Asymmetric Information, Exchange Rate Uncertainty and Banking Competition

by

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Abstract

This thesis analyzes two separate issues. Chapters two and three study the role played by asymmetric information in determining the market structure of the banking industry. Banks offering credit to firms are faced with uncertainty about their credit worthiness. If banks obtain information about firms after lending to them, they are able to reject riskier firms when refinancing them. Potential entrant banks will face an adverse selection problem stemming from their inability to distinguish new firms from old firms which have been rejected from their previous bank. I present two different models in which adverse selection generates a sort of "endogenous fixed cost" that represents a barrier to entry for new financial intermediaries. In chapter two I show that the inclusion of asymmetric information in the analysis of competition among financial intermediaries might help to explain the ineffectiveness of the cross-border liberalization and deregulation in the European banking markets. I also show that borrowers characterized by higher degrees of informational asymmetries might be hurt by the deregulation of the banking industry. Chapter three analyzes the effects of exchange rate uncertainty on bilateral trade. Using a gravity model and panel data from Western Europe, I find that exchange rate uncertainty has a negative effect on international trade. Particular attention is reserved to the problems of simultaneous causality that usually arise in this kind of studies.

Thesis Supervisor: Rudiger Dornbusch
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Chapter 1

Introduction

This thesis is a collection of three papers for which it is difficult to find a common denominator. Chapters two and three analyze the role played by informational asymmetries in the competitive interaction among financial intermediaries, chapter four studies the effects of exchange rate uncertainty on international trade.

In the last ten years legal obstacles to trade in financial services have been virtually eliminated in many countries. Nevertheless, retail banking markets have remained concentrated and dominated by domestic banks, while cross-border activities have been limited to wholesale banking. Informational asymmetries between creditors and borrowers and between different banks can represent a significant economic barrier to entry in the credit industry, even in the wake of the removal of legal obstacles. Hence the inclusion of asymmetric information in the analysis of banking markets can contribute to explain the apparent ineffectiveness of trade liberalization, while the presence of borrowers that differ in the importance of private information can explain the variation of the degree of competition across different segments of the market.

In chapter two I present a model of competition in banking in which asymmetric information, generating adverse selection, behaves as a barrier to entry on the loan markets. Banks considering offering loans to applicant firms always face an asymmetric information problem to the extent that managers and/or owners know their firms better than the
banks do. The main point of this paper is that banks learn some of their clients private information. Then incumbent banks might have an advantage over potential entrant, being able to better distinguish good firms from bad ones among those with whom they have already established a lending relationship. In other words, incumbent banks face a better distribution of firms than the entrant banks. Potential entrants into a loan market suffer an adverse selection problem stemming from their inability to determine whether applicant firms are new firms seeking financing for their untested project or "bad" firms rejected by an incumbent bank. This puts entrants into a worse position relative to the incumbents, and may lead to diminished or deterred entry. As a consequence, deregulation is more likely to induce entry on those segments of the market where asymmetric information is less important. In that case it is possible that the opening up of the banking market will imply a reallocation of loans in the direction of the segments of the credit market were the competitive impact of the deregulation was larger. Then it is possible that borrowers characterized by a higher degree of asymmetric information will end up suffering form the cross-border liberalization. In the model I develop in this chapter there is product differentiation. The framework used is a dynamic version of the classical Salop’s model of competition on the circle. I show that in a context of asymmetric information, as depicted above, adverse selection plays the role of a fixed cost leading to a steady state equilibrium with a finite number of firms, even in the absence of exogenous fixed cost. Then the pro-competitive effects associated with the economies of scale at the international level are diminished in the market segments where informational asymmetries are important.

In chapter three the same kind of issues are analyzed in the context of pure Bertrand competition. This leads, as often in Bertrand setups, to rather extreme results. The only equilibrium is characterized by blockaded entry with only two banks in the market. In other words, the market for loans is a sort of natural duopoly. We also show that no pure strategy equilibrium exist in this model.

Chapter four analyzes the effects of exchange rate volatility on trade. The idea that
exchange rate uncertainty depresses international trade has been one of the main arguments in favor of fixed rate regimes. For example, the trade issue has always been one of the major motivations adduced in favor of the EMS and EMU. However, there is not a strong and unambiguous empirical evidence to support this view. Although there is a quite extensive literature testing the effects of exchange rate regimes on trade, the results are not always significant and they change across studies. Most papers use only cross-sectional data and just a few use bilateral data. In this chapter I try to provide some more empirical evidence, using a gravity model of international trade and panel data to estimate the effects of exchange rate volatility on bilateral trade among Western European countries. There are various reasons to limit the scope of this study to Europe. First the theoretical foundations of the gravity model assume identical and homothetic preferences across countries and rely heavily on the concept of intra-industry trade. European countries are relatively homogeneous in terms of technology, factors endowments and per capita income, thus the model seems particularly appropriate to this case. Moreover, as Bayoumi and Eichengreen (1995) notice, the relationship between trade and other economic characteristics might be different for industrial and developing countries. Thus restricting the sample to Western European countries we minimize problems due to heteroskedasticity. From a policy point of view the issues related to the choice of an exchange rate regime are particularly relevant for the debate about the transition to the European Monetary Union (EMU). Thus it seems interesting to try to estimate the effects of exchange rate volatility on trade in the set of countries that would be involved in EMU. Finally limiting the scope of this study to Western European countries increases the availability of both trade and financial data, allowing me to use panel data instead of cross-sections only. In this chapter I test the effects of exchange rate volatility on trade using different measures and techniques. Particular attention is dedicated to the simultaneous causality problem that arises in this kind of studies. If central banks make an effort to stabilize the exchange rate against their main trade partners, a negative correlation between exchange rate volatility and trade would appear from the
data, but it would not mean that trade reacts negatively to exchange rate instability.

The empirical evidence in this chapter supports the view that exchange rate uncertainty depresses international trade. The results are robust with respect to the particular measures chosen to represent uncertainty. They also show that the negative correlation between exchange rate volatility and bilateral trade remains significant when we control for simultaneous causality. However, I can reject the hypothesis of the absence of a simultaneity bias.
Chapter 2

Cross-Border Banking Liberalization with Asymmetric Information

2.1 Introduction

In the last ten years legal obstacles to trade in financial services have been virtually eliminated in many countries. Nevertheless, retail banking markets have remained concentrated and dominated by domestic banks, while cross-border activities have been limited to wholesale banking. Informational asymmetries between creditors and borrowers and between different banks can represent a significant economic barrier to entry in the credit industry, even in the wake of the removal of legal obstacles. Hence the inclusion of asymmetric information in the analysis of banking markets can contribute to explain the apparent ineffectiveness of trade liberalization, while the presence of borrowers that differ in the importance of private information can explain the variation of the degree of competition across different segments of the market.

At the end of the 1970s banking markets across the industrialized world were highly regulated. Some countries had interest rate and credit regulations and many had significant restrictions on the scope of activities and the geographical location of financial intermediaries. Domestic regulations contributed to shield the banking industry from
international competition and, not surprisingly, cross-border banking was a limited phenomenon. More precisely, the market for loans to large corporations was already internationalized, while markets for loans to small and medium firms were still dominated by domestic banks. The 1980s deregulation process removed most of the legal obstacles to trade in banking services\textsuperscript{1}, with the intent of promoting competition among financial intermediaries.

Standard models predict that trade liberalization and deregulation should lead to an increase in the degree of competition: the entry of new competitors or the threat represented by potential new entrants would cause a reduction of the price-cost margins and hence an increase of consumers' welfare\textsuperscript{2}. These are also the conclusions of the Price Waterhouse report to the European Commission. However, the observation of the European banking industry reveals a very different picture. Concentration ratios are still high (specially when compared to the US) and do not exhibit a general decreasing trend (see Figure 1.1), while the degree of foreign penetration remains on average low, varying across countries (see Table 1). Moreover the evolution of the interest rate markups does not show any clear pattern\textsuperscript{3} (see Figure 1.2). At the same time there is evidence that cross-border banking is not distributed uniformly across different segments of the market. In particular it appears that foreign banks limit their cross-border activities to wholesale banking\textsuperscript{4}.

The prediction that cross-border liberalization will induce financial integration leading to a competitive market relies on the assumption that relevant barriers to entry will be eliminated as well. Then a deregulated banking industry will reach the competitive outcome through the entry of new competitors or as a "contestable" market, where

\textsuperscript{1}See Borio and Filosa (1995) and Gual and Neven (1992) for a detailed overview of the deregulation process.

\textsuperscript{2}For a synthesis of models with product varieties see Helpman and Krugman (1985). See Brander and Krugman (1983) for an homogeneous product example.

\textsuperscript{3}To this regard Gual and Neven (1992) find evidence of a change in the competitive regime only in Spain (more competitive) and in Netherland (less competitive).

\textsuperscript{4}For example in 1996 in Italy foreign banks had on average 1.5 branches compared to the 25 of domestic banks.
potential competition plays the role of actual entry. However, if significant economic barriers to entry exist in credit markets, the removal of legal barriers will not necessarily increase competition.

In Europe legal barriers to cross-border banking have been virtually removed. The Second Banking Directive of the European Union allows credit institutions chartered in any member state to engage in a broad range of activities throughout the whole Union. Hence the actual structure of banking markets suggests that relevant economic barriers to entry still exist.

In the broadest definition an economic barrier to entry is some characteristic of the demand or the cost structure that gives incumbents an advantage over potential entrants, so that existing firms enjoy some market power and earn oligopolistic rents. Economies of scale, the ownership of scarce inputs, a proprietary technology on the cost side, and reputation and switching costs on the demand side can represent barriers to entry. Investment in physical capital, the establishment of a network, reputation effects and switching costs for depositors have been identified as factors that make the banking market a "non contestable" market\(^5\). In this paper I show that asymmetric information can constitute by itself a barrier to entry in the banking industry and that it has a crucial role in determining the effects of cross-border deregulation on different segments of the market.

One of the peculiar functions of financial intermediaries is to signal and monitor firms' quality in the presence of informational asymmetries. Hence the analysis of competition in the banking sector should not ignore the effects of asymmetric information on the strategic interaction among banks. Banks considering offering loans to applicant firms always face an asymmetric information problem to the extent that managers and/or owners know their firms better than the banks do. However, this problem does not have to be of the same magnitude for all banks and for all categories of firms. Typically borrowers are characterized by different degrees of informational asymmetries. It might be that the cost of evaluating the credit worthiness of a firm differs across industries and/or firms.

For example, there might be economies of scale in acquiring information about particular firms, so that lending to small firms involves a higher "information cost" per unit of loan. On the other hand asymmetric information may arise between agents that are on the same side of the market: some banks may have better knowledge about some firms than others. In particular banks may be able to gather information about prospective clients from previous lending arrangements, and hence may be able to better distinguish good firms from bad ones among those with whom they have established a relationship than among firms that are new and unknown to them. This kind of informational asymmetry can represent a barrier to entry in the banking industry. Potential entrants into a loan market suffer an adverse selection problem stemming from their inability to determine whether applicant firms are new firms seeking financing for their untested project or "bad" firms rejected by an incumbent bank. This puts entrants into a worse position relative to the incumbents, and may lead to diminished or deterred entry. Hence the deregulation process is more likely to induce entry on those segments of the market where asymmetric information is less important. As suggested by Vives (1991) the increase in competition will not be uniform. Different degrees of competition will prevail on different segments of the market and the effects of financial integration will be different for different categories of borrowers. As a consequence the deregulation process could benefit some firms more than others and could even hurt some borrowers to the extent that the new structure of the banking industry reallocates funds away from them.

Recent literature addressed the role of asymmetric information and competition in banking. The common point of this literature is the fact that the standard competitive results do not necessarily hold in the presence of asymmetric information between bank and customers and between different banks. Broecker (1990) analyzes a market for credit where banks compete Bertrand style in the interest rate and have the ability to test the credit worthiness of applicants. He shows that if the test is imperfect and banks perform it independently, the equilibrium loan interest rate can be increasing with the number of banks in the market. The intuition behind this result is that the average
credit worthiness of firms that pass at least one test is decreasing with the number of banks. In other words, the larger the number of banks the larger the probability that a new applicant is a bad one rejected by all the other banks. Riordan (1992) offers an analysis similar to that in Broecker (1990) using an application of auction theory. Sharpe (1990) concentrates on the notion that high quality firms are "informationally captured" by their own bank: when "good" firms find it difficult to signal their quality to other banks, adverse selection makes difficult for banks to "steal" each other's good customers without attracting the bad ones as well. Banks will then offer low introductory rates because asymmetric information enables them to extract surplus from their good firms in future periods. Petersen and Rajan (1995) show that with asymmetric information banks' willingness to lend to new "unknown" firms increases with the banking market concentration, while the interest rate charged decreases. The intuition is that as the market power of the bank increases, it can extract a larger share of the future surplus from the firm. In other words, the value of lending relationships diminishes with the degree of competition among banks\footnote{They do not model explicitly the interaction among banks. In their paper "market power" is an exogenous variable.}. Dell'Ariccia, Friedman and Marquez (1996) show that informational asymmetries in the banking industry can be a barrier to entry by themselves. The idea is that incumbent banks can discriminate better than potential entrants between "bad" and "good" borrowers by virtue of their established relationship with firms seeking credit. The result of this informational asymmetry is that potential entrants face a "worse" distribution of applicant borrowers than the incumbent banks, and this leads to a situation of blockaded entry. The model in this paper develops that idea in a dynamic context with differentiated products. Finally some analogies can be found with the literature analyzing the labor market in the presence of informational asymmetries\footnote{See in particular Greenwald (1986).}.

In section 2 I describe the model for a closed economy. In section 3 I analyze the effects of trade liberalization. Section 4 concludes.
2.2 The Closed Economy Model

Consider first a closed economy. In this paper the basic setup is a spatial competition model a la’ Salop in which banks compete in the interest rate for loans to firms. Most literature about competition in banking considers Cournot or Bertrand competition. However, Cournot competition implicitly assumes homogeneous consumers that makes difficult to introduce asymmetric information in the analysis. On the other hand, Bertrand competition has the disadvantage of making the demand function at the bank level infinitely price elastic leading to interesting, but rather extreme results. The introduction of product differentiation provides each competitor with some market power, so that each bank faces a demand function that is continuous in both its own and its competitors interest rates.

In the Salop’s model consumers with a unit demand are uniformly distributed around a circle of measure one, that represents the space of product varieties. Producers are located equidistant around the circle, so that maximal differentiation is exogenously imposed. Given this location producers compete in price for customers. Consumers have a transportation cost \( t \) per unit of length. Thus the total cost of buying one unit of product is the sum of price and transportation cost. An individual consumer is indifferent between two producers when the total costs are equalized.

In this model banks compete in the interest rate for borrower firms. Both banks and firms are distributed on a circle of measure one. All firms live two periods (OLG), while banks live forever. Thus in any period there are new and old firms on the market. For new firms I mean agents that are applying for credit for the first time. Not necessarily

---


\(^9\)See Dell’Ariccia, Friedman and Marquez (1996) where Bertrand competition involves mixed strategies equilibria and leads to a natural duopoly. See also Yannelle (1993) for models of banking competition a la’ Bertrand where banks compete simultaneously for loans and deposits. Marquez (1996) provides a general overview of the results of Bertrand competition models with different fixed costs.

\(^{10}\)This assumption simplifies the analysis. I intend to generalize the model to the case of firms potentially living forever, with a probability of death. My intuition is that the main results are going to hold.
this has to do with age, it could be firms that until that moment auto-financed their operations, or firms that just moved in the area etc. The same argument can be applied to firms that die: firms can become large enough to finance without intermediation, move to another region etc.

Banks have an advantage against each other with respect to the borrowers with which they are familiar. By lending to a firm a bank is able to learn some of that firm’s private information and exploit it in subsequent periods. As observed before, borrowers might be characterized by different degrees of informational asymmetries. In other words, the importance of private and asymmetric information might differ across market segments. For example, we can imagine that the presence of economies of scale in the acquisition of information at the firm level make the average "informational cost" higher for personal and small firms loans than for corporate loans. In what follows it is the size of the firms to determine the importance of asymmetric information, but the results would be the same if we had that the informational cost differed across industries. In this model there are two sizes of firms: small firms and large firms. Large firms credit-worthiness is public information\textsuperscript{11}. The small firms market is characterized by asymmetric information. Banks know the distribution of new small firms but cannot observe their type. New firms do not know their own type. At the end of their first period new firms learn their type, while banks learn type and "location" of their old client firms. However, banks do not learn the type and "age" of their competitors' customers\textsuperscript{12}, so that they cannot distinguish a new good firm from an old bad one, unless the second was their client in the previous period.

Banks can perfectly observe whether a firm is large or small, thus they can charge different interest rates conditionally on size. In other words, we can consider large and

\textsuperscript{11}In the model I assume all large firms are the same type. This assumption is not important for the result. The relevant assumption is that the type is public information.

