's-length lender with unlimited capacity. There we examine how credit allocation reacts to changes in the lending capacity of the bank. In the spirit of the "lending view," we apply this framework to analyze how credit allocation responds to monetary policy innovations.[6]

In that context, our results can be compared to those of the "*fight to quality*" literature, which argues that creditors will optimally shift funds away from "high agency cost" borrowers during periods of recessions or when borrowers' balance sheets deteriorate. These models argue that moral hazard considerations create a link between borrowers' net worth and their ability to obtain financing, so that anything that affects a borrower's net worth should also affect its access to credit. When agency costs of lending increase, lenders will reduce the amount of credit to firms requiring monitoring and shift funds towards safer alternatives.

In our framework, "*flight to quality*" and "*flight to captivity*" coexist. When a bank is hit by a negative shock (e.g., an increase in its cost of funding, or a reduction of its lending capacity relative to that of alternative sources of credit for its borrowers), it does reduce lending to lower quality borrowers (which can be interpreted as a form of *flight to quality*). At the same time, this reduction is more pronounced for market segments where borrowers are less opaque. This latter effect we term the "*flight to captivity*". Hence, these two effects, rather than opposing each other, act simultaneously along different dimensions. Therefore, this paper can be seen as an attempt to complement and expand the above-cited literature.

The paper proceeds as follows. Section 2 presents and analyzes the model with price shocks. Section 3 presents and analyzes the model with quantity shocks. Section 4 concludes.

2 A Model of Prices

In this section, we examine how shocks to the cost of funds of individual banks affect their credit allocation decisions. Here, we focus on a situation where

[6] The bank lending channel view of monetary policy holds that not only do monetary contractions reduce the supply of bank loans, but that there are some borrowers for whom nonbank sources of credit are not perfect substitutes for bank loans. Therefore, when tight monetary policy forces a reduction in bank lending, bank-dependent borrowers are affected more than borrowers with alternative sources of financing. See Kashyap, Stein, and Wilcox (1993) for further implications of this view.

an informed monopolist bank faces the competition of an uninformed entrant. We analyze how the monopolist changes the allocation of credit across groups of borrowers characterized by different informational structures in response to changes in the cost of funds for the entrant. A natural application of the model is to the analysis of credit allocation and market structure in the wake of a financial liberalization in developing countries and transition economies, where informationally advantaged local banks have to compete with cost efficient foreign banks. We discuss this application in more detail at the end of this section.

This model uses a setup similar to that in Dell'Ariccia et al. (1999). We consider an economy where each entrepreneur is endowed with an investment project that requires a capital inflow of 1, but has no private resources, so that they must look to banks to obtain this financing. Projects pay off an amount R with probability θ, and 0 with probability $1-\theta$, and we assume that this outcome is perfectly observable and contractible by both parties, but that the parameter describing the probability of success, θ, is unknown to either the borrower or the bank before entering into a credit relationship. We assume that θ is uniformly distributed between 0 and 1, with average success probability $\overline{\theta} = 1/2$. We assume that once a borrower obtains a loan from a given bank, that bank learns the borrower's type θ. This learning generates a specificity in the bank-client relationship, as neither the bank nor the entrepreneur can credibly communicate the type information to other lenders.

In the market there are two kinds of borrowers: λ new borrowers and $1-\lambda$ old borrowers. Both of these groups have the same distribution over types given above. Moreover, we assume that banks are unable to distinguish between new borrowers and borrowers that are being rejected by a competitor bank or who are simply switching banks to take advantage of lower rates. This is admittedly a strong assumption. Generally borrowers carry with them some kind of credit history, and such history is usually publicly available to competitor banks, so that any bank should be able to tell whether a borrower has had a previous banking relationship. In defense, we argue that this assumption captures the idea that a borrower's inside bank possesses better information than what is available on a credit record. This information may be gathered through either monitoring or having access to books or simply through being able to better observe the kind of projects in which a borrower invests. In this sense, the borrower's old bank has an informational advantage over competitor banks. New banks are only able to less precisely determine an applicant borrower's type, and may not have much more information about that borrower than about one for which it knows nothing. This provides a borrower's old bank with an informational advantage over potential competitors.[7]

The degree of specificity of the bank-client relationship is likely to vary across segments of the market. In this model, we capture that idea by assuming that the proportion of new and old borrowers varies across market segments. We assume that the market consists of a continuum of segments, each characterized by its proportion of new borrowers λ, where λ is public information: segments characterized by a larger proportion of new borrowers are those where the inside bank's advantage is smaller.

From the above, we see that borrowers can be identified by two parameters: their profitability θ, and the proportion of new borrowers in their market segment λ. While θ has a natural interpretation as a measure of quality, we can interpret λ as the inverse of a measure of opaqueness. Indeed, as we will show in what follows, when λ is high, it is easier for outside banks to compete away clients from incumbent banks.

We model the competition for borrowers in each segment in two stages. First, all banks simultaneously choose an interest rate for the "free market," which is the pool of size λ composed of all new plus all old rejected borrowers. Banks choose their gross interest rates from the set $[0, R] \cup \{\mathcal{D}\}$, where $\mathcal{D}$ represents not offering a loan (denying credit). Then, after observing the realized rates for all banks, they simultaneously choose type-contingent interest rates for their old customers. We assume that the borrower acts last by choosing the lowest available interest rate.