\textsuperscript{12}This assumption seems very strong. In the real world banks have ways to learn the credit history of applicants etc. Nonetheless as long as it is costly for banks to screen new projects results do not change qualitatively. Also, even if banks can distinguish new firms from old ones, they still do not know if old firms are applying because rejected by their previous bank or because they are dissatisfied with it.
small firms as two separate markets.

In each period the game has two stages. In stage one banks compete in a Bertrand fashion for the "free market", that is new firms (50% of firms population) and old bad firms rejected by competitor banks. In stage two banks offer their old good firms a rate to keep them from switching to the competition\textsuperscript{13}. At the end of each period banks learn the type and the position of the firms to which they lend money. For now I assume that banks face a constant cost of funds obtained from the money market. In other words, each bank has access to an unlimited quantity of funds at cost $c$ equal to $1 + C$ per period, where $C$ is the money market rate. This assumption allows me to treat the two markets as separated in the bank's maximization problem. In section 2.1 I analyze the small firms market, in section 2.2 the large firms market.

2.2.1 The Small Firms Loans Market

Here I characterize the symmetric equilibrium in the loans market for small firms. The attention is restricted to symmetric Nash equilibria in location and interest rate, and to Markov strategies\textsuperscript{14}. There is a continuum of firms located around a circle of measure 1. Assume for now that there are $N$ banks located symmetrically around the circle. Each firm is asking for a loan of size 1. Firms can be "bad" or "good" with probability $\xi, 1 - \xi$. Bad firms have zero probability of returning the loan, so that banks get no money back from lending to them\textsuperscript{15}. Good firms always return the loan as agreed, thus banks will receive the payment $r$ equal to $1 + R$, where $R$ is the interest rate. Young firms do not know their type. At the end of its first period each firm and its present bank learn the firm's type.

To solve this game we use backward induction. First solve stage two: banks observe the realization of stage one, in which they compete for the new firms, and then offer

\textsuperscript{13}Greenwald (1986) uses the same timing setup.
\textsuperscript{14}The analysis of "collusive" equilibria should be the next step in the research agenda.
\textsuperscript{15}This hypothesis can be relaxed. As long as the expected return on the bad type is negative, the results hold.
to their good old clients an interest rate. Each bank maximizes the profits from its old
good customers. Let \( r_{old} \) be the payment that old customers have to pay given interest
rate they are charged by bank \( i \), and \( r_m \) the payment based on the market rate (from
stage one), that is the rate new firms can get from bank \( i \)'s neighbor competitor banks
\((i-1, i+1)\). Given good firms are riskless, as long as \( r_m > c \) bank \( i \) will offer them
an interest rate that will keep them from switching to competitors. The indifference
condition between bank \( i \) and bank \( i+1 \) for a good old firm located at \( x \in \left[0, \frac{1}{N}\right] \) is:

\[
 r_{old} + \tau x = r_m + \tau \left(\frac{1}{N} - x\right)
\]

where \( \tau \) is the "transportation cost" for the firms; thus in order to keep an old client
located at \( x \) bank \( i \) has to charge at most:

\[
 r_{old}(x) = r_m + \tau \left(\frac{1}{N} - 2x\right) \tag{2.1}
\]

Then we can write the profits from old good customers as a function of \( N \) and \( r_m \):

\[
 \Pi_{old}^t(r_m, N, c) = 2 \int_0^{x_{t-1}} \left[(r_m - c) + \tau \left(\frac{1}{N} - 2\zeta\right)\right] d\zeta
\]

\[
 = 2 \left\{ x_{t-1} \left[(r_m - c) + \frac{\tau}{N}\right] - \tau (x_{t-1})^2 \right\}
\]

where \( x_{t-1} \) is the market share of bank \( i \) in period \( t-1 \) divided by two and \( c \) is the
marginal cost of a unit loan for the bank at the money-market rate \( C \). As expected the
profit from old good customer is increasing with the importance of product differentiation:
banks' market power increases with the "transportation cost". As in standard models
\( \Pi_{old}^t(r_m, N, c) \) is decreasing with the number of banks in the market and the cost of funds \( c \).

Now look at stage one. In each period, in stage one, banks maximize the sum of
the profits they make in \( t \) on the "free market" (new firms plus old firms rejected by

18
competitors) and the discounted total profit in period \( t + 1 \). Because of asymmetric information, profits in \( t + 1 \) depend on the bank's market share in \( t \), and thus on \( r^t \). The larger the market share in \( t \), the larger the number of firms the bank "knows" in \( t + 1 \). Then the bank's objective function is:

\[
\max_{r^t} \Pi^t_{\text{free}} \left( r^t, r^t_o, s^{t-1}, N \right) + \delta \left[ \Pi^{t+1}_{\text{free}} \left( r^{t+1}, r^{t+1}_o, s^t, N \right) + \Pi^{t+1}_{\text{old}} \left( r^{t+1}_m, N, s^t \right) \right] \tag{2.3}
\]

where \( r_o \) is the payment based on the interest rate offered by the bank's closest competitors. A new firm located at a distance \( x \in \left[0, \frac{1}{N}\right] \) from bank \( i \) is indifferent between \( i \) and its neighbors if:

\[
\xi r_i + \tau x + \delta \left[ \xi E(r^{t+1}_o) + \tau \left( \frac{1}{N} - x \right) \right] = \xi r_o + \tau \left( \frac{1}{N} - x \right) + \delta \left[ \xi E(r^{t+1}_i) + \tau x \right] \tag{2.4}
\]

notice that the payment has to be multiplied by \( \xi \) because the new firms do not know their type\(^{16} \). The discounted terms represent the cost of borrowing in the second period conditionally on being a "good" or a "bad" type, given the banks' strategy for loans to old customers. Letting \( \gamma = \frac{\tau}{\xi} \) and solving for \( x \) we get:

\[
x(r_i, r_o, N) = \frac{(r_o - r) - \delta \cdot (E(r^{t+1}_o) - E(r^{t+1}_i))}{2\gamma \cdot (1 - \delta)} + \frac{1}{2N}
\]

thus the market share of bank \( i \) as a function of \( N, r_i, r_o \) is:

\[
2x(r_i, r_o, N) = \frac{(r_o - r) - \delta \cdot (E(r^{t+1}_o) - E(r^{t+1}_i))}{\gamma \cdot (1 - \delta)} + \frac{1}{N} \tag{2.5}
\]

Given banks learn the type of their customer, old bad firms cannot borrow from their old bank. Thus for old bad firms the two closest available banks are \( 2/N \) apart. Then the indifference condition between bank \( i \) and bank \( i + 2 \) for a bad old firm located at a

\(^{16}\)The expected payment to the bank is \( \xi r \). This effect reminds the result in Stiglitz and Weiss (1981).
distance $y \in [0, \frac{2}{N}]$ from bank $i$ is:

$$\tau y = \tau \left( \frac{2}{N} - y \right)$$

where the payment term does not appear because bad firms know that they are not going to return the money. In other words bad firms care only about the distance from the bank. Solving for $y$ we get:

$$y(r_i, r_o, N) = \frac{1}{N}$$

thus bank $i$'s share of bad old firms will be:

$$2y(r_i, r_o, N) - 2x_{t-1} = \frac{2}{N} - s_i^{t-1} \quad (2.6)$$

where $s_i^{t-1}$ is the share of bank $i$ in period $t - 1$.

Now plugging 2.2, 2.5, and 2.6 in 2.3, we get the objective function\(^{17}\) for bank $i$. Then imposing symmetry and steady state in the first order conditions\(^{18}\), and assuming that firms' expectations are satisfied we get the payment based on the equilibrium interest rate:

$$\hat{r} = \frac{\xi (1 - \delta)}{N (1 + \delta)} + c \frac{(1 + \delta \xi - \delta (1 - \xi))}{\xi (1 + \delta)} \quad (2.7)$$

$\hat{r}$ is decreasing with the percentage of good firms in the market\(^{19}\) and with the number of banks, while it increases with the amount of product differentiation $\tau$ and the money-market rate $C$. Any change in the money-market interest rate is more than fully passed through on the loan interest rate. Banks have to compensate for the higher losses they suffer from the bad firms when the cost of funds increases. Notice that with $\delta = 1$ (no discounting) banks charge the money market rate $C$, and the payment becomes just

\(^{17}\)For the explicit derivation of the equilibrium payment see the Appendix.

\(^{18}\)See Appendix.

\(^{19}\)\(\frac{\partial \hat{r}}{\partial \xi} = -\frac{\xi (1 - \delta)}{N (1 + \delta)} + c \left[ \frac{\xi(1-\delta)}{\xi^2(1+\delta)} \right] < 0\)
c attaining the Bertrand competition result. This result depends on the assumption that banks learn the position of their customers. Then the higher transportation cost sustained by firms choosing the furthest bank in the first period is exactly matched by a lower rate paid to that bank in the second period. The intuition for this effect is that in the second period a good old firm is the more "captive" the further it is from the closest competitor bank.

We can now compute the various components of the bank’s profits. Remember that in each period there are $\frac{1}{2}$ new firms and $\frac{1}{2}$ old firms. Starting with the profit coming from the firms that are unknown to the bank (new firms plus bad old firms rejected by competitors banks) when $s^{t-1} = \frac{1}{N}$, we get:

$$\Pi_{free}^{1/N} = \frac{\tau (1 - \delta)}{2N^2 (1 + \delta)} - \frac{c (1 - \xi) (1 + 3\delta)}{2N (1 + \delta)} \quad (2.8)$$

As expected $\Pi_{free}^{1/N}$ is increasing in the amount of product differentiation: the larger $\tau$, the larger banks’ market power and the less fierce the competition. It is decreasing in the cost of funds and the share of bad firms in the market, that can be interpreted as the asymmetric information cost. In equilibrium the profit from old good firms when $s^{t-1} = \frac{1}{N}$, is given by equation 2.2 multiplied by the weight of old good firms on the market, that is $\frac{\xi}{2}$:

$$\Pi_{old}^{1/N} = \frac{\tau (1 - \delta)}{2N^2 (1 + \delta)} + \frac{c (1 - \delta) (1 - \xi)}{2N (1 + \delta)} + \frac{\tau \xi}{4N^2} \quad (2.9)$$

and summing 2.8 and 2.9 we get the per period profit in steady state:

$$\Pi_{old}^{1/N} + \Pi_{free}^{1/N} = \frac{\tau (1 - \delta)}{N^2 (1 + \delta)} - \frac{2c (1 - \xi) \delta}{N (1 + \delta)} + \frac{\tau \xi}{4N^2}$$

Notice that the per period profit is increasing in $\tau$ and in $\xi$ as expected, and is decreasing in $\delta$. The intuition behind this result is straightforward: $\delta$ is the inverse of the

\[\text{The derivative of the period profit respect to } \delta \text{ is:}\]
discount rate, the lower the discount rate (the larger \( \delta \)), the larger the effect of asymmetric information on competitive behavior. If banks care only about the present period, they do not consider the informational effects of their pricing strategy, thus they compete less aggressively for new customer. The extreme case when \( \delta = 0 \), future does not matter, represents an upper bound for the ”free market” interest rate.

Until now I have treated \( N \) as exogenous. One important and non standard result is that even without fixed costs this market can sustain only a limited number of banks\(^{21}\). The intuition for this is that increasing the number of banks competing on the market the equilibrium interest rate decreases, while the relative composition of good and bad clients in banks’ portfolios does not change (each bank always gets one \( N \)th of both types). Then for \( N \) large enough the profits from the good firms are not enough to cover the losses from the bad ones. We can derive the equilibrium number of banks \( \hat{N} \) from the no-entry and the no-exit conditions. Notice that in this model to be on the market is valuable by itself, thus we expect: \( N_{\text{no-entry}} \leq N_{\text{no-exit}} \). This is because banks sustain an ”informational sunk cost” to enter the market. The no-entry condition with zero fixed costs is\(^{22}\):

\[
\Pi^0_{\text{free}} + \frac{\delta}{1 - \delta} \left( \Pi^{1/N}_{\text{old}} + \Pi^{1/N}_{\text{free}} \right) \leq 0 \tag{2.10}
\]

There is a problem to compute \( \Pi^0_{\text{free}} \), the profit of an entrant with zero market share in period \( t - 1 \). In standard models with competition on the circle the assumption is that competitors relocate if entry occurs, so that they are always equidistant. In our model this is not the case. To move is costly because reduces the profit on old good customers. It is clear from 2.1 that moving away from the center of the segment of firms

\[
-2^{\frac{\tau + c (1 - \xi)}{N}} N^\frac{1}{2} (1 + \delta)^{\frac{1}{2}} < 0
\]

\(^{21}\)In standard models of competition on the circle, without fixed cost there is an infinite number of competitors that enter the market.

\(^{22}\)This is equivalent to: \( \Pi^0_{\text{free}} + \delta V_{\text{in}} \leq \delta V_{\text{out}} \), where \( V_{\text{in}} \) and \( V_{\text{out}} \) represent the value of being in and out. See appendix.
it knows, a bank has to decrease the interest rate charged to its old clients in order to keep them from switching to its competitors. Hence when we assume equidistant banks in computing $\Pi^0_{\text{free}}$, we make entry easier than it really is in this model or, in other words, $N^\text{true}_{\text{no-entry}} \leq N^\text{equid}_{\text{no-entry}}$. Nonetheless, given here I am interested in showing that this market sustains only a finite number of banks, I can assume equidistant banks. With this assumption the first order conditions for the entrant are the same as for the banks already on the market (indeed the f.o.c. do not depend on period $t - 1$ market shares\textsuperscript{23}). That is: $\hat{\tau}$ is the same as in 2.7. Thus for an entrant with $s^{t-1} = 0$ we have:

$$\Pi^0_{\text{free}} = \frac{\tau (1 - \delta)}{2N^2 (1 + \delta)} - \frac{c (1 - \xi) (1 + 2\delta)}{N (1 + \delta)}$$  \hspace{1cm} (2.11)

and from 2.10 (with equidistant banks)\textsuperscript{24} we get:

$$\hat{N}_{\text{no-entry}} = \frac{\tau (2 (1 - \delta) + \xi \delta)}{4c (1 - \xi)}$$  \hspace{1cm} (2.12)

As expected $\hat{N}_{\text{no-entry}}$ goes to infinity as $\xi$ goes to 1, that is as the market approaches a standard market without asymmetric information. $\hat{N}_{\text{no-entry}}$ increases with market differentiation $\tau$ (because banks can make more profit from good firms); while it decreases with $c$ and the discount rate for the same reasons discussed before: when the discount rate increases the future counts less, thus competition becomes less fierce and profits increase. Notice that it is asymmetric information and not risk that generates this result. In the appendix I show that a banking industry with no asymmetric information and an average credit worthiness equal to $\xi$ behaves as a standard differentiated market.

The second threshold is given by the no-exit condition. In each period it has to be profitable for banks to compete for the "free market". If in period $t$ a bank does not compete for new firms, in period $t + 1$ it will be out of the market (given firms live

\textsuperscript{23}This is because the number of old firms that each bank gets in each period does not depend on the interest rate the bank charges to the free market in that period, but only on its market share in the previous one.

\textsuperscript{24}See Appendix.
only two periods). Thus in order to have no bank exiting the market, it has to be more profitable for banks to serve both new and old firms than to lend to their own old good customers only. Then the no-exit condition is\(^{25}\):

\[
\Pi_{free}^{1/N} + \delta \Pi_{old}^{1/N} \geq 0
\]  

(2.13)

and the solution is\(^{26}\):

\[
\bar{N}_{no-exit} = \frac{\tau (2 (1 - \delta) + \xi \delta)}{2c (1 + \delta) (1 - \xi)}
\]  

(2.14)

that for \(\delta < 1\) is larger than \(\bar{N}_{no-exit}\). Hence our steady state is still an equilibrium when we allow for entry-exit if and only if:

\[
\frac{\tau (2 (1 - \delta) + \xi \delta)}{4c (1 - \xi)} \leq N \leq \frac{\tau (2 (1 - \delta) + \xi \delta)}{2c (1 + \delta) (1 - \xi)}
\]  

(2.15)

Notice that this result is valid with a zero "external" fixed cost. Asymmetric information determines a limit for the number of banks that the market can sustain in equilibrium. Even with zero fixed cost only a finite number of banks can make non negative profits in this market. In other words \(\bar{N}_{no-entry}\) and \(\bar{N}_{no-exit}\) represent an upper bound for the no-entry/no-exit band with a positive fixed costs. This makes the equilibrium number of banks "partially" independent from the size of the market defined as the density of firms around the circle. With zero fixed costs if we double the density of firms without changing their type composition the equilibrium does not change. What matters is the relative weight of bad and good firms in the market. The intuition is that the adverse selection stemming from the informational asymmetries in the market represents a sort of endogenous fixed cost; and that this endogenous fixed cost is larger the larger the percentage of bad firms in the market.

Now consider the case where banks sustain a positive exogenous fixed cost \(f > 0\) in

---

\(^{25}\)That is equivalent to \(\Pi_{old}^{1/N} + \Pi_{free}^{1/N} \geq \Pi_{old}^{1/N} + \delta V_{in} \geq \Pi_{old}^{1/N} + \delta V_{out}\). See appendix.

\(^{26}\)See Appendix.
order to be on the market. The no-entry condition becomes:

\[ N \geq N_{\text{no-entry}}(f) = \frac{-c(1 - \xi)}{2f(1 - \delta)} + \sqrt{\frac{c^2(1 - \xi)^2}{(2f(1 - \delta))^2} + \frac{\tau(2(1 - \delta) + \delta \xi)}{4f(1 - \delta)}} \]

where:

\[ \lim_{f \to 0} N_{\text{no-entry}}(f) = \frac{\tau(2(1 - \delta) + \xi \delta)}{4c(1 - \xi)} = \tilde{N}_{\text{no-entry}} \]

Assuming that the fixed cost is not a sunk cost, the no-exit condition is determined by the solution to the equation:

\[ \frac{1}{1 - \delta} \left( \Pi_{\text{old}}^{1/N} + \Pi_{\text{free}}^{1/N} \right) - f = 0 \quad (2.16) \]

that is:

\[ N \leq N_{\text{no-exit}}(f) = \frac{-c\delta(1 - \xi)}{f(1 - \delta^2)} + \sqrt{\frac{c^2\delta^2(1 - \xi)^2}{f^2(1 - \delta^2)^2} + \frac{\tau(4(1 - \delta) + \xi(1 + \delta))}{4f(1 - \delta^2)}} \]

subject to the condition that the bank prefers to be on the free market than to lend to its own old customers only, hence:

\[ N_{\text{no-exit}}(f) \leq \frac{\tau(2(1 - \delta) + \xi \delta)}{2c(1 + \delta)(1 - \xi)} = \tilde{N}_{\text{no-exit}} \]

As in a standard model the number of banks that the market can sustain in equilibrium is larger the smaller the fixed cost. However, here even with zero fixed cost in equilibrium only a finite number of banks can be on the market.

### 2.2.2 The Large Firms Loans Market

In this model large firms credit-worthiness is public information. As observed before there might be economies of scale in acquiring information at the firm level, so that informational costs are less important for larger loans. One other argument for this assumption
is that small firms assets and credit-worthiness depend mainly on the reputation and the skills of the manager/owner, while for medium/large size firms there can be more objective factors that determine their type. The model would be the same if the degree of asymmetric information differed across industries. I assume here that large firms are all "good", but the model can be generalized. The results do not change qualitatively as long as the type of the firms is known to everybody. For symmetry I assume that, also for large firms, banks learn the position of their clients after one period. Then we can compute the equilibrium for a market without asymmetric information just imposing $\xi = 1$. Assume there are $M$ banks in the market, then from 2.7 the payment based on the equilibrium interest rate charged to new firms is:

$$\hat{r}_l = \frac{\tau (1 - \delta)}{M (1 + \delta)} + c$$  \hspace{1cm} (2.17)$$

Then from 2.9 the equilibrium profits from old clients are:

$$\Pi_{old}^{1/M} = \frac{\tau (3 - \delta)}{4M^2 (1 + \delta)}$$

while the equilibrium profits from the new firms market are defined by 2.8 and are:

$$\Pi_{free} = \frac{\tau (1 - \delta)}{2M^2 (1 + \delta)}$$

Now assuming an exogenous fixed cost $f$, we can derive the equilibrium number of banks. Given banks learn the position of their clients, also in this case to be on the market is valuable by itself, and we expect: $M_{no-entry} \leq M_{no-exit}$. Plugging the results above in 2.10 we get the no-entry condition for the large firms market, while from equation 2.16

\footnote{If the type is public information, banks can condition the interest rate on it; thus we can consider different types as different markets. Then on each market banks will charge a different interest rate as a function of firms riskiness.}
we get the no-exit condition\textsuperscript{28}, and solving for $M$ we get:

\[
M_{\text{no-entry}} = \sqrt{\frac{\tau (2 - \delta)}{4f (1 - \delta)}}
\]

\[
M_{\text{no-exit}} = \sqrt{\frac{\tau (5 - 3\delta)}{4f (1 - \delta^2)}}
\]  

(2.18)

Here, as in the standard model, the number of banks that the market can sustain in equilibrium increases with the "transportation cost" and decreases with the size of the fixed cost. It tends to infinite for the fixed cost that goes to zero.

### 2.3 Cross-Border Banking

In this section I am interested in how the market equilibrium changes if we allow countries to trade in banking services. The question is whether standard theorems of gains from trade apply to the financial sector and how different categories of borrowers are affected by the trade liberalization. I show that in the presence of economies of scale at the international level the effects of trade liberalization are smaller when there is asymmetric information. In other words cross-border entry is more likely in segments of the market where informational asymmetries are less important\textsuperscript{29}. Hence the benefits of trade liberalization will be smaller than in standard intra-industry trade models and the effects will not be uniform in different segments of the market. In the last section I show that this might lead to reallocative effects among different borrowers.

In standard models economies of scale are the basic cause of intra-industry trade. The effects of trade liberalization are an expansion of the available varieties of products, the exploitation of increasing returns to scale, or the disciplining effects that actual or potential foreign competition has on domestic industries. In a Dixit-Stiglitz setup

\textsuperscript{28}I assume that $f$ is not a sunk cost. If $f$ is sunk $M_{\text{no-exit}}$ is infinite.

\textsuperscript{29}In the appendix I show that when there are economies of scope in serving the small and the large firms market together, it is possible that trade liberalization does not affect at all the small firms market.
the result of trade opening is an increase in the number of products through country specialization\textsuperscript{30}. In Cournot competition settings the removal of legal barriers to trade induce firms to enter each other market because each firm's perceived marginal revenue is decreasing with its market share. With symmetric firms in the free trade equilibrium the number of competitors in each country increases reducing the price-cost margins, while the total number of firms declines\textsuperscript{31}. In the model presented here economies of scale at the international level induce banks to enter foreign markets, generating intra-industry trade\textsuperscript{32}. However, the presence of informational asymmetries reduces the pro-competitive effects of trade liberalization.

I assume that there are two identical countries, one "domestic" and one "foreign". Because of symmetry I need to consider only the domestic country. I assume that there are economies of scale at the international level. To enter the domestic market an existing foreign bank has to sustain an additional fixed cost of only $\lambda f$, with $0 \leq \lambda < 1$. The idea is that at least some of the banks' activities need not to be duplicated in order to serve two markets.

In order to keep the algebra simple, I assume that the two countries are identical in terms of the varieties of banking products that firms demand. That is the two circles are identical. This assumption is not essential for my results. The alternative would be to model the "global" market as one single "larger" circle of measure $1 + \zeta$ and density $\frac{2}{1+\zeta}$ (with $0 \leq \zeta < 1$), with a fixed cost $(1 + \lambda) f$ to enter the market. In that setting my results would hold qualitatively as long as $(1 + \lambda) \leq \frac{2}{1+\zeta}$. That is as long as the density of firms around the circle increases more than the fixed cost or, in other words, as long as there are economies of scale at the international level.

First consider the standard case. The new no-entry and no-exit conditions on the

\textsuperscript{30}See Krugman (1981).
\textsuperscript{31}See Brander and Krugman (1983).
\textsuperscript{32}In the presence of non perfectly correlated country risks, banks' risk aversion could be another cause of intra-industry trade.
large firms "global" market are\textsuperscript{33}:

\[
M \geq M_{\text{no-entry}}^{\text{open}} = \sqrt{\frac{\tau (2 - \delta)}{2 (1 - \delta) (1 + \lambda) f}}
\]
\[
M \leq M_{\text{no-exit}}^{\text{open}} = \sqrt{\frac{\tau (5 - 3\delta)}{2 (1 - \delta^2) (1 + \lambda) f}}
\]

notice that given \( \lambda \leq 1 \) no bank enters a single country market. The 2.19 show that the open economy no-entry/no-exit boundaries can be obtained multiplying the closed economy boundaries by \( \sqrt{\frac{2}{(1+\lambda)}} \). As a consequence some closed economy equilibria are no longer sustainable when we allow cross-border banking. The no-entry condition on the large firms market as in 2.18 does not hold anymore because foreign banks can enter the domestic market incurring a cost of only \( \lambda f \). If \( \lambda \) is small enough and \( \delta \) large enough no bank can survive lending to its own domestic market only\textsuperscript{34}, so that also the no-exit condition is violated and no closed economy equilibrium is still valid. In this case the no-entry condition for existing foreign banks implies a number of banks on the domestic market large enough to push out any bank lending only on its home market. Then in equilibrium all banks serve both their domestic and the foreign large firms loan markets. The effects of trade opening are an increase in the degree of competition and a reduction in the loan interest rate. As expected from standard results, cross-border banking liberalization benefits borrowers and hurts lenders by a reduction of oligopolistic rents.

Now consider the market for loans to small firms. From section 2 we know that there is an upper bound to the number of banks that a market with asymmetric information can sustain. Here I show that trade opening is less effective in increasing the number of competitors on this market with respect to the large firms market. Moreover I show that the upper bound to the number of banks in the market does not depend on the size of

\textsuperscript{33}See Appendix.

\textsuperscript{34}The condition is: \( \lambda \leq \frac{1+\delta(3+\delta)}{4+\delta} \) see the appendix for a proof.
the market. The new no-entry and no-exit boundaries are:

\[
N_{\text{no-entry}}(f) = \frac{-c(1-\xi)}{f(1+\lambda)(1-\delta)} + \sqrt{\frac{c^2(1-\xi)^2}{f((1+\lambda)(1-\delta))^2}} + \frac{\tau(2(1-\delta)+\xi\delta)}{f(1+\lambda)(1-\delta)} \\
N_{\text{no-exit}}(f) = \frac{-2c(1-\xi)}{f(1+\lambda)(1-\delta^2)} + \sqrt{\frac{4c^2\delta^2(1-\xi)^2}{f^2((1+\lambda)(1-\delta^2))^2}} + \frac{\tau(4(1-\delta)+\xi(1+\delta))}{2(1+\lambda)f(1-\delta^2)}
\] (2.20)

still subject to:

\[
N_{\text{no-exit}}(f) \leq \frac{\tau(2(1-\delta)+\xi\delta)}{2c(1+\delta)(1-\xi)} = \bar{N}_{\text{no-exit}}
\]

In the Appendix I show that:

\[
N_{\text{no-entry}}^{\text{open}}((1+\lambda)f) < \sqrt{\frac{2}{1+\lambda}}N_{\text{no-entry}}(f) \quad (2.21)
\]

\[
N_{\text{no-exit}}^{\text{open}}((1+\lambda)f) < \sqrt{\frac{2}{1+\lambda}}N_{\text{no-exit}}(f)
\]

Moreover the upper bounds for the no-entry and the no-exit conditions do not change. The limit of 2.20 for \( f \) that goes to zero is still \( \bar{N}_{\text{no-exit}} \).

The 2.21 means that the presence of informational asymmetries diminishes the gains from trade stemming from the scale economies at the international level. The intuition is that in the small firms market the equilibrium number of banks is determined by the "exogenous" fixed cost \( f \) and the "endogenous" fixed cost generated by the adverse selection. Expanding abroad banks can exploit the economies of scale associated with the external fixed cost. However, the market opening does not affect the endogenous fixed cost that is proportional to the size of the market and inversely proportional to the number of competing banks. Hence, trade liberalization is less effective in the presence of asymmetric information. This result provides a partial explanation for the higher degree of foreign penetration in wholesale banking respect to retail banking. To the extent that small loans are characterized by a higher degree of asymmetric information, on the basis
of the predictions of this model we should not expect a large number of entries in retail banking markets after deregulation. Nevertheless, we might see mergers and acquisition as an alternative to entry: by buying an existing bank the entrant avoids the adverse selection problems due to asymmetric information.

2.3.1 Competition for Funds and Allocative Effects

In the model presented in the previous sections asymmetric information decreases the pro-competitive effects of trade liberalization in banking. Nevertheless, trade opening still benefits all borrowers through lower interest rates. In the presence of an infinitely elastic supply of funds for the banks, the small and large firms market are completely separate. Hence, at worst, in the open economy equilibrium small firms do as well as in autarky. In this section I am interested in whether new entry on the large firms loan market can hurt the small firms in the presence of an upward sloping supply of funds. The idea is that the increased competition on the large firms market may cause funds to be competed away from the small firms. If the market supply of funds is upward sloping, an increase in the amount of loans supplied to large firms raises the cost of funds for the banking system, and as a consequence the interest rate charged to small firms may increase. This issue is relevant from a policy point of view. To liberalize trade in banking services becomes less attractive and more controversial to the extent that it might hurt some categories of consumers.

In this model there are no quantity effects, because firms have a unit demand for loans. However, the inter-market effects of a positively sloped supply of funds can be introduced considering competition for deposits. For symmetry with the loan markets I use a model of competition on the circle also for the deposits market. Assume that banks compete for deposits on a circle of measure one, where depositors are uniformly distributed around the circle and offer a unit of deposits. Deposits can be invested in the money market or used as an alternative source of funds for lending to firms. For every

\[ \text{35 This model is the same as in Chiappori et al. (1995).} \]
unit of deposits a bank raises, it gets the difference between the money-market rate and the deposits rate: \( c - d \), where \( d \) is equal to \( 1 + D \), and \( D \) is the interest rate paid on deposits. Assume there are \( M \) banks located equidistant in the deposits market. The indifference condition for a depositor located at \( x \in [0, 1/M] \) is:

\[
D_i - \varphi x = D_0 - \varphi \left( \frac{1}{M} - x \right) \iff d_i - \varphi x = d_0 - \varphi \left( \frac{1}{M} - x \right)
\]

where \( \varphi \) is the "transportation cost" for depositors. Banks want to minimize their cost of funds. Because of the buffer represented by the money market, we can separate the general maximization problem\(^{36}\). Thus given \( c \), each bank tries to maximize the gain from using deposits as an alternative source of funds, that is:

\[
\max_d \left[ (c - d) \left( \frac{d - d_0}{\varphi} + \frac{1}{M} \right) \right]
\]

imposing symmetry in the first order conditions\(^{37}\) we get:

\[
\hat{d} = c - \frac{\varphi}{M}
\]

(2.22)

that, as expected, is increasing with \( M \) for effect of the competition among banks. Then, in equilibrium (that is with one Mth of the deposits market), the gain from using deposits instead of money-market funds is:

\[
(c - \hat{d}) \frac{1}{M} = (c - c + \frac{\varphi}{M}) \frac{1}{M} = \frac{\varphi}{M^2}
\]

(2.23)

I assumed until now that banks consider the money market rate, and thus \( c \) as given.

\(^{36}\)See Yannelle(1993) for the complications that arise when banks have to set active and passive rate simultaneously.

\(^{37}\)The f.o.c. are:

\[
\frac{c - d}{\varphi} - \frac{d - d_0}{\varphi} - \frac{1}{M} = 0
\]
The idea is that a single bank is too small to affect the equilibrium of the entire financial system, even though it has market power on deposits and loans markets\(^{38}\). However, the money-market rate depends on the deposits interest rate through depositors’ portfolio choices. If the deposit rate goes up also the money-market rate will go up. To describe this I introduce the next equation:

\[ c = f(\hat{d}, R) \]

with \( R \) a vector of all other variables affecting \( c \). The assumption is that: \( f'_d \geq 0 \). Notice that I excluded that firms finance themselves directly on the market, thus \( c \) does not depend directly on the loans interest rates. Then substituting \( \hat{d} \) we get:

\[ \hat{c} = f(c - \frac{\varphi}{M}, R) \Rightarrow \hat{c} = g(\varphi, M, R) \] (2.24)

where \( g'_M > 0 \). Notice that here we should recompute the entire market equilibrium including the deposits market in the no-entry/no-exit conditions. I consider here only the more extreme case shown in the appendix, in which there is no entry on the small firms market. We can rewrite the upper bound for the no-entry and no-exit conditions, 2.10 and 2.13 as a function of \( M \):

\[ \bar{N}_{\text{no-exit}} = \frac{\tau (2(1 - \delta) + \xi \delta)}{2(1 + \delta)(1 - \xi)g(\varphi, M, R)} \]

\[ \bar{N}_{\text{no-entry}} = \frac{\tau (2(1 - \delta) + \xi \delta)}{4(1 - \xi)g(\varphi, M, R)} \]

and the payment based on the equilibrium loan rate for small firms is:

\[ \hat{\tau} = \frac{\tau(1 - \delta)}{N\xi(1 + \delta)} + g(\varphi, M, R) \left[ \frac{1 + \delta \xi - \delta(1 - \xi)}{\xi(1 + \delta)} \right] \]

---

\(^{38}\)This setting is known as the Klein/Monti model of banking competition, where banks are price takers in the bond and interbank markets, and compete with some market power in the markets for loans and deposits.
Then cross-border entry on the large firms segment of the market affects small firms in two ways. A larger number of banks on the deposit market not only increases the cost of funds and thus the loan rate for small firms, but also lowers the no-entry/no-exit thresholds for the small firms market, potentially reducing the number of banks lending to small firms. The size of this "cost of funds" effect depends on the elasticity of the money-market rate respect to the deposits rate and on the sensitivity of the deposit rate to the degree of competition. The larger the product differentiation on the deposits market (v), the larger the response of the deposits interest rate to the increased competition. The more sensitive the money-market rate to the deposits rate, the larger the negative effect for the small firms of any number of new entrants on the deposits market. In the case where some entry occurs on the small firms market the net result on the loan interest rate will depend on the elasticity of the money-market rate to the deposits rate and on the extent of entry in the small firms market relatively to the entry on the large firms market.