2.1 Equilibrium Analysis

We consider the case where there are only two banks in the market. Specifically, we consider a situation where one bank enjoys an informational advantage, while the other enjoys a lower cost of funding. In each segment,

[7] An alternative justification for this assumption is that it provides us with a very simple measure of the degree of information asymmetry across banks. We believe that similar results would be obtained if we assumed that there were no new borrowers, but rather that the inside bank observed a private signal about the quality of its borrowers. We could then characterize the different markets by the quality (informativeness) of the signal being observed, with more opaque borrowers being those for whom the inside bank has very precise information.

bank 1 (incumbent) has a pre-existing market share of one, and thus perfect information about all the old borrowers. Bank 2 (entrant) has a pre-existing market share of 0, and thus no information about old borrowers. Bank 1 has access to an unlimited supply of funds at a constant gross interest rate, which we normalize to 1. Bank 2 has access to an equally unlimited supply of funds at a constant gross rate $\delta \in \left[\frac{1}{2}, 1\right]$.[8]

Since the segments are perfectly distinguishable on the basis of λ, and both banks' costs are linear, we can treat all markets separately. Therefore, for a fixed market segment (for a fixed λ) we can write the profits for each bank as a function of their interest rate offers.

We solve the game by backward induction. We first characterize the equilibrium of the subgame after banks submit a bid to the free market, when bank 1, the only bank with a pre-existing market share, bids for its old customers. Then we solve the first stage, where both banks compete for new borrowers.

It is straightforward to show that, in equilibrium, bank 1 is able to retain all of its borrowers of sufficiently good quality, and rejects all borrowers for whom lending at prevailing interest rates would yield it losses. This is a direct result of our assumption that bank 1 is always able to make a final offer to its old customers. To be explicit, let r_i be the interest rate charged by bank i to the free market, and let $r_{1\theta}$ be the interest rate charged by bank 1 to an old customer of type θ (r_i denotes a gross interest rate, that is, net interest plus principal). To retain a customer, bank 1 needs to charge it a rate no higher than that being charged by bank 2. Therefore, all old borrowers retained by bank 1 are charged $r_{1\theta} = r_2$. But from this it is clear that only borrowers for whom $\theta \geq \tilde{\theta} \equiv \frac{1}{r_2}$ will be retained by bank 1. Note that $\tilde{\theta}$ can be thought of as a threshold or cutoff value of θ in order to obtain informed financing.[9]

We can now use the above to characterize the equilibrium of the whole

[8]Note that this is equivalent to assuming that the informed bank has a cost *disadvantage*, so that its cost of funding is greater than 1 ($= 1 + \xi$, $\xi > 0$). Lowering δ is then equivalent to increasing ξ, so that we can look at shocks that increase the cost of funding to the informed bank.

We also only consider values of $\delta \geq \frac{1}{2}$ since it is easy to show that for $\delta < \frac{1}{2}$, bank 2 always captures the entire market for new borrowers.

[9]Note that this is only true as long as bank 2 bids. If bank 2 does not bid, bank 1 can charge its old customers the maximum rate R without fear of losing them, so that the cutoff value $\tilde{\theta}$ becomes $1/R$.

game. A well-known result of models of competition under adverse selection is that the equilibrium in these models usually involves competitors playing mixed strategies.[10] This will also be true in our model for parameter values that lead to true competition between the two banks. We offer the following characterization of the equilibrium in this game.

Proposition 1 *A unique equilibrium to the two-stage game exists and is characterized as follows.*

1. *For* $\delta < \underline{\delta}(\lambda) = \frac{3\lambda+1}{2(\lambda+1)}$, *both banks bid* $r = \frac{1}{\theta}$. *Bank 1 obtains zero borrowers and profits, while bank 2 obtains positive profits.*

2. *For* $\underline{\delta}(\lambda) \leq \delta < \overline{\delta}(\lambda) = \frac{\lambda R^2+1-\lambda}{2(\lambda R+1-\lambda)}$, *the unique equilibrium is characterized by a distribution function over strategies (interest rates and credit denial probability) for each bank,* $F_i(r), i = 1, 2$, *where* $F_i(r) = prob(r_i \leq r)$. *In equilibrium, the uninformed bank (bank 2) makes zero expected profits off of its new customers. The informed bank (bank 1) makes strictly positive expected profits off of its new customers.*

3. *For* $\delta \geq \overline{\delta}(\lambda)$, *bank 2 does not bid on the free market. Bank 1 offers the monopolistic interest rate and makes positive profits.*

Proof: See the Appendix for a more detailed characterization and proof. □

This proposition points out that, as long as bank 2's cost advantage is not too large, the informational advantage of bank 1 also endows it with a competitive advantage, which allows it to obtain positive profits in the credit market. The information advantage allows the informed bank to reap profits not just from its old customers but also from borrowers to which it has not previously lent, which in this case are just the new borrowers. Moreover, a sufficiently large informational advantange will grant bank 1 full monopoly power. At the other extreme, a very large cost advantage allows bank 2 to underbid bank 1 and drive it out of the market for new borrowers.