The results in this section point to the possible redistributive effects of cross-border banking liberalization. In this setup new entry causes a compression in the intermediation margins for loans to large firms, and at the same time an increase in the loan rate for small firms. Berger, Kashyap and Scalise (1995) find some evidence of a reduced supply of funds to small business after the deregulation in the US. However, it is necessary to collect more empirical evidence to reach any conclusion about this aspect of the model.

2.4 Conclusions

In this paper I addressed the issue of trade liberalization in banking markets. I started from the observation that the removal of legal obstacles to cross-border banking did not significantly reduce market concentration and that intermediation margins did not exhibit a clear downward trend suggesting that relevant economic barriers to entry exist in credit markets. I showed that asymmetric information might represent by itself a
barrier to entry for new banks, and that in that context deregulation will be more likely to induce entry in segments where informational asymmetries are less important. Finally I pointed out that it may be the case that trade opening will hurt those borrowers which are characterized by a higher degree of asymmetric information.

The framework presented in this paper captures only a particular aspect of the interaction among financial intermediaries. Hence, we have to be very cautious in extrapolating policy recommendations from this model. Nevertheless, some insights may be relevant for the debate about regulation in banking. In particular, the role played by informational asymmetries suggests that the incumbents' advantage should be larger in universal bank systems (German style) than in "market based" systems (US style)\(^{39}\). It has been argued that banks arise as monitoring and screening devices in a context of asymmetric information and that universal banks are more efficient in collecting information. Hence, in this view a universal bank system would sacrifice competition to screening efficiency\(^{40}\). However, more empirical evidence should be collected before reaching any definitive conclusion.

On the theoretical side there are two natural extension of this model: the first is to include collusive equilibria in the analysis, the other, more ambitious, is to allow banks to compete with more than one instrument. It has been argued that an important effect of trade liberalization and deregulation in banking will be to create an environment in which collusion is more difficult; thus the analysis of banks' collusive behavior might provide a better comprehension of the evolution of the credit markets after deregulation. In the real world banks are partially able to screen bad and good loan applicants by offering a variety of contracts. In particular, prospective applicants are offered both an interest rate and a loan size. Hence a model that considered explicitly this aspect of banks' competition would help to better comprehend the characteristics of strategic interaction

\(^{39}\)To this regard Steinherr and Huvencers (1994) find that the market share of foreign banks is significantly lower in universal bank countries.

\(^{40}\)For a general discussion of the welfare implication of different financial systems see Allen and Gale (1995).
among financial intermediaries.
2.5 Appendix

Derivation of the equilibrium interest rate

The bank’s objective function is:

$$\max_{r_t} \Pi^t_{\text{free}} \left( r^t, r^t, s^t, N \right) + \delta \left[ \Pi^{t+1}_{\text{free}} \left( r^{t+1}, r^{t+1}, s^t, N \right) + \Pi^{t+1}_{\text{old}} \left( r^{t+1}_{m}, N, s^t \right) \right]$$

and plugging 2.2, 2.5, and 2.6 in 2.3, we get:

$$\max_{r_t} \left( r^t \xi - c \right) \left( \xi \cdot \frac{r^t - \delta (E(r^{t+1}) - E(r^{t+1}))}{\tau(1-\delta)} + \frac{1}{N} \right) \frac{1}{2} - c (1 - \xi) \left( \frac{2}{N} - s^t \right) \frac{1}{2}$$

$$+ \delta \frac{1}{2} \left[ \left( r^{t+1} \xi - c \right) \left( \xi \cdot \frac{r^{t+1} - \delta (E(r^{t+1}) - E(r^{t+1}))}{\tau(1-\delta)} + \frac{1}{N} \right) \right]$$

$$- \delta \frac{1}{2} \left[ c (1 - \xi) \left( \frac{2}{N} - \xi \cdot \frac{r^t - \delta (E(r^{t+1}) - E(r^{t+1}))}{\tau(1-\delta)} + \frac{1}{N} \right) \right]$$

$$+ \delta \frac{1}{2} \left( \xi \cdot \frac{r^t - \delta (E(r^{t+1}) - E(r^{t+1}))}{\tau(1-\delta)} + \frac{1}{N} \right) \left( r^{t+1} - c + \frac{\gamma \xi}{N} \right)$$

$$- \delta \xi \frac{\gamma \xi}{2} \left( \xi \cdot \frac{r^t - \delta (E(r^{t+1}) - E(r^{t+1}))}{\tau(1-\delta)} + \frac{1}{N} \right)^2$$

Deriving respect to \( r \) we get the first order conditions:

$$\frac{\partial OF}{\partial r} = \xi \left( \frac{\xi (r^t - \delta (E(r^{t+1}) - E(r^{t+1}))}{\tau(1-\delta)} + \frac{1}{N} \right) - \frac{(\xi - c)}{\gamma (1-\delta)} \frac{\delta (1 - \xi) c}{2 \gamma (1-\delta)}$$

$$+ \delta \frac{\xi}{2 (1-\delta) \tau} \left[ - \left( \frac{r^{t+1}}{\gamma} + \frac{\xi}{N} \right) + \xi \tau \left( \frac{\xi (r^t - \delta (E(r^{t+1}) - E(r^{t+1}))}{\tau(1-\delta)} + \frac{1}{N} \right) \right] = 0$$

The second order conditions are satisfied:

$$\frac{\partial^2 OF}{\partial r^2} = \frac{1}{2} \frac{(1 + \delta)}{(1 - \delta) \tau} \xi^2 < 0$$

Then assuming that frms have rational expectations and imposing symmetry and
steady state, and substituting $\gamma = \frac{\tau}{\xi}$, we get the equilibrium interest rate:

$$\hat{\rho} = \frac{(1 - \delta) \tau}{N \xi (1 + \delta)} + \frac{c(1 - \delta + 2\delta \xi)}{\xi (1 + \delta)}$$

**No-entry/No-exit Conditions**

Consider the value functions of being "in" or "out" the market:

$$V_{out} = \max \left[ 0 + \delta V_{out}, \Pi_{free}^0 + \delta V_{in} \right]$$

$$V_{in} = \max \left[ \delta V_{out}, \Pi_{free}^N + \delta V_{in} \right] + \Pi_{old}^N$$

Notice that given $\Pi_{old}^N > 0$ and $\Pi_{free}^N \geq \Pi_{free}^0$ we have always $V_{in} \geq V_{out}$

The no-entry condition is:

$$\Pi_{free}^0 + \delta V_{in} \leq \delta V_{out} \iff \Pi_{free}^0 + \delta (V_{in} - V_{out}) \leq 0$$

the no-exit condition is:

$$\Pi_{old}^N + \Pi_{free}^N + \delta V_{in} \geq \Pi_{old}^N + \delta V_{out} \iff \Pi_{free}^N + \delta (V_{in} - V_{out}) \geq 0$$

**Claim:** $\Pi_{free}^0 + \delta (V_{in} - V_{out}) \leq 0 \iff \Pi_{free}^0 + \frac{\delta}{1 - \delta} \left( \Pi_{free}^N + \Pi_{old}^N \right) \leq 0$

**Proof:** assume that the no-exit condition is verified, that means:

$$V_{in} = \Pi_{free}^N + \delta V_{in} + \Pi_{old}^N \Rightarrow V_{in} = \frac{1}{1 - \delta} \left( \Pi_{free}^N + \Pi_{old}^N \right)$$

if $\Pi_{free}^0 + \delta (V_{in} - V_{out}) \leq 0$ then $V_{out} = 0$, from $V_{out}$ definition;
then substituting we get:

\[
\Pi_{\text{free}}^0 + \frac{\delta}{1 - \delta} \left( \Pi_{\text{free}}^{1/2} + \Pi_{\text{old}}^{1/2} \right) \leq 0
\]

if \( \Pi_{\text{free}}^0 + \delta (V_{in} - V_{out}) > 0 \) then \( V_{out} = \Pi_{\text{free}}^0 + \delta V_{in} \), then substituting we get:

\[
\Pi_{\text{free}}^0 + \delta (V_{in} - \Pi_{\text{free}}^0 - \delta V_{in}) > 0 \Leftrightarrow (1 - \delta) \Pi_{\text{free}}^0 + (1 - \delta) \delta V_{in} > 0
\]
\[
\Leftrightarrow \Pi_{\text{free}}^0 + \delta V_{in} > 0 \Leftrightarrow \Pi_{\text{free}}^0 + \frac{\delta}{1 - \delta} \left( \Pi_{\text{free}}^{1/2} + \Pi_{\text{old}}^{1/2} \right) > 0
\]

assume now that the no-exit condition is not verified, then the no-entry condition is always verified, because \( \Pi_{\text{free}}^{1/2} \geq \Pi_{\text{free}}^0 \), then \( V_{out} = 0 \) and from no-exit violated we know that

\( V_{in} = \delta V_0 + \Pi_{\text{old}}^{1/2} \).

Then we can rewrite the no-entry condition as: \( \Pi_{\text{free}}^{1/2} + \delta \Pi_{\text{old}}^{1/2} \leq 0 \).

from \( \Pi_{\text{free}}^{1/2} \geq \Pi_{\text{free}}^0 \) we have:

\[
(1 - \delta) \Pi_{\text{free}}^{1/2} \geq (1 - \delta) \Pi_{\text{free}}^0 \Leftrightarrow \Pi_{\text{free}}^{1/2} \geq \Pi_{\text{free}}^0 - \delta \Pi_{\text{free}}^0 + \delta \Pi_{\text{free}}^{1/2}
\]

we want to show that:

\[
\Pi_{\text{free}}^0 + \frac{\delta}{1 - \delta} \left( \Pi_{\text{free}}^{1/2} + \Pi_{\text{old}}^{1/2} \right) \leq 0
\]

\[
\Pi_{\text{free}}^0 + \frac{\delta}{1 - \delta} \left( \Pi_{\text{free}}^{1/2} + \Pi_{\text{old}}^{1/2} \right) \leq 0 \Leftrightarrow \Pi_{\text{free}}^0 - \delta \Pi_{\text{free}}^0 + \delta \Pi_{\text{free}}^{1/2} + \delta \Pi_{\text{old}}^{1/2} \leq 0
\]
then from above we know that:

\[ \Pi_{free}^0 - \delta \Pi_{free}^0 + \delta \Pi_{free}^\frac{1}{2} + \delta \Pi_{old}^\frac{1}{2} \leq \Pi_{free}^\frac{1}{2} + \delta \Pi_{old}^\frac{1}{2} \leq 0 \]

q.d.e.

Claim: \( \Pi_{free}^\frac{1}{2} + \delta (V_{in} - V_{out}) \geq 0 \iff \Pi_{free}^\frac{1}{2} + \delta \Pi_{old}^\frac{1}{2} \geq 0 \)

Proof: assume that the no-entry condition is verified. Then \( V_{out} = 0 \). From no-exit verified we know that: \( V_{in} = \frac{1}{1-\delta} \left( \Pi_{free}^\frac{1}{2} + \Pi_{old}^\frac{1}{2} \right) \), then substituting we get:

\[ \Pi_{free}^\frac{1}{2} + \frac{\delta}{1-\delta} \left( \Pi_{free}^\frac{1}{2} + \Pi_{old}^\frac{1}{2} \right) \geq 0 \]

that is the same as:

\[ ((1-\delta) + \delta) \Pi_{free}^\frac{1}{2} + \delta \Pi_{old}^\frac{1}{2} \geq 0 \iff \Pi_{free}^\frac{1}{2} + \delta \Pi_{old}^\frac{1}{2} \geq 0. \]

If \( \Pi_{free}^\frac{1}{2} + \delta (V_{in} - V_{out}) < 0 \Rightarrow V_{in} = \delta V_{0} + \Pi_{old}^\frac{1}{2} \). From no-entry verified we have \( V_{out} = 0 \).

then substituting we get: \( \Pi_{free}^\frac{1}{2} + \delta \Pi_{old}^\frac{1}{2} < 0 \).

Assume now that no-entry is not satisfied. Then the no-exit is always true. Also we have

\[ V_{out} = \Pi_{free}^0 + \delta V_{in} \]

and from no-exit verified we get:

\[ V_{in} = \frac{1}{1-\delta} \left( \Pi_{free}^\frac{1}{2} + \Pi_{old}^\frac{1}{2} \right) \]

then the no-exit condition becomes:
\[ \Pi_{free}^N + \delta \left( \Pi_{free}^N - \Pi_{free}^0 + \Pi_{old}^N \right) \geq 0 \Rightarrow \Pi_{free}^N + \delta \Pi_{old}^N \geq 0 \]

q.d.e.

**The Perfect Test Case**

In this section I show that the main results of this paper hold when we relax the assumption that banks cannot distinguish between new firms and old firms rejected by other banks. As long as the procedure to discriminate is costly asymmetric information represents a barrier to entry. Here I assume that banks can use a perfect test to evaluate firms credit-worthiness\(^{41}\).

The bank's objective function is:

\[
\max_{r^t} \Pi_{free}^t \left( r^t, r_o^t, s^{t-1}, N \right) + \delta \left[ \Pi_{free}^{t+1} \left( r^{t+1}, r_o^{t+1}, s^t, N \right) + \Pi_{old}^{t+1} \left( r_m^{t+1}, N, s^t \right) \right]
\]

Here \( v \) is the test cost and \( c \) is the funds cost. The objective function becomes:

\(^{41}\)Notice that with a perfect test we have to assume that it is not costly for old firms to be tested. Otherwise there is no-pure strategy equilibrium. Here I am only interested in generalizing my result, hence I just make this heroic assumption.
\[
\max_r (r \xi - u - c) \left( \xi \cdot \frac{(r_o - r) - \delta \cdot (E(r_{t+1}^o) - E(r_{t+1}^i))}{\tau (1-\delta)} + \frac{1}{N} \right) \frac{1}{2} - v(1 - \xi) \left( \frac{2\xi}{N} - s_i^{t-1} \right) \frac{1}{2} + \\
\delta \frac{1}{2} \left( r_{t+1}^i \xi - u - c \right) \left( \xi \cdot \frac{(r_{t+1}^o - r_{t+1}) - \delta \cdot (E(r_{t+2}^o) - E(r_{t+2}^i))}{\tau (1-\delta)} + \frac{1}{N} \right) \\
- \delta \frac{1}{2} \left[ v(1 - \xi) \left( \frac{2\xi}{N} - \xi \cdot \frac{(r_o - r) - \delta \cdot (E(r_{t+1}^o) - E(r_{t+1}^i))}{\tau (1-\delta)} + \frac{1}{N} \right) \right] \\
+ \delta \xi \frac{1}{2} \left( r_{m+1}^i - c + \frac{\gamma \xi}{N} \right) \left( \xi \cdot \frac{(r_o - r) - \delta \cdot (E(r_{t+1}^o) - E(r_{t+1}^i))}{\tau (1-\delta)} + \frac{1}{N} \right) \\
- \delta \xi \frac{1}{2} \left[ \frac{\gamma \xi}{2} \left( \xi \cdot \frac{(r_o - r) - \delta \cdot (E(r_{t+1}^o) - E(r_{t+1}^i))}{\tau (1-\delta)} + \frac{1}{N} \right)^2 \right]
\]

deriving respect to \( r \) we get the first order conditions:

\[
\frac{\partial OF}{\partial r} = \frac{\xi}{2} \left( \xi \cdot \frac{(r_o - r) - \delta \cdot (E(r_{t+1}^o) - E(r_{t+1}^i))}{\tau (1-\delta)} + \frac{1}{N} \right) - \frac{(r\xi - c - u)}{2\gamma (1-\delta)} - \frac{\delta (1-\xi) u}{2\gamma (1-\delta)} \\
+ \frac{\delta \xi}{2 (1-\delta) r} \left( -\xi \left( r_{m+1}^i - c + \frac{\gamma \xi}{N} \right) \right) + \frac{\delta \xi^2}{2 (1-\delta) r} \left( \xi \cdot \frac{(r_o - r) - \delta \cdot (E(r_{t+1}^o) - E(r_{t+1}^i))}{\tau (1-\delta)} + \frac{1}{N} \right) = 0
\]

The second order conditions are satisfied:

\[
\frac{\partial^2 OF}{\partial r^2} = -\frac{\xi^2}{\tau (1-\delta)} - \frac{1}{2} \delta \frac{\xi^3}{\tau (1-\delta)^2} < 0
\]

Then imposing symmetry and steady state, and assuming that firms do not have sistematically bised expectations, we substitute \( \gamma = \frac{\xi}{\xi} \) to get the equilibrium interest rate:

\[
\hat{r} = \frac{\tau (1-\delta)}{N (1+\delta) \xi} + \frac{c (1+\delta \xi)}{(1+\delta) \xi} + \frac{v (1-\delta + \delta \xi)}{(1+\delta) \xi}
\]

the profit on the free market in equilibrium for a bank with \( \frac{1}{N} \) market share is:

\[
\Pi_{free}^{1/N} = \frac{1}{2N} \left( \xi \cdot \left( \frac{\tau (1-\delta)}{N (1+\delta) \xi} + \frac{c (1+\delta \xi)}{(1+\delta) \xi} + \frac{v (1-\delta + \delta \xi)}{(1+\delta) \xi} \right) - v - c - v (1 - \xi) \right)
\]
and rearranging:
\[ \Pi^{1/N}_{\text{free}} = \frac{\tau (1 - \delta)}{2N^2 (1 + \delta)} - \frac{\delta (1 - \xi) c}{2N (1 + \delta)} - \frac{(1 + 3\delta - 2\delta \xi - \xi) v}{2N (1 + \delta)} \]

plugging the equilibrium interest rate in the profit from old good firms, we get:

\[ \Pi^{1/N}_{\text{old}} = \frac{\xi}{2} \left( \frac{1}{N} (r_m - c) + \frac{\tau}{2N^2} \right) \]

\[ \Pi^{1/N}_{\text{old}} = \frac{\tau (2 (1 - \delta) + (1 + \delta) \xi)}{4N^2 (1 + \delta)} + \frac{(1 - \delta + \delta \xi) v}{2N (1 + \delta)} + \frac{(1 - \xi) c}{2N (1 + \delta)} \]

Then the no-exit condition becomes:

\[ \Pi^{1/N}_{\text{free}} + \delta \Pi^{1/N}_{\text{old}} \geq 0 \]

that is:

\[ \Pi^{1/N}_{\text{free}} + \delta \Pi^{1/N}_{\text{old}} = \frac{\tau (2 (1 - \delta) + \delta \xi)}{4N^2} - \frac{(1 + \delta) (1 - \xi) v}{2N} \geq 0 \]

then solving for \( N \):

\[ \tilde{N}_{\text{no-exit}} = \frac{\tau (2 (1 - \delta) + \delta \xi)}{2 (1 + \delta) (1 - \xi) v} \]

The no-entry condition is:

\[ \Pi^{0}_{\text{free}} + \frac{\delta}{1 - \delta} \left( \Pi^{1/N}_{\text{old}} + \Pi^{1/N}_{\text{free}} \right) \leq 0 \]

where:

\[ \Pi^{0}_{\text{free}} = \frac{\tau}{2N^2 (1 + \delta)} - \frac{\delta (1 - \xi) c}{2N (1 + \delta)} + \frac{(-2 - 4\delta + 3\delta \xi + 2\xi) v}{2N (1 + \delta)} \]

and:

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\[
\Pi^{1/N}_{\text{free}} + \Pi^{1/N}_{\text{old}} = \frac{\tau (4 + (1 + \delta) \xi)}{4N^2 (1 + \delta)} + \frac{(1 - \delta) (1 - \xi) c}{2N (1 + \delta)} - \frac{(4\delta - 3\delta\xi - \xi) v}{2N (1 + \delta)}
\]

then the condition is:

\[
\Pi^{0}_{\text{free}} + \frac{\delta}{1 - \delta} (\Pi^{1/N}_{\text{old}} + \Pi^{1/N}_{\text{free}}) = \frac{\tau (2 (1 - \delta) + \delta\xi)}{4N^2 (1 - \delta)} - \frac{(1 - \xi) v}{N (1 - \delta)} \leq 0
\]

and solving for \( N \):

\[
\tilde{N}_{\text{no-entry}} = \frac{\tau (2 (1 - \delta) + \delta\xi)}{4 (1 - \xi) v}
\]

q.d.e.

**Risk does not generate a barrier to entry**

**Claim:** the introduction of risk does not generate equilibria with a finite number of banks in absence of an exogenous fixed cost.

**Proof:** consider first the indifference condition for firms with an expected credit worthiness equal to \( \xi \):

\[
r \xi + \tau x = r_0 \xi + \tau \left( \frac{1}{N} - x \right)
\]

then bank \( i \) market share as a function of \( r \) is:

\[
s (r | r_0) = \frac{(r_0 - r) \xi}{\tau} + \frac{1}{N}
\]

the profit maximization problem is:

\[
\max_r (\xi r - c) \left[ \frac{(r_0 - r) \xi}{\tau} + \frac{1}{N} \right]
\]
f.o.c. are:

\[
\xi \left[ \frac{(r_0 - r) \xi}{\tau} + \frac{1}{N} \right] - \frac{\xi}{\tau} (\xi r - c) = 0
\]

then imposing symmetry the equilibrium interest rate is:

\[
\hat{r} = -\frac{\xi}{N} + \frac{c}{\xi}
\]

the equilibrium profit gross of fixed costs is:

\[
\Pi = (\xi r - c) \frac{1}{N} = \left[ \xi \left( \frac{\xi}{N} + \frac{c}{\xi} \right) - c \right] \frac{1}{N} = \frac{\tau}{N^2}
\]

then the profit net of fixed costs is:

\[
\Pi (f) = \frac{\tau}{N^2} - f
\]

and the equilibrium number of banks is:

\[
N = \sqrt{\frac{\tau}{f}}
\]

q.d.e.

**No-exit/No-entry Conditions in the Free Trade Equilibrium**

When we double the market the f.o.c. do not change, so that the equilibrium interest rate remains the same. Hence to compute the profit gross of fixed costs we have just to multiply the old one by two. And the solution for the no-entry condition is, as before:

\[
N = \frac{\tau (2(1 - \delta) + \delta \xi)}{4c \cdot (1 - \xi)}
\]

considering a fixed cost of \( f (1 + \lambda) \) the condition becomes:
\[
\frac{\tau \left( 2(1 - \delta) + \delta \xi \right)}{2(1 - \delta)} - \frac{2Nc \cdot (1 - \xi)}{(1 - \delta)} - f(1 + \lambda)N^2 = 0
\]

and the solution is:

\[
N_{\text{no-entry}}^{\text{open}} ((1 + \lambda)f) = -\frac{c(1-\xi)}{f(1+\lambda)(1-\delta)} + \sqrt{\frac{c^2(1-\xi)^2}{(f(1+\lambda)(1-\delta))^2} + \frac{\tau(2(1-\delta)+\delta\xi)}{2f(1+\lambda)(1-\delta)}}
\]

(2.25)

while the limit for \( f \to 0 \) is still:

\[
\lim_{f \to 0} N_{\text{no-entry}}^{\text{open}} ((1 + \lambda)f) = \frac{\tau(2(1-\delta)+\delta\xi)}{4c \cdot (1-\xi)}
\]

From 2.25 we can get the no-entry condition for the large firms market imposing \( \xi = 1 \). In that case we have that: \( N_{\text{no-entry}}^{\text{open}} = \sqrt{\frac{2}{1+\lambda}}N_{\text{no-entry}} \). Analogously for the no-exit condition.

Now I want to show in the case with asymmetric information we have that trade opening induces less entry.

Claim: \( N_{\text{no-entry}}^{\text{open}} ((1 + \lambda)f) < \sqrt{\frac{2}{1+\lambda}}N_{\text{no-entry}} (f) \)

Proof: define:

\[
x = \frac{c(1-\xi)}{2f(1-\delta)} > 0
\]

\[
y = \frac{\tau \cdot (2(1-\delta)+\delta\xi)}{4f(1-\delta)} > 0
\]

\[
z = \frac{2}{1+\lambda} > 1
\]

then:

\[
N_{\text{no-entry}} (f) = -x + \sqrt{x^2 + y}
\]

\[
N_{\text{no-entry}}^{\text{open}} ((1 + \lambda)f) = -zx + \sqrt{(zx)^2 + zy}
\]

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I want to show that:

\[-zx + \sqrt{(zx)^2 + zy} < \sqrt{z} \left(-x + \sqrt{x^2 + y}\right)\]

\[\iff\]

\[+\sqrt{(zx)^2 - \sqrt{zx^2}} > \sqrt{(zx)^2 + zy - \sqrt{zx^2 + zy}}\]

the derivative of the RHS respect to y is:

\[
\frac{\partial}{\partial y} \left(\sqrt{(zx)^2 + zy} - \sqrt{zx^2 + zy}\right) = \frac{1}{2\sqrt{(zx)^2 + zy}} - \frac{1}{2\sqrt{zx^2 + zy}} < 0 \text{ for any } x, y > 0
\]

and evaluated at \(y = 0\):

\[
\frac{1}{2\sqrt{(zx)^2}} - \frac{1}{2\sqrt{zx^2}} < 0 \text{ because } z > 1
\]

q.d.e.

A special case: Economies of Scope

Until now I assumed that the markets for loans to small and large firms were completely separated. However, the existence of some economies of scope seems reasonable. Some of the bank’s activities might not need to be duplicated to serve both markets, so that it might be cheaper for the bank to lend to both kinds of firms. The reason is that some banking services are jointly produced. Branches and network fixed cost might be common to different kinds of loans; and reputation effects and risk differentiation can be other factor in favor of large "multi-product" banks\(^{42}\). In this section I show that in the presence of economies of scope it is possible that trade liberalization does not affect at

\(^{42}\)See Neven (1989).
all the segment of the market where informational asymmetries are more important.

Consider an economy with two markets as depicted above. Let $\mu$ be the relative weight of the "large" firms market, that does not have any asymmetric information problem. While $1 - \mu$ is the weight of the small firms market with asymmetric information. I assume economies of scope in the form of a common fixed cost, so that banks sustain a fixed cost $f$ and then are able to supply loans on both markets. Given banks face a constant marginal cost for funds, they can split the maximization problem for the two markets; thus we can use the results form the previous two sections.

First notice that profits before the fixed cost are always positive in the large firms market. Then, for the assumption of a "common" fixed cost, in equilibrium every bank lending to the small firms has to be on the large firms market too. Banks will enter the market has long the discounted value of the sum of the future profits on the two markets exceeds the fixed cost. For the small firms market the profit before fixed costs becomes zero if the number of banks exceeds $\bar{N}_{\text{no-entry}}$, so we can write the general no-entry condition as:

$$
\mu \left[ \Pi^l_{\text{new}} + \frac{\delta}{1 - \delta} \left( \Pi^l_{\text{old}} + \Pi^l_{\text{new}} \right) \right] + (1 - \mu) \max \left[ 0, \Pi^0_{\text{free}} + \frac{\delta}{1 - \delta} \left( \Pi^{1/M}_{\text{old}} + \Pi^{1/M}_{\text{free}} \right) \right] - f \leq 0
$$  \hspace{1cm} (2.26)

where the first term represents the profits on the large firms loans market and the second term the profits from the small firms market. We can distinguish two cases: 1) the fixed cost $f$ is small enough and the large firms share $\mu$ big enough for the total number of banks be larger than the upper bound for the no-entry threshold on the small firms market: $M_{\text{no-entry}} \geq \bar{N}_{\text{no-entry}}$ as defined in 2.12. 2) The fixed cost $f$ is big enough and $\mu$ is small enough to have positive profits on the small firms in equilibrium. In other words $M_{\text{no-entry}}$ is smaller than $\bar{N}_{\text{no-entry}}$. I limit the analysis to the first case corresponding to an economy where large firms represent a large share of the market. In this case\textsuperscript{43} the

\textsuperscript{43}Condition 2.26 becomes:
solution to 2.26 is:

\[ M \geq M_{\text{no-entry}} = \sqrt{\frac{\mu \tau (2 + \delta)}{4 (1 - \delta) f}} \quad (2.27) \]

We saw before that the equilibrium on the small firms market (in absence of fixed costs) does not depend on the size of the market defined as the density of the firms around the circle. Thus the no-entry condition on the small firms market (for banks already on the large firms market) remains:

\[ N \geq N_{\text{no-entry}} = \frac{\tau (2 (1 - \delta) + \xi \delta)}{4c (1 - \xi)} \]

In equilibrium we have at least \( M_{\text{no-entry}} \) banks with at least \( N_{\text{no-entry}} \) banks serving both the small and the large firms markets. A bank lending only to large firms will not exit the market if the discounted value of the future profits (starting from a market share of one \( M_{th} \)) exceeds the fixed cost:

\[ \frac{1}{1 - \delta} (\Pi_{\text{old}}^l + \Pi_{\text{new}}^l) - f \geq 0 \]

that is if:

\[ M \leq M_{\text{no-exit}}^l = \sqrt{\frac{\mu \tau (5 + \delta)}{4 (1 - \delta^2) f}} \quad (2.28) \]

then in equilibrium there cannot be more than \( M_{\text{no-exit}}^l \) banks in the large firms market. Banks lending to both kinds of firms will exit the small firms market, if there they make negative profits. In this case the no-exit condition is still the 2.14:

\[ N \leq N_{\text{no-exit}} = \frac{\tau (2 (1 - \delta) + \xi \delta)}{2c (1 + \delta) (1 - \xi)} \]

\[ \left[ \frac{\tau}{2M^2 (1 + \delta)(1 - \delta)} + \frac{\delta}{1 - \delta} \cdot \frac{\tau \cdot (3 + \delta)}{4M^2 (1 + \delta)} \right] \cdot \mu - f \leq 0 \]
While they will exit both markets if the joint discounted profits are not enough to cover the fixed cost\(^{44}\). Notice that this condition is never binding when 2.14 and 2.28 are respected. Then for this case the equilibrium is characterized by \( M \) banks serving the large firms market, with only \( N \) of them lending also to small firms. Where \( M \) and \( N \) respect the 2.12, 2.14, 2.27, and 2.28, that is:

\[
\sqrt{\frac{\mu \tau (2 + \delta)}{4 (1 - \delta) f}} \leq M \leq \sqrt{\frac{\mu \tau (5 + \delta)}{4 (1 - \delta^2) f}}
\]

\[
\frac{\tau (2 (1 - \delta) + \xi \delta)}{4c (1 - \xi)} \leq N \leq \frac{\tau (2 (1 - \delta) + \xi \delta)}{2c (1 + \delta) (1 - \xi)}
\]

When we allow for cross-border banking some closed economy equilibria are no longer sustainable. The no-entry condition on the large firms market as in 2.27 does not hold anymore because foreign banks can enter the domestic market incurring a cost of only \( \lambda f \). If \( \lambda \) is small enough and \( \delta \) large enough, then no bank can survive lending to its own domestic large firms market only\(^{45}\), so that also the no-exit condition is violated and no closed economy equilibrium is still valid. The no-entry condition for existing foreign banks implies a number of banks on the domestic market large enough to push out any bank lending only on its home market. In this case in equilibrium all banks serve both their domestic and the foreign large firms loan markets. If in the closed economy equilibrium \( M_{no\text{-}entry} \), exceeded the "zero fixed cost" no-entry threshold for the small firms market \( \bar{N}_{no\text{-}entry} \), then that is also going to be the case for the open economy equilibrium. As in the equilibrium described by 2.29, also in the open economy it has to be that only some banks serve the small firms loan markets. The solution for the

\(^{44}\)That is:

\[
\frac{\mu}{(1 - \delta)} \left[ \frac{\tau (4 + \delta)}{2M^2 (1 + \delta)} \right] + \frac{1 - \mu}{(1 - \delta)} \left[ \frac{\tau (4 + \xi (1 + \delta))}{4N^2 (1 + \delta)} \right] - f < 0
\]

\(^{45}\)The condition is: \( \lambda \leq \frac{1 + \delta(3 + \delta)}{4 + \delta} \).
no-entry condition is\textsuperscript{46}:

\[ M \geq M_{\text{no-entry}}^{\text{open}} = \frac{\mu \tau (2 + \delta)}{2 (1 - \delta) (1 + \lambda) f} \]

notice that given \( \lambda \leq 1 \) this guarantees that no bank enters a single country market. The no-exit condition is:

\[ M \leq M_{\text{no-exit}}^{\text{open}} = \frac{\mu \tau (5 + \delta)}{2 (1 - \delta^2) (1 + \lambda) f} \]

In the cross-border banking equilibrium the number of banks exceeds the number of banks present in each country market in autarchy. More precisely the open economy no-entry/no-exit boundaries can be obtained multiplying the closed economy boundaries by \( \sqrt{\frac{2}{1+\lambda}} \). This implies (from 2.17) that the interest rate charged on loans to large firms decreases respect to autarchy. Cross-border entry generates a more competitive banking industry and pushes the price-cost margin down by \( \sqrt{\frac{2}{1+\lambda}} \) percent.