Figure 2 illustrates the regions characterized above. The proposition provides us with two bounds on δ as a function of λwhich serve to partition

[10] This result has been established in models of banking competition in Broecker (1990) and von Thadden (1998), among others. See Dell'Ariccia et al. (1999) for a proof of the nonexistence of a pure strategy equilibrium in the context of a model similar to the one used in this paper.

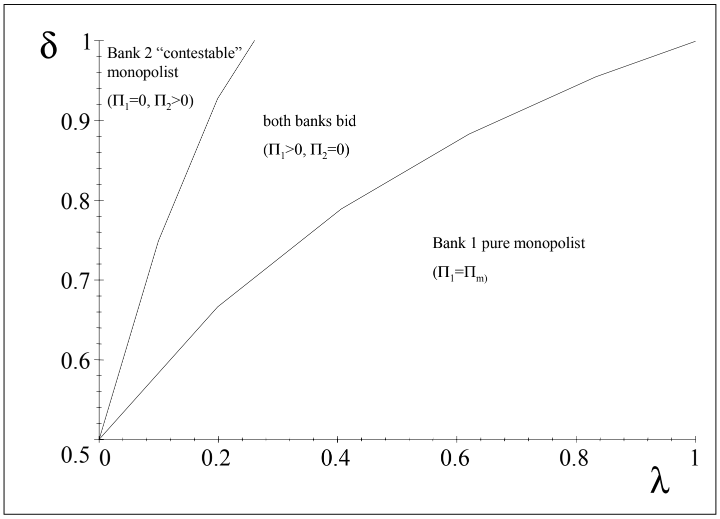

Figure 2: Equilibrium for model in prices.

the space. The first bound, $\underline{\delta}(\lambda)$, establishes the size of the cost advantage needed for bank 2 to be able to squeeze bank 1 out of the market. This bound is increasing in λ, since higher values of λ imply lower degrees of information asymmetries for bank 2. The second bound, $\overline{\delta}(\lambda)$, simply tells us that if bank 1's information advantage is sufficiently large relative to bank 2's cost advantage, bank 2 will be unable to compete.

Having characterized the equilibrium, we proceed with the analysis. As emphasized earlier, we are interested in the allocation of credit by informed lenders when hit by a negative shock that forces them to curtail lending. Such a negative shock can be modeled as a shock to δ, with a *lowering* of δ, which lowers the cost of funding of an uninformed bank, being equivalent to raising the cost of funding to the informed bank (see an earlier footnote). The effects on credit allocaton in the two extreme regions of our partition are trivially null and will not be discussed here. Instead, we concentrate on the intermediate region, where both banks actually compete for borrowers and have positive expected market shares. As argued above, bank 1 grants credit to all borrowers of type $\theta \geq \tilde{\theta} = \frac{1}{r_2}$ as long as bank 2 bids, and $\frac{1}{R}$ otherwise. Therefore, the expected quality of the marginal borrower to obtain credit by the informed bank is $E[\tilde{\theta}] = F_2(R)E\left[\frac{1}{r_2}|r_2 \leq R\right] + (1 - F_2(R))\frac{1}{R}$.

Corollary 1 *The expected marginal borrower ($E[\tilde{\theta}]$) obtaining credit by an informed bank is:*

1. *increasing in λ: $\frac{\partial E[\tilde{\theta}]}{\partial \lambda} > 0$, and*

2. *decreasing in δ: $\frac{\partial E[\tilde{\theta}]}{\partial \delta} < 0$.*

Proof: See the Appendix.

The result above follows directly from the proof of Proposition 1, where the mixing distributions for both banks, F_1 and F_2, are constructed. As the severity of the information asymmetry decreases (i.e., as λ increases), the uninformed bank is able to bid more aggressively without fear of being saddled with only the informed bank's "lemons." This implies not only that $E[r_2]$ decreases, but also that the probability that bank 2 bids increases. This can then be shown to imply that $E[\tilde{\theta}]$ increases in λ.

Note further that one immediate implication of this result is that, in equilibrium, the average quality of an informed bank's borrowers is lower for more opaque market segments. Another way of stating this is that, since profits depend on both the quality of a borrower as well as its transparency, low quality but highly opaque borrowers may be able to obtain financing even if better quality but more transparent borrowers are denied informed financing.

Conversely, as δ increases, the cost advantage of the uninformed bank (or the cost disadvantage of the informed bank) is *reduced*. This leads the uninformed bank to bid *less* aggressively, so that $E[r_2]$ increases with δ. This implies that shocks to a bank's cost of funds leads to reductions in $E[\tilde{\theta}]$, the expected cutoff quality level of borrowers obtaining (informed) bank financing. Note also that, as should be expected, the mass of borrowers granted a loan by bank 1, $1 - E[\tilde{\theta}]$, is also reduced as its cost of lending increases.[11]

However, one of our stated goals is to show that this reduction in bank 1's lending to low quality borrowers is relatively more pronounced for market

[11] This latter effect is reminiscent of the "flight to quality" effect (see, e.g., Bernanke et al. (1996)). When the informed bank suffers a shock that raises its cost of funds relative to alternative sources of credit, it raises the threshold quality level below which it denies credit. In other words, bank 1 reduces lending to less creditworthy borrowers, and allocates credit only to higher quality borrowers.

segments where borrowers are less opaque. For that we have the following result.