For the small firms segment nothing changes. The number of banks serving the small firms loan market does not change. Indeed if \( f \) is small enough to have \( M \) larger then the upper bound for the no-entry threshold on the small firms market, the number of banks that this markets can sustain in equilibrium does \textit{not} depend on the size of the market measured as the density of firms around the circle\textsuperscript{47}. Then no entry occurs as a consequence of the opening. In other words cross-border competition does not affect the equilibrium in the market for loans to small firms. Thus in this case the open economy equilibrium is characterized by \( M \) banks serving both the domestic and the foreign large

\textsuperscript{46}Indeed the no-entry condition on the domestic and foreign large firms markets is:

\[ \left[ \frac{\tau}{2M^2 (1 + \delta) (1 - \delta)} + \frac{\delta}{1 - \delta} \cdot \frac{\tau \cdot (3 + \delta)}{4M^2 (1 + \delta)} \right] \cdot 2 \mu - (1 + \lambda) f \leq 0 \]

\textsuperscript{47}If we model the "global" market as one single circle of measure \( 1 + \zeta \) and density \( \frac{2}{1+\zeta} \), then the equilibrium number of banks changes respect the closed economy case, but the equilibrium interest rate does not.

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firms markets, with \( N \) of them present on each country small firms market; where \( M \) and \( N \) are such that:

\[
\sqrt{\frac{\mu \tau (1 + \delta (3 + \delta))}{(1 - \delta^2) (1 + \lambda) f}} \leq M \leq \sqrt{\frac{\mu \tau (4 + \delta)}{(1 - \delta^2) (1 + \lambda) f}}
\]

\[
\frac{\tau (2 (1 - \delta) + \xi \delta)}{4c (1 - \xi)} \leq N \leq \frac{\tau (2 (1 - \delta) + \xi \delta)}{2c (1 + \delta) (1 - \xi)}
\]

This result is not surprising. We saw that asymmetric information generates an endogenous fixed cost proportional to the size of the market. This fixed cost determines an upper bound on the number of banks the small firms market can sustain in equilibrium. Then if in the closed economy equilibrium there are enough banks to reach the upper bound, the opening to international competition cannot induce new entry. For the large firms market opening to trade in banking services is equivalent to reduce the fixed cost and thus determines an equilibrium with a larger number of banks through cross-border entry.
2.6 Figures and Tables

Table 1, Market Shares of Foreign Banks (1994)

<table>
<thead>
<tr>
<th>Country</th>
<th>% foreign banks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>4.2</td>
</tr>
<tr>
<td>France</td>
<td>7.8</td>
</tr>
<tr>
<td>Italy</td>
<td>4.5</td>
</tr>
<tr>
<td>Spain</td>
<td>14.7</td>
</tr>
<tr>
<td>Finland</td>
<td>1.1</td>
</tr>
<tr>
<td>Sweden</td>
<td>9.7</td>
</tr>
</tbody>
</table>

Source: OECD, Banco de Espana, Banca d'Italia, Bundesbank.

Table 2, Germany: Evolution of the Banking Industry

<table>
<thead>
<tr>
<th>year</th>
<th>all banks</th>
<th>foreign</th>
<th>foreign owned</th>
<th>tot foreign</th>
<th>ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>3691</td>
<td>66</td>
<td>91</td>
<td>157</td>
<td>0.043</td>
</tr>
<tr>
<td>1994</td>
<td>3727</td>
<td>63</td>
<td>92</td>
<td>155</td>
<td>0.042</td>
</tr>
<tr>
<td>1993</td>
<td>4038</td>
<td>57</td>
<td>80</td>
<td>137</td>
<td>0.034</td>
</tr>
<tr>
<td>1992</td>
<td>4200</td>
<td>56</td>
<td>74</td>
<td>130</td>
<td>0.031</td>
</tr>
<tr>
<td>1991</td>
<td>4460</td>
<td>59</td>
<td>67</td>
<td>126</td>
<td>0.028</td>
</tr>
<tr>
<td>1990</td>
<td>4711</td>
<td>60</td>
<td>57</td>
<td>117</td>
<td>0.025</td>
</tr>
<tr>
<td>1989</td>
<td>4297</td>
<td>60</td>
<td>42</td>
<td>102</td>
<td>0.024</td>
</tr>
<tr>
<td>1988</td>
<td>4428</td>
<td>57</td>
<td>32</td>
<td>89</td>
<td>0.020</td>
</tr>
</tbody>
</table>

Source: Bundesbank.
Figure 2-1: CR3 Market Share of the 3 Largest Banks

In terms of assets.
Source: OECD, The Banker, own calculations.

Figure 2-2: Interest Rate Markup

Source: OECD, Financial Statistics Monthly
Chapter 3

Adverse Selection as a Barrier to Entry in the Banking Industry$^1$

3.1 Introduction

In this paper, we investigate the effects of adverse selection on the market structure of the banking industry. By endogenizing entry, we are able to focus on the equilibrium industry structure when information asymmetries play an important role in the market. Specifically, we ask whether informational asymmetries in the banking industry can create a barrier to entry for other banks. We have in mind a situation where existing (i.e. "incumbent") banks in a market have an informational advantage over other potential lenders (i.e. "entrants") by virtue of their established relationships with firms seeking credit, and are able to use this advantage to prevent other banks from entering their market. Potential entrants into a banking market suffer an adverse selection effect stemming from their inability to determine whether applicant firms are new firms seeking financing for their untested projects, or whether these are in fact firms that have been previously rejected by an incumbent bank, and are looking elsewhere for financing. This puts entrants into a worse position relative to the incumbents in that industry, and may

$^1$with Ezra Friedman and Robert Marquez.
lead to diminished or deterred entry.

Asymmetric information is a driving force in this kind of analysis. Banks considering offering funding to applicant firms are always faced with an information problem to the extent that managers and/or owners always know more about their firms than the banks who are considering making the loan can know, and hence will usually wind up making some loans that are ex-ante unprofitable (as opposed to loans that may not pay off ex-post, even though they have a positive expected return.) Moreover, this is a problem that applies to all banks making loans when faced with a credit prospect for whom they have limited information. However, this effect need not be of the same magnitude for all firms as some banks may have better knowledge about some firms than others, and may also differ across banks, as each bank may have superior information about different firms than its competitor banks. It is precisely this kind of informational asymmetry of banks vis-a-vis each other on which we focus. Banks are able to gather information about prospective clients from previous lending arrangements, and hence are better able to distinguish the good and the bad risks among firms with whom they have established a relationship than among firms that are new and unknown to them. Hence, banks that have been around longer might be believed to have a greater informational advantage if they have made loans to more firms than younger banks have, and certainly we might expect that any existing banks would posses an advantage over entrant banks, which have no private knowledge about firms. Note that the incumbents’ comparative advantage is not driven by the informational asymmetry that exists between banks and firms, but rather by the asymmetry of information between banks, and all that we require is some amount of heterogeneity among firms (the results can be obtained even if we assume that firms themselves don’t know their own quality.)

Recent literature has attempted to address similar issues of asymmetric information in banking, and possible adverse effects of increasing competition. A paper similar in spirit to ours is Broecker (1990), which analyzes a competitive credit market where banks have the ability to perform binary credit worthiness tests on applicant firms, and offer
credit conditional on the realization of this test. He finds that as long as interest rate offer (the least attractive for it,) it must have been rejected by all other banks, and therefore represents a very bad risk on average. This is similar to the adverse selection effect that we envisage, where raising the interest rate a bank offers only leads to worse and worse risks on average, as a bank begins to attract only the most risky firms that are being held by other banks. ² However, in Broecker the number of banks is exogenous, and does not depend on the effects of adverse selection.

Another related paper is Riordan (1992), who offers an analysis similar to that performed by Broecker (1990). Using an application of auction theory, and allowing firms to have continuous quality signals, he finds that the adverse selection generated by increasing the number of banks has the perverse effect of increasing the cutoff value of the quality signal above which financing is offered. A somewhat different perspective is offered by Sharpe (1990), where information asymmetries among banks and competition between them leads to inefficiencies in loan granting. In particular, Sharpe (1990) finds that banks may offer firms lower introductory rates since they know that they will be able to extract surplus from good firms in future periods due to the quasi-monopoly power that banks obtain because of their informational advantage vis-à-vis other banks. Finally, Rajan (1992) considers the financing decision from the point of view of the firm, which has the incentive to prevent banks from obtaining private information regarding its projects and using that information to extract surplus from the firm. The main difference between our analysis and that found in most of the previous literature is that we focus on the organizational structure of the banking industry itself, and the forces that might lead to deterred entry.

The main result we obtain in this paper is one of blockaded entry for any bank once there are already two banks serving a particular credit market. When banks actively compete for customers by offering them lower interest rates, an equilibrium with homogeneous firms or with symmetric information would be characterized by each bank's

²This is also similar to the credit rationing model of Stiglitz and Weiss (1981).
profits being reduced to zero, and with no further entry by new banks if entry must be preceded by a decision to incur a sunk entry cost. However, we find if we allow banks to be asymmetrically informed regarding firms' credit worthiness, the limited entry result holds even in the absence of any sunk cost of entry or fixed cost of operation. Moreover, the equilibrium we obtain for the two bank case is no longer characterized by a zero profit condition for each bank, but rather allows each bank's profit to depend on its informational advantage.

We find that with just two banks, competition will drive the profits of the smaller of the two banks down to zero. In the context of our model, we will interpret the smaller bank as the one who had granted loans to a smaller fraction of the population of firms in the past, and hence is more "informationally challenged". The profits to the larger bank will then be determined by the extent to which it has superior information about potential borrowers. The intuition for our result of blockaded entry can now be gleaned from this argument. A potential entrant bank is in a worse informational position than either of the incumbents. Any action by an entrant could of course always be mimicked by an incumbent to yield it strictly higher profits (since, by virtue of its tenure in the market, it suffers less from the adverse selection of having to finance bad firms.) Since the only possible equilibrium will involve the second largest bank obtaining zero profits, this implies that the entrant would make negative profits. Thus, it can never be optimal for another bank to enter a market where two rival banks are already active. In what follows, we formalize these arguments and demonstrate our result regarding blockaded entry.

The rest of the paper proceeds as follows. Section 2 presents the basic setup of the model, and establishes the nature of competition among the banks in the industry. Section 3 characterizes the equilibrium that obtains with just two banks. Section 4 contains the main results of this paper. There we show that the equilibrium we obtained for just two banks is also an equilibrium to the game with three banks, thus leading to deterred entry for the third bank. Moreover, we demonstrate that entry by a third bank
is blockaded after two banks are already in the market. We provide an example where we explicitly compute the equilibrium strategies for each bank under the assumption that there is a uniform distribution of firms in section 5. Section 6 concludes with a discussion of the key results and their applicability to other contexts, as well as some possible extensions under consideration.

3.2 Model

The basic setup we have in mind is a form of Bertrand competition among banks for loans to firms in the market, with banks potentially having some informational advantages against each other with respect to the firms with which they are familiar. By financing a firm, a bank is able to learn some of that firm’s private information, which it uses in subsequent periods when it comes time to refinance these firms and attract new borrowers.

Specifically, we assume that firms have an investment project that requires a capital inflow of $K$, which we normalize to 1, but have no private resources, so that they must look to banks to obtain this financing. This project pays off an amount $R$ with probability $\theta$, 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, $\theta$, is private knowledge to the firm before it enters into a relationship with a bank. Firms are heterogeneous in their probability of success $\theta$, with a distribution in the population given by the distribution function $G(\theta)$. We assume that once a firm borrows from a given bank, that bank learns the firm’s type $\theta$, but is unable to credibly communicate it to other banks (this information becomes private to the two parties in the relationship - the bank and the firm.)

In each period, a share $\lambda$ of firms with the same distribution over types as the total population dies (exits the market,) and is replaced by an equal mass of new firms that have the same distribution over types. ³ In essence, we assume that every firm has the

³For new firms we mean ones that are applying for credit for the first time. This does not necessarily
same probability $\lambda$ of dying, and is replaced with a firm of similar quality. We normalize the population to have size 1, so that we assume that a mass of size $1 - \lambda$ of firms is already in the market and seeking refinancing (and hence their type is already known by one bank) and a mass $\lambda$ of firms are seeking a loan for the first time.

As previously stated, we assume that banks compete in a Bertrand fashion over interest rates for the pool (of size $\lambda$) of new firms, and are able to charge differential rates to their pool of remaining old customers (for which the bank already knows the firm’s probability of success.) We assume that firms are free and able to switch banks in order to obtain the “market rate” that is being offered to potential new firms by a competitor bank, and will do so if that rate is lower than the one currently being offered to them by their current bank (so we are inherently assuming that firms have the last move in this setup.)

We assume that banks are unable to distinguish between new firms and firms that are being rejected by a competitor bank or who are simply switching banks to take advantage of lower rates. This assumption may seem somewhat extreme in light of the fact that generally firms carry with them any kind of credit history they have earned, and that this history is usually publicly available to any new bank, so that in particular a bank should be able to tell whether a firm has had a previous banking relationship. We defend our assumption by arguing that it captures the stylized notion that a firm’s old bank may know more than what is available on a credit record, either from monitoring or having access to books or by simply being able to better observe what kind of projects a firm is investing. 4 In this sense, the firm’s old bank has an informational advantage, and a new bank is only able to less precisely determine an applicant firm’s type, and may not have much more information about that firm than about one for which it knows nothing. 5

have to do with age, it could be firms that until that moment auto-financed their operations, or firms that just moved into the area, etc. The same can be said about firms that die. Firms could become large enough to finance without intermediation, move to another region, etc.

4See also the explanation at the end of section 3.
5We assume that banks are not limited by capacity (on this market at least.) We have in mind generally small markets that may be subject to entry by competitor banks.
In modeling the extensive form of this game, we have focused on a two-stage game in which all banks first simultaneously choose an interest rate for the free market. Then, after observing the realized rates for all banks, they simultaneously choose interest rates for their old customers. The story we have in mind is that firms are able to observe what the "market rate" is that they could obtain if they go elsewhere, and use that to bargain for lower rates from their banks if their bank wants to keep them. \(^6\) Note that we assume that the firm acts last by choosing the lowest available interest rate. \(^7\)

### 3.3 Equilibrium with two banks

As described above, we assume that banks have two sequential moves, where they first all simultaneously choose an interest rate to charge to the free market, and then, after observing everyone's market rate, they all simultaneously choose an interest rate to charge to their old customers. Firms act last by choosing the lowest interest rate offered to them. Again, the justification for this is simply that any firm can use the threat of leaving and obtaining the free market rate in order to bargain for a lower rate (or at least a rate that is no higher) by their current bank. We obtain a characterization of the equilibrium for an arbitrary distribution of firms types, \(G(\theta)\), and are able to provide an explicit example for the case where \(\theta\) is distributed uniformly between \([0, 1]\).

We begin by stating some specifications that will be used throughout the analysis. Consider that there are two banks in the market, with existing shares of the market of

---

\(^6\)Greenwald (1986) uses a similar extensive form in his analysis of adverse selection in the labor market. This setup can be regarded as the result of a traditional market mechanism. The free market rate can be thought of as the rate offered by Bertrand competitors to firms seeking financing. In Greenwald, it is the wage that would be offered to workers in a traditional Walrasian auction market. Firms behave competitively by simply taking the lowest rate offered to them. However, banks faced with these conditions are able to use their "inside" knowledge of firms' qualities to maximize profits. As we will see, this will lead them to offer "competitive" rates to firms they wish to keep, and deny credit to low quality firms.

\(^7\)If an old firm can get the same interest rate from both banks, we assume that it stays with its current bank, while if there is a tie in the free market, all banks split the market equally. The idea is that if there are (epsilon) positive switching costs for the firms to change banks, they prefer to borrow from their old bank for the same interest rates.
size $\alpha_1, \alpha_2$ (where $\alpha_2 = 1 - \alpha_1$) and assume WLOG that $\alpha_1 > \alpha_2$. Now let a mass $\lambda$ of firms die (exit the market) and a new mass of equal size show up this period, so that banks must compete for these $\lambda$ firms and try to hang on to their existing clients if they are good.

We first need to characterize the equilibrium of the subgame after banks submit a bid to the free market, when banks are bidding for their old customers. Let $S_i$ be the interest rate charged by bank $i$ to the free market, and let $S_{i\theta}$ be the interest rate charged by bank $i$ to an old customer of type $\theta$. Also, let $\sigma_i$ be the probability that bank $i$ doesn’t bid at all on the free market (“stays out”), and $F_i(S_j) = \text{prob}(S_i < S_j)$ the probability that free market rate for bank $i$ is less than $S_j$ (the rate charged by the other bank on the free market.) We then have the following result:

**Claim 1** (1) All old firms (i.e. already known by bank $i$) for whom $\theta \geq \frac{1}{S_j}$ will be charged $S_{i\theta} = S_j$ (good firms are charged a rate equal to the rate charged by the competitor bank to the free market.); and (2) firms known by bank $i$ for whom $\theta < \frac{1}{S_j}$ will be denied credit.

Claim 1 holds because $S_j$ is the maximum bank $i$ can charge its old customers without losing them to its rival bank, bank $j$.  

For firms whose quality parameter $\theta$ is less than $\frac{1}{S_j}$, bank $i$ clearly loses money by offering them credit at an interest rate of $S_j$, and any other higher offer will be rejected by these firms since they can always obtain $S_j$ elsewhere. Therefore bank $i$ simply does not provide credit to any of these low quality firms.

Using this simple claim which effectively characterizes the equilibrium of the subgame, we can now characterize the equilibrium of the whole game. Notice that claim 1 gives

---

8The fact that all old firms that are “good enough” are charged the same (high) interest rate $S_{i\theta} = S_j$ is an artifact of the fact that outside banks have no information about firms, and that we are only in one period. With multiple periods (an extended horizon for the firms,) we would obtain that banks need to offer their good firms a discount early on in order to keep them, and this discount can very well depend on the type of the firm. Additionally, if we allow outside banks to observe some signal of the firms’ profitability, such as whether they have been successful in the past, we might again obtain banks offering different rates to different firms.
us the result that high quality old firms are charged at least as much as new firms, or, conversely, that new firms are offered a lower introductory rate in order to attract their business. This is consistent with the finding of Sharpe (1990), where asymmetric information and competition leads banks to charge firms a lower interest in the first period of their relationship, even though they are able to extract surplus from the good firms in future periods.

For the rest of the firms, banks compete for the new market (of mass \( \lambda \)), and they always get the rejects from other bank. Suppose that bank \( i \) charges \( S_i \). Then, using claim 1 above, its payoffs are:

\[
\pi_i(S_i|w) = \lambda \int_0^1 (S_i \theta - 1)g(\theta)d\theta + \int_0^{\tilde{\theta}} \alpha_j(1 - \lambda)(S_i \theta - 1)g(\theta)d\theta
\]

\[
= \lambda(S_i \tilde{\theta} - 1) + \alpha_j(1 - \lambda)
\left( S_i \tilde{\theta} - G \left( \frac{1}{S_i} \right) \right)
\]

\[
(3.1)
\]

\[
\pi_i(S_i|l) \equiv \int_0^{\tilde{\theta}} \alpha_j(1 - \lambda)(S_i \theta - 1)g(\theta)d\theta = \alpha_j(1 - \lambda)
\left( S_i \tilde{\theta} - G \left( \frac{1}{S_i} \right) \right)
\]

\[
(3.2)
\]

where \( g = G' \), \( \tilde{\theta} = \int_0^1 \theta g(\theta)d\theta \), and \( \tilde{\theta} = \int_0^{\tilde{\theta}} \theta g(\theta)d\theta \). \( \pi_i(S_i|w) \) represents the bank’s expected profits conditional on winning the free market, and \( \pi_i(S_i|l) \) is the bank’s profit conditional on not obtaining (“losing”) the free market. Note that the equation 3.2 is negative by the result that competitor banks only cast out those firms for which \( \theta S_i < 1 \).

We now can state the following result:

**Lemma 1** There does not exist an equilibrium with banks playing a pure strategy on the free market as long as \( \pi_i(R|w) > 0, i = 1, 2 \).

**Proof:** Let \( \sigma_i \) be the probability that bank \( i \) does not bid on free market. Clearly, the strategies where no bank bids on the new market cannot be an equilibrium as long as \( \pi_i(R|w) > 0 \). Similarly, any set of strategies where one bank, say bank \( i \), does not bid on free market \( (\sigma_i = 1) \) and where \( S_j < R \) cannot be an equilibrium, since given \( i \) does not bid, \( j \) can always increase profits by increasing \( S_j \) up to \( R \). Consider the strategies
\((\sigma_i = 1, S_j = R)\). Then makes zero profits on this market, and \(\pi_j(R) > 0\). But then i can charge \(S_i = R - \epsilon\) obtain \(\pi_i(R - \epsilon|w) > 0\), and do strictly better for small enough \(\epsilon\).

Finally, consider the possible equilibrium \((S_i, S_j)\), and WLOG assume that \(S_i > S_j\). As shown above, \(\pi_i(S_i|l) < 0\). If \(\pi_j(S_j|w) > 0\), and if \(\pi_i(S_j|w) > 0\), then i prefers to charge \(S_i = S_j - \epsilon\). Otherwise, i prefers to set \(\sigma_i = 1\) and not enter market at all. Therefore no equilibrium exists in pure strategies. □

From the above it can be verified that it is precisely the adverse selection in the competition for firms that leads to the non-existence of a pure strategy Nash equilibrium. Because the bank with the higher interest rate winds up making loans only to low quality firms and making negative profits, no pure strategy equilibrium could specify a different interest rate for each bank. At the same time, both banks bidding the same interest rate also cannot be an equilibrium. In that case, each bank would have an incentive to undercut slightly and obtain all the new firms (instead of dividing them up among the tying firms) and hence improve its distribution of firms to which it grants loans.

The non-existence of a pure strategy equilibrium is a standard feature of Bertrand games with players that are asymmetric in their fixed costs. The interpretation of mixed strategies is not always straightforward. In this context we can imagine that the randomization is the result of a process in which banks bargain over the interest rate separately with each individual client, where clients are heterogeneous in their bargaining skills, and these skills are uncorrelated with their type. \(^9\)

However, while no equilibrium exists in pure strategies, we do find an equilibrium in mixed strategies where both banks mix continuously over some range \([r, R]\). Establishing the details of the equilibrium will provide a stepping stone for the analysis that is central to this paper, the case where we allow for a third possible entrant bank into this market.

**Proposition 2** An equilibrium to the two-stage game exists and will be characterized by

\(^9\)This is similar also to other results obtained in the literature, such as in Broecker (1990), or to the result obtained by Rajan (1990) when we allows firms to seek competitive bids from many banks. He argues that it is not uncommon to see firms seeking sealed bids from a number of different banks, and that this kind of behavior leads to mixed strategy equilibria.
a distribution function over strategies for each bank, \( F_i(S), i = 1, 2 \). The equilibrium has the following properties:

1. Both banks cannot be making positive profits (and in fact it will be the smaller bank that makes zero profits.)

2. Both banks play completely mixed strategies over the same interval \([r, R]\).

3. There exist no atoms in the mixing probabilities of either bank over the interval \((r, R)\).

4. One bank "stays out" with positive probability (i.e. does not bid on free market with some probability, so that \( \sigma_i > 0 \)).

**Proof:** By claim 1 above, bank \( j \) will charge its old customers \( S_i \) if \( \theta \geq \frac{1}{S_i} \) and will charge \( r > S_i \) (or deny credit) if \( \theta < \frac{1}{S_i} \). This implies that bank \( i \) gets all \( \theta \) belonging to \( j \) for whom \( \theta < \frac{1}{S_i} \). Define \( m(\theta) = \int_0^\theta \frac{w(t)}{C(t)} \, dt \), and let \( \bar{\theta} = \text{mean of } \theta \) (= \( m(1) \).) For a bid by bank \( i \) of \( S_i \), we obtain the payoffs:

\[
\pi_i(S_i) = \lambda(S_i\bar{\theta} - 1) + \alpha_j(1 - \lambda)G\left(\frac{1}{S_i}\right)\left(S_im\left(\frac{1}{S_i}\right) - 1\right) \quad \text{if } S_i < S_j \\
= \frac{1}{2}\lambda(S_i\bar{\theta} - 1) + \alpha_j(1 - \lambda)G\left(\frac{1}{S_i}\right)\left(S_im\left(\frac{1}{S_i}\right) - 1\right) \quad \text{if } S_i = S_j \\
= \alpha_j(1 - \lambda)G\left(\frac{1}{S_i}\right)\left(S_im\left(\frac{1}{S_i}\right) - 1\right) \quad \text{if } S_i > S_j
\]

Since the action space is a real interval, given by \([r, R]\) (to be defined,) we can observe that this payoff function (and consequent game) satisfies the conditions in Dasgupta and Maskin (1986) for the existence of a mixed strategy equilibrium. Using the definition of \( F_i(s) = \text{prob}(S_i < s) \), we have the following important lemma, the proof of which can be found in the appendix.

**Lemma 3** \( F_i(s) \) and \( F_j(s) \) will be continuous and strictly monotone increasing on an interval \((r, R)\) (i.e. \( f_i(s) > 0 \ \forall s \), so that \( \exists \) an interval \((s_1, s_2) \subseteq (r, R) \) where \( f_i(s) \equiv 0 \ \forall s \in (s_1, s_2) \).)
We can now write

$$\pi_i(S_i) = \lambda(1 - F_j(S_i))(S_i\bar{\theta} - 1) + \alpha_j(1 - \lambda)G\left(\frac{1}{S_i}\right)\left(S_im\left(\frac{1}{S_i}\right) - 1\right)$$

Since $m\left(\frac{1}{S_i}\right) < \frac{1}{S_i}$, the second term is negative, so that it will be optimal for bank $i$ to enter only if $\lambda(1 - F_j(S_i))(S_i\bar{\theta} - 1) \geq -(1 - \lambda)\alpha_jG\left(\frac{1}{S_i}\right)\left(S_im\left(\frac{1}{S_i}\right) - 1\right)$. In order for this to continue to hold as $s \to R$, we require that

$$\lim_{s \to R} (1 - F_j(s)) \geq \frac{(1 - \lambda)}{\lambda} \frac{\alpha_jG\left(\frac{1}{R}\right)\left(Rm\left(\frac{1}{R}\right) - 1\right)}{R\bar{\theta} - 1}$$

But the only way for $\lim_{s \to R} (1 - F_j(s)) > 0$ is if either there is an atom at $R$ in $F_j$, or if bank $j$ does not always enter into free market bid. There cannot be an atom in both $F_1$ and $F_2$ since then neither $S_2 = R$ nor $S_1 = R$ would ever be optimal. Therefore at least one bank must be not entering the free market with positive probability. Note that this establishes that at least one bank is making zero expected profit. Let us call this bank 2 (the smaller bank), and we will later show that it must indeed be the smaller of the two banks.

We can now use the zero profit condition for bank 2 to solve for $\tau$, since $\tau$ must satisfy:

$$\lambda(\tau\bar{\theta} - 1) + \alpha_1(1 - \lambda)G\left(\frac{1}{\tau}\right)\left(\tau m\left(\frac{1}{\tau}\right) - 1\right) = 0 \quad (3.3)$$

because at $\tau$, bank 2 wins the free market with probability one. \(^{10}\) That bank 2 must

\(^{10}\)Note that for $\lambda$ very small, $\tau > R$, so that in effect there is no interest rate at which bank 2 can make non-negative expected profits, even assuming it wins the market with probability 1. Call such a cutoff value $\Lambda(\alpha_1)$. That it is a function of $\alpha_1$ (given a fixed $R$) is clear from the equation. As a matter of fact, the exact condition that we need for this result is that $\pi_2(R|w) > 0$ (that the profits of bank 2 when it charges the highest interest rate $R$ and wins the free market be positive,) which we can solve to obtain:

$$\Lambda(\alpha_1) = \frac{\alpha_1G\left(\frac{1}{R}\right)\left(1 - Rm\left(\frac{1}{R}\right)\right)}{R\bar{\theta} - 1 + \alpha_1G\left(\frac{1}{R}\right)\left(1 - Rm\left(\frac{1}{R}\right)\right)} > 0$$

If this condition, that $\lambda > \Lambda(\alpha_1)$, is not satisfied, then a monopoly will be the only viable market structure. Note that this is always less than 1 if $G\left(\frac{1}{R}\right) > 0$, so for any distribution of types such that $G\left(\frac{1}{R}\right) > 0$ there is a $\lambda$ which results in a duopoly. $\Lambda(\alpha_1)$ is an increasing function so there are values
indeed be the zero profit bank can now be verified by comparing equation 3.3 with equation 3.4 below, the profits for bank 1, and noting that the profits for bank 2 are unambiguously lower at \( r \) given that \( \alpha_2 < \alpha_1 \).

We then have that, for bank 1,

\[
\pi_1(r) = \lambda (r \bar{\theta} - 1) + \alpha_2 (1 - \lambda) G \left( \frac{1}{r} \right) \left( rm \left( \frac{1}{r} \right) - 1 \right) \tag{3.4}
\]

and using condition above for bank 2, we can rewrite this as:

\[
\pi_1(r) = - (\alpha_1 - \alpha_2) (1 - \lambda) G \left( \frac{1}{r} \right) \left( rm \left( \frac{1}{r} \right) - 1 \right) = \left( 1 - \frac{\alpha_2}{\alpha_1} \right) \lambda (r \bar{\theta} - 1) \equiv \bar{\pi},
\]

which is greater than zero, and specifies the positive profits that bank 1 makes, and which holds \( \forall s \in (r, R) \), since bank 1 is mixing in equilibrium. We can now use \( \bar{\pi} \) to solve for \( F_2(s) \) directly as:

\[
\pi_1(s) = \bar{\pi} = \lambda (1 - F_2(s)) (s \bar{\theta} - 1) + \alpha_2 (1 - \lambda) G \left( \frac{1}{s} \right) \left( sm \left( \frac{1}{s} \right) - 1 \right)
\]

\[
\Rightarrow F_2(s) = 1 + \frac{\alpha_2 (1 - \lambda) G \left( \frac{1}{s} \right) (sm \left( \frac{1}{s} \right) - 1)}{\lambda (s \bar{\theta} - 1)} - \frac{\left( 1 - \frac{\alpha_2}{\alpha_1} \right) (r \bar{\theta} - 1)}{s \bar{\theta} - 1}, \tag{3.5}
\]

after replacing \( \bar{\theta} \). We can similarly solve for the other mixing probability, using the zero profit condition for bank 2.

\[
0 = \lambda (1 - F_1(s)) (s \bar{\theta} - 1) + \alpha_1 (1 - \lambda) G \left( \frac{1}{s} \right) \left( sm \left( \frac{1}{s} \right) - 1 \right)
\]

\[
\Rightarrow F_1(s) = 1 + \frac{\alpha_1 (1 - \lambda) G \left( \frac{1}{s} \right) (sm \left( \frac{1}{s} \right) - 1)}{\lambda (s \bar{\theta} - 1)}, \tag{3.6}
\]

which concludes the proof with the equilibrium characterized by \( F_1, F_2 \). \( \Box \).

This equilibrium fits well with our intuition and with other known results for Bertrand
competition. We can illustrate this by doing some comparative statics on $F_i$, and observing how we converge to standard results as we vary the proportion of new firms in the market. As $\lambda$ increases, we observe that $F_i(s)$ increases for any $s$. This implies that an increase in $\lambda$ leads to a decrease in the expected free market rate. This is comforting, since it implies that a drop in the importance of the adverse selection term (as proxied by $\lambda$) leads to an increase in competition and a fall in the expected interest rate. The decrease in the market rate coincides with a decrease in the rents being extracted from high quality old firms. Notice further that in the limit, as $\lambda \to 1$, $F_i(s) \to 1 \forall s$ in the interior of the support of the distribution. But this essentially says that we are concentrating all mass on the bottom of the support, or in other words that we are coming closer to playing a pure strategy. To see what this strategy is, we look at what happens to $r$. From equation (3.3), we see that as $\lambda \to 1$, $r$ has to satisfy $\lambda(r\bar{\theta} - 1) = 0$, or that $r = 1/\bar{\theta}$. This is what we should expect, that we obtain a pure strategy equilibrium where everyone bids $S_i = S_j = 1/\bar{\theta}$ and breaks even as the proportion of new firms in the market goes to 1, so that the proportion of old firms is going to zero, and there is no longer any adverse selection effect from other bank’s rejectees.

It is worth noticing that the total profit of the industry increases with $\alpha_1$, the large bank’s previous market share, or size. In other words, the banking system becomes less competitive as the two banks become more asymmetric. This is primarily because the smaller bank’s costs rise because it faces a higher adverse selection cost stemming from the larger bank’s rejected customers. Thus the smaller bank’s disciplining effect on bank 1’s pricing decreases. An example of this equilibrium is provided in section 5, where we explicitly compute the equilibrium strategies for the case where $\theta$ is uniformly distributed between 0 and 1.