Proposition 2 *The relative effect of a credit reduction is larger in more transparent markets. Specifically,*

$$\frac{\partial}{\partial \lambda}\left(\frac{\frac{\partial E[\tilde{\theta}]}{\partial \delta}}{1 - E[\tilde{\theta}]}\right) < 0. \tag{1}$$

Proof: See the Appendix.

The proposition illustrates our main result. When curtailing credit, banks cut lower quality borrowers first, and the proportion of borrowers cut is greater in more transparent markets. One clear implication is that for two different markets segments characterized by λ_1, λ_2, with $\lambda_1 < \lambda_2$, a lower quality borrower of type $\theta_1 < \theta_2$ may be kept in market 1 even as a higher quality borrower of type θ_2 is being cut in market 2. This is exactly what we term the "flight to captivity" effect: when curtailing credit, banks are willing to cut higher quality borrowers in more transparent markets.

The results above demonstrate that bank profits can vary along two dimensions: quality and degree of informational capture. Moreover, the degree of informational capture, or an inside bank's information advantage, is increasing in the opaqueness of a borrower. Therefore, for a given amount of public information about a borrower, higher quality borrowers generate higher rents. However, it must also be true that, given the quality of a borrower (the success probability θ), more opaque (and therefore more captured) borrowers also generate higher rents. This is exactly the intuition conveyed by our simple example in the introduction, where we illustrated how credit is allocated across two markets with different demand elasticities for loans. Less opaque borrowers are precisely borrowers that have a more elastic demand for loans as they have less difficulty signaling their information to outsiders. The impact of a reduction in lending by an inside bank should therefore be felt more in this market that in the market of more opaque borrowers, who have a less elastic demand for loans.

2.2 Discussion

Western banks first entered markets in emerging and transition economies by following their client firms from their domestic markets. Consequently, their initial activities consisted of providing cross-border services to multinationals that were expanding to these newly opened markets. However, their comparative advantage in the provision of high quality services and the relatively lower cost of funds allowed foreign banks in transition countries to become dominant in the highest segments of the market attracting the "best domestic customers."[12] On the depositor side, these have been typically the richest individuals. On the borrower side, such clients have often been firms with relatively better accounting and reporting standards or with previously established international links by virtue of their import/export activities.[13] Conversely, with few exceptions, foreign banks have been reluctant to expand their activities beyond their established niche, being concerned with the quality of the available information about average borrower firms.[14]

The predictions of the model in this section naturally fit the pattern of foreign entry into the banking markets of transition economies. Foreign banks were able to attract the better and most transparent borrowers by virtue of their cost advantage, while local banks retained a dominant position on more opaque clients by virtue of the superior information in their possess.[15]

In the model, for sake of simplicity, we assumed that θ and λ are uncorrelated. However, in practice there likely exists a positive correlation between borrower quality and transparency, with important consequences for the effects of cross-border liberalization. The entry of foreign banks has the potential to change the loan portfolio composition of domestic banks not only with respect to the transparency of borrowers, but also with respect to their average quality. Foreign banks would attract the more transparent and creditworthy borrowers leaving domestic banks to deal solely with loans associated with opaque borrowers and characterized by higher risk. The local banking system would find itself with a deteriorated loan portfolio and, thus,

[12]See Bonin, Mizsei, Szekely, and Wachtel (1998) for a general discussion of these issues. Bonin and Leven (1996) discuss the case of Poland, and van Elkan (1998) that of Hungary.

[13]Dittus (1994) makes these arguments for transition economies in central Europe, particularly for Poland and the Czech Republic.

[14]See Bonin, Mizsei, Szekely, and Wachtel (1998).

[15]This model is also consistent with the data from Japan following the deregulation of public bond markets. Hoshi, Kashyap, and Scharfstein (1993) argue that, after the liberalization in Japan, it was mostly high net worth companies that were able to access public debt markets. If high net worth correlates with age, quality, and the amount of publicly available information concerning these borrowers, this model would argue that Japanese banks might have been left with significantly worse loan portfolios. This is also consistent with recent work by Hoshi and Kashyap (1999) on the Japanese banking crisis.

more prone to fall into financial distress in case of macroeconomic downturns. From this point of view, it becomes crucial that adequate supervisory and prudential frameworks be put in place before the banking sector is liberalized. Furthermore, the entry of foreign banks through the acquisition of existing domestic institution (with the associated improvement in technology and managerial ability) should be preferred over de-novo entry.

3 A Model of Quantities

In this section we examine how shocks to the lending capacity of the banking system affect credit allocation. While we do not specify the origin of the shocks to lending capacity, a natural application of the model is to analyze the reallocative effects of monetary policy innovations.

It has been argued that monetary policy contractions directly affect bank credit by compressing bank lending capacity through a reduction of the deposit base ("lending view").[16] In that context, the model in this section provides a framework for thinking about how banks reallocate their lending in response to such negative shocks. We present a model where a bank with limited capacity and superior information competes with a non-bank financial intermediary with unlimited capacity, but inferior information. As in the rest of the paper, we focus on how credit to groups of borrowers characterized by different degrees of opaqueness/captivity is affected by an overall contraction (or expansion) of bank lending capacity.

We consider a setup where a bank with limited lending capacity operates in two separate markets segments. The two segments are characterized by different market and information structures. To keep things simple, we push these differences to the extreme as described in what follows.

The first segment is a competitive market, meaning that the bank and non-bank financial intermediary compete for borrowers. In addition, in this market segment information flows freely across financial intermediaries, and bank-client relationships are not specific. Consequently, the two lenders are symmetrically informed when competing for borrowers. For simplicity, we assume that no client-specific information is available to either bank and that lenders only know the type distribution of potential borrowers. In the notation of the model in the previous section this would correspond to a market with $\lambda = 1$, so that there is complete turnover of borrowers.

[16] For example, see Kashyap and Stein (2000) and references therein.

The second segment is a monopolistic market, meaning that the bank's informational advantage is sufficient so as to guarantee it against the threat of entry by any potential competing lender.[17] Again for simplicity, we assume that the bank has specific information about the type of every individual borrower in the market. In the notation of the model in the previous section this would correspond to a market with $\lambda = 0$.

3.1 Equilibrium analysis

To keep the notation consistent with that of the previous section, we will refer to bank 1 as the informed bank, and bank 2 as the uninformed intermediary, which can stand for an anonymous credit market or any other arm's length lender. We will also refer to market M as the monopolistic market where only bank 1 is active and has private information about its customers, and market C as the competitive market where both lenders are active and equally informed. We assume that bank 1 has a capacity K to be allocated between loans to markets M and C, with quantities given by K_M and K_C, respectively.

Each market has a mass of borrowers of size one and the distribution of borrower types across both markets is identical. Borrowers are defined as in the previous section, with projects yielding either 0 or R, and are characterized by a probability of repayment θ, which is uniformly distributed between 0 and 1.

We structure the model as a two stage game. In the first stage, bank 1 decides how to allocate its lending capacity between the two market segments. In the second stage, banks 1 and 2 compete over interest rates in the competitive segment; bank 1 maximizes its profit as a monopolist in the protected segment (market M).

We solve the game by backward induction. In the subgame after capacity allocations have been made, we solve for both the equilibrium in the competitive market (market C) and in the monopolistic market. We provide a full characterization of these equilibria in the appendix. We can then solve for the optimal allocation of capacity for bank 1 in stage 1. From the analysis of the equilibria in the subgames, we can show that, in stage 1, bank 1

[17] This assumption puts a constraint on the minimum level of lending capacity for the bank. For the condition guaranteeing an informational natural monopoly in this setup, but without binding capacity constraint, see Dell'Ariccia, Friedman, and Marquez (1999).

maximizes expected profits

$$\Pi_1 = \frac{R}{2}(2K_M - K_M^2) - K_M + K_C(1 - K_C)(R\overline{\theta} - 1)$$

with respect to K_M and K_C, subject to the constraint that $K_M + K_C = K$. This leads us to the following proposition.

Proposition 3 *The equilibrium of this game in stage 1 is characterized by a capacity allocation* $\{K_M^*, K_C^*\}$ *by bank 1, where* $K_M^* = \frac{R\left(1-\overline{\theta}\right)+2K\left(R\overline{\theta}-1\right)}{R+2\left(R\overline{\theta}-1\right)}$ *and* $K_C^* = K - K_M^*$.

Proof: This follows directly from the first order conditions for profit maximization of the above equation. □

Proposition 3 gives us the optimal allocation of bank 1's capital across the two market segments, for a given level of total capacity K. However, our concern is with how banks readjust their loan portfolios following a shock to bank capital. For that, we have the following result, which is the main result of this section.

Corollary 2 *Lending is cut (increased) relatively more following a contraction (expansion) in bank 1's capital in the competitive market (C) than in the monopolistic market (M):*

$$\frac{\left(\frac{\partial K_M}{\partial K}\right)}{K_M} < \frac{\left(\frac{\partial K_C}{\partial K}\right)}{K_C}$$

The proposition above shows that the elasticity of K_M with respect to changes in total capacity is smaller than that of K_C. The interpretation of this result is straightforward. A contraction of lending capacity results in a relative reallocation of lending away from market C, the competitive market, and towards market M, the monopolistic market. In other words, bank 1 rebalances its portfolio in favor of more captive borrowers.

In what follows, we use the results in this section to analyze how bank lending behaves in response to monetary policy innovations.

3.2 Discussion

The bank lending channel view of monetary policy has argued that, since nonbank loans are not perfect substitutes for bank loans for some borrowers, monetary policy contractions that force banks to curtail lending (or expansions that lead to an increase in bank lending) have real effects beyond those resulting from the conventional money channel.[18] Consistent with this view, there has been much evidence showing that bank lending is indeed susceptible to monetary policy innovations (Kashyap and Stein (1995)) and that borrowers are differentially affected by monetary contractions (Kashyap et al. (1993), Kashyap and Stein (2000)). The model from the previous section can be used to analyze how bank credit is allocated following a monetary policy contraction.

In the context of our model, we can interpret bank 1, with lending capacity K, as representing the banking sector in the economy, and bank 2, with unlimited capacity, as any other non-bank source of financing.[19] With this setup, a reduction to bank 1's lending capacity, K, can then be interpreted as a forced reduction in bank lending resulting from a monetary contraction that causes reserves to flow out of the system. Therefore, the model implies that, following a monetary contraction, banks should cut lending relatively more to borrowers who, because they have alternative sources of financing, are more sensitive to interest rate changes on their bank loans. These borrowers are precisely the more transparent borrowers in our model, who, because they are better able to signal their quality to other lenders, do not expose these competing lenders to large adverse selection problems. This is exactly what we call the "flight to captivity," in that banks should attempt to retain their more profitable loans when following a monetary contraction, these loans very often being the ones to borrowers with few alternatives for financing.[20]

[18]The "money" channel for monetary policy is simply the conventional effect through the liability side of banks' balance sheets: as reserves flow out of the system, there is a fall in the stock of money.

[19]For our purposes, it is not crucial that the non-bank intermediaries be completely unconstrained. We only require either that their capacity to grant loans be less sensitive to monetary policy innovations than that of banks, or that their capacity to grant loans not be a binding constraint relative to the size of their market.

[20]An alternative interpretation is that banks should sell their more liquid assets when faced with a need to raise capital. These assets are just loans to their most transparent borrowers, so that those are the loans that are sold first.

It is worth emphasizing that, while more transparent borrowers are denied bank credit, these borrowers are not necessarily the ones that are most impacted as a result of the monetary contraction. Lending to the more transparent sectors is curtailed (or liquid loans are sold) precisely because these borrowers have alternative sources of financing they can tap, and so are very sensitive to increases in interest rates. However, the more opaque borrowers suffer a form of credit rationing as a result of the contraction of the banking sector, as marginal (and even some good) risks that are released by banks are unable to obtain financing elsewhere.

Note also that, as alluded to in the introduction, the results can also be seen to incorporate a "flight to quality" effect in that, for a given level of opaqueness, banks first shed their lower quality loans before getting rid of their high quality loans. Monetary contractions therefore have the effect of reallocating bank credit away from both low quality and more transparent borrowers, and towards better quality but also more captured borrowers.

4 Conclusions

This paper presented a framework to think about how competition among financial intermediaries affects credit allocation under asymmetric information. It showed that, when there are informational asymmetries among lenders, the profitability to a bank of a borrower's loan is determined along two different dimensions. First, the quality of the borrower in terms of creditworthiness affects the bank's expectation of recovering the invested funds. Second, the degree of opacity of the borrower, or its ability to credibly communicate its quality to outside lenders, affects the bank's ability to extract monopolistic rents by charging high interest rates. In two different models, this paper showed that when forced to curtail lending, banks take into account these two dimensions of loan profitability by reallocating their loan portfolio towards both more creditworthy and more opaque borrowers.

The framework in this paper can be applied to two different contexts. First, it may us help understand the changes in bank portfolio associated with liberalization reforms that bring new banks into the market, such as those that have taken place in transition economies and some emerging markets. Second, in the spirit of the "lending view", it may help to explain the changes in the allocation of aggregate credit associated with monetary policy innovations.

Appendix

1 Proofs of results from Section 2

As argued in the text, in the subgame after offers to new borrowers have been made, bank 1 can retain any borrower by matching the rate of its competitor, r_2. From this it is obvious that the only old borrowers retained are those of sufficiently high quality, so that $\theta r_2 \geq 1 \Rightarrow \theta \geq 1/r_2$. We can now define the "free market" faced by bank 2 explicitly as all new borrowers plus all borrowers rejected by bank 1.

Consider then the competition for the free market. Using the argument above, the banks' free market profits, conditional on "winning" the free market (having the strictly lowest rate), are

$$\pi_1(r_1|w) = \lambda \int_0^1 (r_1\theta - 1)d\theta = \lambda(r_1\overline{\theta} - 1) \tag{2}$$

$$\begin{aligned} \pi_2(r_2|w) &= \lambda \int_0^1 (r_2\theta - \delta)d\theta + (1-\lambda)\int_0^{\frac{1}{r_2}} (r_2\theta - \delta)d\theta \\ &= \lambda(r_2\overline{\theta} - \delta) + (1-\lambda)\int_0^{\frac{1}{r_2}} (r_2\theta - \delta)d\theta \end{aligned} \tag{3}$$

The second term in equation (3), which can be written as $(1-\lambda)\frac{1}{r_2}\left(\frac{1}{2} - \delta\right)$, is negative for $\delta > \frac{1}{2}$, since bank 1 only casts out those borrowers for which $\theta r_2 < 1$.

Conditional on losing, bank 1 simply makes zero profits as it makes no new loans. Bank 2, however, makes loans to bank 1's rejected borrowers, so that its payoff is given by

$$\pi_2(r_2|l) = \int_0^{\frac{1}{r_2}} (1-\lambda)(r_2\theta - \delta)d\theta, \tag{4}$$

Note that while equation (4) is negative, equation (3) can be positive for sufficiently large values of r_2 or low values of δ. This is simply because no adverse selection effects operate with respect to the new borrowers (the first term in equation (3)), so that their expected repayment probability is the mean of the full distribution of borrowers.

This observation gives us the bound in part 3 of Proposition 1. In order for bank 2 to be willing to bid at all, it must be able to obtain positive profits from doing so, at least some of the time. Therefore, if $\pi_2(R|W) < 0$, bank 2 will never bid, since even if it were to have the monopolistic rate and were to be assured of winning it would still make losses. Using equation (3) we derive the cutoff value of $\overline{\delta}(\lambda)$ such that bank 2 is willing to bid at all. For $\delta \geq \overline{\delta}(\lambda)$, bank 2 never bids, and bank 1 offers the monopolistic interest rate to all of its customers and to any new customers.

To obtain the bound in part 1 of Proposition 1, notice that, if $\delta \leq \frac{1}{2}$, $\pi_2(R|L)$, given by equation 4, will always be positive for any value of λ. Moreover, for $\delta < \underline{\delta}(\lambda) = \frac{3\lambda+1}{2(\lambda+1)}$, bank 2 can always undercut bank 1 by bidding $r_2 = \frac{1}{\theta}$ and still make positive profits. Therefore, in equilibrium banks 1 and 2 bid the rate $r = \frac{1}{\theta}$, and bank 2 always obtains the entire market.[21]

For $\underline{\delta}(\lambda) \geq \delta < \overline{\delta}(\lambda)$, we can now state the following proposition regarding the equilibrium of the full game. Note that this result is just a restatement of Proposition 1.

Proposition 4 *A unique equilibrium to the two-stage game exists and is characterized by a distribution function over strategies (interest rates and credit denial probability) for each bank, $F_i(r), i = 1, 2$, where $F_i(r) = prob(r_i \leq r)$. These distribution functions are continuous and strictly increasing over an interval $[\underline{r}, R)$, where $\underline{r} = \delta + \frac{1}{\lambda}\sqrt{\lambda^2\delta^2 + \lambda(2\delta - 1)(1-\lambda)}$. The equilibrium has the following additional properties:*

1. *The uninformed bank (bank 2) makes zero profits off of its new customers. The informed bank (bank 1) makes strictly positive profits off of its new customers.*

2. *The uninformed bank (bank 2) "stays out" with positive probability (i.e. does not bid on the free market with some probability, so that $1 - F_2(R) > 0$, and the probability that bank 2 plays the strategy $\mathcal{D}$ is positive).*

3. *Bank 1 bids $r_1 = R$ with positive probability ($\mu_1(R) > 0$, where $\mu_i(r)$ represents the mass F_i puts on r, if any: $prob(r_i < r) = F_i(r) - \mu_i(r)$).*

Proof: This model fits the setup in Dell'Ariccia, Friedman and Marquez (1999), with pre-existing market shares of 1 for one bank (bank 1) and 0 for the other (bank 2). For values of δ within the specified bounds, the proof in that paper follows directly. The lower bound of the mixing distributions, $\underline{r}$, can be obtained directly from the zero-profit condition for bank 2, $\lambda\left(\frac{1}{2}\underline{r} - \delta\right) + (1-\lambda)\int_0^{1/\underline{r}}(\underline{r}\theta - \delta)\,d\theta = 0$, which when solved for $\underline{r}$ yields the expression above. □

Proof of Corollary 1: Recalling that $\tilde{\theta} = \frac{1}{r_2}$ whenever bank 2 bids, and R, the maximum, otherwise, we can write that $E[\tilde{\theta}] = F_2(R)E\left[\frac{1}{r_2}|r_2 \leq R\right] + (1 - F_2(R))\frac{1}{R}$. It is useful to define the variable r_1^{old} as the rate bank 1 charges its old customers. The expected value of this rate can be expressed as $E[r_1^{old}] = F_2(R)E[r_2|r_2 \leq R] + (1 - F_2(R))R$. From this, it is straightforward to show that $E[\tilde{\theta}]$ will increase if $E[r_1^{old}]$ decreases, and decrease if $E[r_1^{old}]$ increases.

[21] Strictly speaking, bank 2 must bid a rate of $r_2 = \frac{1}{\theta} - \epsilon$ in order to win the entire market. This is the usual Bertrand result, that the equilibrium of the game is characterized by taking the limit as ϵ goes to zero.

To show the first part of the corollary, we compute $\frac{\partial E[r_1^{old}]}{\partial \lambda}$. Performing a simple integration by parts, we can write $E[r_1^{old}] = R - \int_{\underline{r}}^{R} F_2(r)dr$. Therefore, the derivative can be expressed as

$$\frac{\partial E[r_1^{old}]}{\partial \lambda} = -\int_{\underline{r}}^{R} \frac{\partial}{\partial \lambda} F_2(r)dr$$

We can obtain F_2 from Proposition 1 as

$$F_2(r) = \frac{\lambda\overline{\theta}\left(r - \underline{r}\right)}{\lambda\left(r\overline{\theta} - 1\right)}$$

From the definition of $\underline{r}$, it is clear that $\frac{\partial}{\partial \lambda}\underline{r} < 0$. We can then see that $\frac{\partial}{\partial \lambda}F_2(r) > 0$. But this then implies that $\frac{\partial E[r_1^{old}]}{\partial \lambda} < 0$, so that $\frac{\partial E[\tilde{\theta}]}{\partial \lambda} > 0$, as desired.

The second part of the corollary is proven similarly. We first show that $\frac{\partial}{\partial \delta}\underline{r} > 0$, so that $\frac{\partial}{\partial \lambda}F_2(r) < 0$. This then implies that $\frac{\partial E[r_1^{old}]}{\partial \delta} > 0$, so that $\frac{\partial E[\tilde{\theta}]}{\partial \delta} < 0$, as desired. □

Proof of Proposition 2: The derivative in the proposition can be written as

$$\frac{\partial}{\partial \lambda}\left(\frac{\frac{\partial E[\tilde{\theta}]}{\partial \delta}}{1 - E[\tilde{\theta}]}\right) = \frac{\frac{\partial^2 E[\tilde{\theta}]}{\partial \lambda \partial \delta}\left[1 - E[\tilde{\theta}]\right] + \frac{\partial E[\tilde{\theta}]}{\partial \lambda}\frac{\partial E[\tilde{\theta}]}{\partial \delta}}{\left[1 - E[\tilde{\theta}]\right]^2}$$

The product of the last two terms in the numerator is negative (Corollary 1). It can be shown (after some straightforward but algebraically complicated computations) that the overall expression is negative as well, so that the relative reduction in lending by bank 1 is greater in more transparent markets. □

2 Proofs of results from Section 3

First, consider the sub-game where the capacity constrained bank and the unconstrained alternative lender compete for unknown borrowers under symmetric information.

Proposition 5 *For any $K_C < 1$, a unique mixed-strategy equilibrium for the sub-game exists and is characterized by a distribution function over interest rates for each lender, $F_i(r)$, $i = 1, 2$, where $F_i(r) = prob(r_i \leq r)$. The equilibrium has the following properties:*

i) Both lenders make strictly positive profits.

ii) Both lenders play completely mixed strategies over the interval $[\underline{r}, R]$, where $\underline{r}$ is defined below.

iii) There exist no atoms in the mixing probabilities of either lender over the interval $[\underline{r}, R)$. The unconstrained lender's mixing distribution has an atom at R.

Proof. The proof of the existence of a mixed strategy equilibrium is standard. Moreover, it is straightforward to show that the mixing distributions, F_1 and F_2, satisfy the conditions above in that they are continuous and strictly increasing, and contain no atoms in the interval $[\underline{r}, R)$.

For the rest of the proposition, consider the following argument. Given $K_C < 1$, $(1 - K_C)\left(R\overline{\theta} - 1\right) > 0$ represents a lower bound for the unconstrained lender's profits. Then, as a result of the usual mixed strategy argument, the unconstrained lender has also to make positive profits at the lower bound of the mixing distribution (which must be the same for both lenders). This means that $\underline{r} > 1/\overline{\theta}$, and hence that both lenders make positive profits in equilibrium. This also implies that both lenders make an interest rate offer with probability one. Consequently in order for both banks to make positive profits at the highest possible interest rate, R, one has to have an atom at R. This has to be the unconstrained lender, as the constrained lender, bank 1 would make zero profits if its probability of winning were zero at $r_1 = R$.

This establishes that the equilibrium profits for bank 2 are

$$\Pi_2^* = (1 - K_C)\left(R\overline{\theta} - 1\right) \ .$$

Since profits have to be the same for every interest rate offered in equilibrium, we can determine the lower bound of the bidding distributions from the equation

$$\underline{r}\overline{\theta} - 1 = (1 - K_C)\left(R\overline{\theta} - 1\right),$$

which gives us

$$\underline{r} = \frac{1}{\overline{\theta}} + \frac{(1 - K_C)\left(R\overline{\theta} - 1\right)}{\overline{\theta}},$$

that, as expected, converges to $1/\overline{\theta}$ as $K_C \to 1$.

We now can write the equilibrium profits for the constrained bank

$$\Pi_C^* = \Pi_C(\underline{r}) = K_C\left(\underline{r}\overline{\theta} - 1\right) = K_C(1 - K_C)\left(R\overline{\theta} - 1\right),$$

which are positive for $K_C < 1$. ■

Now consider the solution of the monopolist problem on market 0. In this market the bank can make offers contingent on the type of individual borrowers. However, since it faces no competition in this market, bank 1 should charge all of its credit worthy borrowers the maximum rate R, and make loans up to its capacity on this market. Given its capacity constraint, its profits, denoted by Π_M, can be written as

$$\Pi_M = \int_{\underline{\theta}}^{1} (R\theta - 1)\, d\theta \ ,$$

where $\underline{\theta}$ is determined by the capacity constraint. Since θ is uniformly distributed between 0 and 1, we simply have

$$\underline{\theta} = 1 - K_M$$

and

$$\Pi_M = \int_{1-K_M}^{1} (R\theta - 1)\, d\theta = \frac{R}{2}\left(2K_M - K_M^2\right) - K_M \ ,$$

Finally, remembering that $K = K_M + K_C$, we can write the total profits for the bank as the sum of its profits in both markets, and solve stage 1. Bank 1's problem can be written as

$$\max_{K_M}(\Pi_M(K_M) + \Pi_C^*(K - K_M)),$$

which gives exactly the expression in the text, once we substitute for Π_M and Π_C^*. The first order conditions for this maximization problem give the following optimal capacity allocations.

$$\begin{aligned} K_M &= \frac{R\left(1-\overline{\theta}\right) + 2K\left(R\overline{\theta} - 1\right)}{R + 2\left(R\overline{\theta} - 1\right)} \\ K_C &= \frac{KR - R\left(1-\overline{\theta}\right)}{R + 2\left(R\overline{\theta} - 1\right)} \end{aligned}$$

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