We should also point out that while the assumption that a bank is unable to ascertain whether an applicant firm has had a previous banking relationship or not is important to our analysis, it is not crucial that it take anywhere near so extreme a form. We could just as well allow banks to review the credit histories of applicant firms. Then, as long as
this review process comes at a positive per firm cost, we immediately obtain that entrant banks face higher costs of reviewing these records than incumbent banks, since there are more firms that are unknown to the entrant. This is sufficient to give us all the previous results, and those that follow. \(^{11}\)

### 3.4 More than two potential banks: Blockaded entry

In the previous section we characterized the equilibrium for the case when there are two banks in the market. However, we did not consider explicitly the possibility of entry by new competitors. In this section we show that our equilibrium is still valid when we assume the existence of a third potential entrant with zero market share. Moreover, we show that the equilibrium described in section 3 is in fact unique. In other words, using Bain’s terminology, we show that we are in a situation of blockaded entry.

The proof of proposition 2 from the last section provides us with an intuition as to why, given the equilibrium of section 3, a third potential bank finds entry blockaded and is unable to penetrate the market without incurring losses. The reason is that a third potential bank considering entry faces a significantly different distribution of firms than the two current incumbents, and given that competition à la Bertrand by the incumbents already forces one bank’s profit down to zero, a potential entrant can only expect to do (strictly) worse than the next smallest bank. \(^{12}\) Loosely speaking, a potential entrant

\(^{11}\)Suppose you have to pay a screening cost \(c\) per firm, and this allows you to observe whether they have newly left a competitor bank, or are new to the market. Then the cost for each bank will be:

\[
C_1 = \lambda c + \alpha_2 c(1 - \lambda)G \left( \frac{1}{S_1} \right)
\]

\[
C_2 = \lambda c + \alpha_1 c(1 - \lambda)G \left( \frac{1}{S_2} \right)
\]

and as long as \(\alpha_1 > \alpha_2\), we will have that \(C_1 < C_2\), and our results continue to hold. We can then interpret our approach as saying that the cost of getting information about a firm is to make them a loan.

\(^{12}\)Note that what we name the “adverse selection” effect can be loosely interpreted as a fixed cost of entry, \((1 - \lambda)\alpha_3 G \left( \frac{1}{S} \right) \left( sm \left( \frac{1}{S} \right) - 1 \right)\), and hence the proof of proposition 2 is similar to the analysis of the mixed strategy equilibrium in Varian (1980). (Although this “fixed cost” is dependent on \(S_i\), we

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faces two “adverse selection terms”, one from each of the incumbent banks, instead of the one term that is faced by each incumbent. Thus the entrant’s payoff function is unambiguously worse than that for the smaller incumbent bank, since it differs by a term that must be strictly negative. The entrant faces losses from both bank 2 and bank 1’s rejects, while bank 2 only need worry about bank 1’s rejects.

The reasoning above leads us to the main result of this paper, that of blocked entry by a third potential bank with no previous market presence. Because of the qualitatively larger cost associated with entry for the third bank, we are able to obtain the result that given the equilibrium we obtained in proposition 2 above for 2 banks, a third bank never finds it optimal to enter the market with positive probability when the two incumbents are competing according to this equilibrium. That is, fixing the competition among the 2 banks (who may be ignoring the possibility of entry,) a third bank nevertheless finds entry blocked when deciding whether to submit a market bid or not. However, this is in some sense a weak result, since it doesn’t address the issue of the timing of entry and of competition, and may not be robust to changes in these, or in a bank’s ability to pre-commit to enter. This pre-commitment issue is particularly important when we consider entry, since a sequential entry / competition decision might lead banks to behave differently (in any subgame perfect equilibrium) than if they are simply ignoring or trying to deter entry. If we accept that entry may be a decision that takes place over a longer period of time and is necessarily a decision made prior to competition, then this kind of result needs to be strengthened to rule out any kind of entry by a third bank. In fact, the result we do obtain is that there does not exist any equilibrium where a third bank enters with positive probability. In other words, the only equilibrium of this game is for bank 3 never to enter, and for banks 1 and 2 to compete as in a duopoly.

can imagine the fixed cost as the portion that a bank pays for a bid of \( R \), and a variable part that is the incremental cost when bidding \( S_i < R \). However, this cost is dependent on the opponent’s market share, \( \alpha_j \), so that we cannot look for symmetric equilibria when market shares differ, and that the firm’s reservation interest rate, \( R \), still leads to negative profits for that bank whenever it obtains its opponents worst firms. This leads us to obtain zero profits for the smaller bank (the one with the highest fixed costs,) but positive expected profits for the larger bank.
To obtain these results, we first find it convenient to establish some notation and preliminary results. Define \( L(s) \equiv (1 - \lambda)G(\frac{1}{s})(sm(\frac{1}{s}) - 1) \), and note that \( L(s) < 0 \ \forall \ s \) by definition of \( m(\cdot) \). We can then write the payoffs in the three bank game as

\[
\pi_i(s) = \lambda(1 - F_j(s))(1 - F_k(s))(s\bar{\theta} - 1) + (1 - F_j(s))\alpha_k L(s) \\
+ (1 - F_k(s))\alpha_j L(s)
\] (3.7)

Now consider the specific case where \( \alpha_3 = 0 \), and \( \alpha_1 > \alpha_2 > 0 \), which reflects the fact that the third bank is a potential entrant with zero market share. Then profits for the three banks are given explicitly by:

\[
\pi_1(s) = \lambda(1 - F_2(s))(1 - F_3(s))(s\bar{\theta} - 1) + (1 - F_3(s))\alpha_2 L(s) \quad (3.8)
\]
\[
\pi_2(s) = \lambda(1 - F_1(s))(1 - F_3(s))(s\bar{\theta} - 1) + (1 - F_3(s))\alpha_1 L(s) \quad (3.9)
\]
\[
\pi_3(s) = \lambda(1 - F_1(s))(1 - F_2(s))(s\bar{\theta} - 1) + (1 - F_1(s))\alpha_2 L(s) \\
+ (1 - F_2(s))\alpha_1 L(s) \quad (3.10)
\]

We know from proposition 2 what the equilibrium for the 2-bank game is. Let this equilibrium be denoted by \( \{F_1^*, F_2^*\} \). We then have the following result.

**Proposition 4** An equilibrium to the 3-bank game is given by the following: \( \{F_1^*, F_2^*, \sigma_3 = 0\} \), where \( \sigma_3 \) represents the probability that bank 3 enters the market by submitting a free market bid.

**Proof:** Given \( \sigma_3 = 0 \), clearly \( \{F_1^*, F_2^*\} \) is an equilibrium for both banks that stay in, since this case is identical to two-bank case. What we need to show is that given \( \{F_1^*, F_2^*\} \), \( \sigma_3 = 0 \) is optimal for bank 3.

We write bank 3's payoffs as:

\[
\pi_3(s) = \lambda(1 - F_1^*(s))(1 - F_2^*(s))(s\bar{\theta} - 1) + (1 - F_1^*(s))\alpha_2 L(s) + (1 - F_2^*(s))\alpha_1 L(s)
\]
\[
= (1 - F_2^*(s)) \left[ \lambda(1 - F_1^*(s))(s\bar{\theta} - 1) + \alpha_1 L(s) \right] + (1 - F_1^*(s))\alpha_2 L(s)
\]

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\[ = (1 - F_2^*(s))\pi_2^*(s) + (1 - F_1^*(s))\alpha_2 L(s) \]

But \( \pi_2^*(s) = 0 \), by construction of \( F_1^*, F_2^* \), implying that \( \pi_3(s) < 0 \ \forall \ s \) as long as \( F_1^*(s) < 1 \ \forall \ s \). Therefore, \( \sigma_3 = 0 \) is an optimal response. \( \blacksquare \).

We can provide intuition as to why bank 3’s profit is negative. Bank 3 is competing on an equal basis with bank 2 for new firms and for bank 1’s old firms, but bank 3 also faces bank 2’s rejected customers. Since bank 2 is being held to zero profits, bank 3 gets zero profit on this segment of the market as well but negative profit on bank 2’s rejected firms. Hence bank 3 must get negative profit overall, if it ever enters. Put simply, entrant banks effectively face higher costs of operation during their period of entry than incumbent banks, which leads to the deterred entry result.

Now we proceed to address the issue of uniqueness of this equilibrium. As argued above, we show in the following that there does not exist any equilibrium to this game for which \( \sigma_3 > 0 \), or, in other words, that there is no equilibrium in which bank 3 ever bids on the free market. The intuition of this result is worth restating, and it is simply that a third bank faces a worse distribution than the other two incumbent banks, and hence never finds it profitable to enter. Note that it is also true that the second bank (the smaller of the two incumbents) also faces a worse distribution than the larger bank, bank 1, because it receives a larger share of bad firms than bank 1 does. However, we have already constructed an equilibrium for this case, and noted that it necessarily implies one bank must be making zero expected profits, and we noted that this bank is indeed the smaller bank. It is exactly this fact, that competition must force some banks’ profits to zero, that gives us the impossibility of entry by a third bank, who must compete in the already “tough” competition in the market.

As a result of the arguments above, we offer the following proposition. The mechanics of the proof, which involve checking a number of special cases and noting that a number of conditions that are implied by the existence of an equilibrium where bank 3 enters with positive probability cannot be satisfied, are rather lengthy and are relegated to the
Proposition 5 There does not exist an equilibrium with $\sigma_3 > 0$. (i.e. where bank 3 enters the market with positive probability.)

Proof: See appendix.

This proposition fully demonstrates our result of blockaded entry in this banking market. Note importantly that the only equilibrium with which we are left is the one obtained in proposition 4, that the two incumbent banks are able to safely compete ignoring the threat of potential entry.

3.5 An example

In this section we try to provide some more intuition about the results of our model solving it for the case where $\theta$ is uniformly distributed between $[0, 1]$. Therefore, let $G(\theta)$ denote a uniform distribution function over $[0, 1]$, with density $g(\theta) = 1$. Then we can explicitly solve for $F_1$, $F_2$, and $r$, and they will be given as follows.

\[
F_1(s) = 1 - \frac{\frac{1}{2}(1 - \lambda)\alpha_1 \frac{1}{s}}{\lambda \left(\frac{1}{2}s - 1\right)}
\]

\[
F_2(s) = 1 - \frac{\frac{1}{2}(1 - \lambda)\alpha_2 \frac{1}{s} - \left(1 - \frac{\alpha_2}{\alpha_1}\right) \left(\frac{1}{\lambda} \sqrt{(1 - \alpha_1)\lambda^2 + \alpha_1 \lambda}\right)}{\lambda \left(\frac{1}{2}s - 1\right)}
\]

Remember that: $\alpha_2 = 1 - \alpha_1$

Thus we have:

\[
F_2(s) = 1 - \frac{\frac{1}{2}(1 - \lambda)(1 - \alpha_1) \frac{1}{s}}{\lambda \left(\frac{1}{2}s - 1\right)} - \left(\frac{2\alpha_1 - 1}{\alpha_1}\right) \left(\frac{1}{\lambda} \sqrt{(1 - \alpha_1)\lambda^2 + \alpha_1 \lambda}\right)
\]
Notice that the lower bound for the free market interest rate is increasing in the market share of the largest bank (in this case $\alpha_1$.) The larger bank 1’s share, the larger the adverse selection problem for bank 2. In other words, when bank 2 gets smaller the distribution that it faces on the free market gets worse. Hence in order to make zero profit bank 2 has to charge a higher interest rate.  

$^{13}$ It is interesting to notice that the effect of $\alpha_1$ on the interest rate lower bound is stronger when $\lambda$ is smaller. $\lambda$ is in some way an index of the importance of the adverse selection problem. If $\lambda = 1$ all firms are new firms and the incumbent’s advantage disappears, so that previous market share do not matter. If $\lambda$ is small most firms are old firms, so that market shares become relevant because they represent valuable knowledge for the banks.

Figure 1 shows plots of $F_1(s)$ and $F_2(s)$ for three different values of $\lambda$, the arrival rate of new firms. It illustrates that as $\lambda$ increases, the importance of the adverse selection effect decreases, leading to increasing probability of lower interest rates. Furthermore as $\lambda$ approaches 1 the two banks’ strategies become closer to each other, and the curves become steeper, indicating less variance in the market interest rate charged. As $\lambda$ approaches 1 the banks’ strategies begin to approximate those predicted by a perfectly competitive market, with each firm putting all their probability weight on the break-even interest rate (i.e. they play a pure strategy.)  

$^{14}$ The effects of adverse selection on the bidding strategies of the two banks are clear from (3.12) and (3.13). Bank 1 will play less aggressively when $\alpha_1$ is large. This result becomes clearer if we think about $\alpha_1$ as a measure of bank 2’s costs: the larger $\alpha_1$, the larger the proportion of bad firms bank 2 faces in the free market. Hence when $\alpha_1$

\[ \frac{1}{2} (1 - \lambda) \left[ (1 - \alpha_1) \lambda^2 + \alpha_1 \lambda \right]^{-\frac{1}{2}} > 0. \]

$^{14}$Note that the interest rate charged, $r$, is extremely high in this example. This is simply because we allow firms to be of an unboundedly poor quality, and there are a larger number of these low quality firms. In figure 2 we allow for a more reasonable distribution of firm qualities, and obtain more realistic interest rates.

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increases bank 1 is facing a less dangerous opponent (since $\alpha_2$ clearly decreases) and can afford to increase the interest rate it charges. More technically, if we look at the equilibrium as a whole, we know that bank 1 has to bid less aggressively in order to keep a less efficient bank 2 at zero profits. In other words, since bank 2 is more "at risk" now because of banks 1's larger size, bank 1 needs to be less aggressive in its bidding strategy to compensate bank 2 for its extra risk. The interpretation for (3.13) is similar. The first term is symmetric to (3.12). The second term goes in the opposite direction. We can think about it as a "cost term": the larger $\alpha_1$, the higher the "informational cost" for bank 2, so that even if it has an incentive to lower its interest rate in order to win more often, it also has to raise it in order to cover costs.

Figure 2 shows $F_1(s)$ for two different distributions of firms over $\theta$, both with the same mean. Under the truncated uniform distribution the firms are uniformly distributed over the interval $[.864, 1]$. The two-step distribution represents a mean preserving spread of the truncated uniform, with 3.6% of the firms distributed uniformly over $[0, 1]$ and the remaining 96.4% distributed uniformly over $[.9, 1]$. It can be seen that $F_1$ for the truncated uniform lies strictly above $F_1$ for the two-step. This implies that banks bid more aggressively under the truncated uniform than under the two-step. In fact, average interest rates faced by new banks are more than 1% lower, even though the average credit worthiness of the whole market is the same. The difference between the two distributions is that firms are more heterogeneous under the two-step, so the adverse selection problem is greater. In other words, the incumbent's advantage is larger and so is its market power.

Consider the equilibrium that would obtain if there were no heterogeneity concerning firms' credit worthiness. In that case, all banks would break even by offering an interest equal to $\frac{1}{\theta}$, the inverse of each firm's success probability, and there would be no incumbency advantage. Moving away from this extreme, but preserving the mean success probability, asymmetric information begins to play a part and the advantage for incumbent banks increases. This emphasizes the fact that our results are driven by the presence of asymmetric information and not just by the riskiness of the market.
3.6 Conclusion

We have argued above that asymmetric information can per se constitute a barrier to entry into a banking market, and that this barrier arises endogenously out of the nature of competition. While the industrial organization literature has often focused on the notion of large fixed costs imposing a barrier to entry, and this is particularly true of models of Bertrand competition, the “fixed cost” we have in mind is one that arises out of a bank’s decision to enter a credit market populated by heterogeneous firms, and is not a direct fixed cost that must be paid up front to enter, or a production cost as in much of the industrial organization literature.

The incentive for a bank to enter at all into the credit market is provided by the fact that with a new pool of firms seeking financing each period, banks would always like to enter as long as the average payback rate for the new firms is sufficiently high to cover the bank’s investment. However, a bank attempting to enter a loan market is always faced with the prospect of receiving some of a competitor’s worst risks, and losing money on them to the extent that it is unable to distinguish between the good and bad risks. If an incumbent bank is able to distinguish between its good and bad firms, then an entrant bank is virtually guaranteed to receive all of these bad firms. This form of adverse selection is in some sense an unavoidable part of the entry decision, and is what leads banks to eschew entry to avoid the expected losses from this pool of “bad” firms.

Our result that the equilibrium number of banks in the market is limited to 2 is clearly an extreme result and is not meant to be a prediction for an actual banking market. It stems from our use of a very extreme form of competition, and under a less extreme form of competition such as one that included differentiation between banks, or capacity constraints, we would expect to see a larger, but still finite, number of banks. What we wish to emphasize is the fact that this informational asymmetry can make entry extremely difficult rather than the specific predictions of our model regarding the equilibrium number of banks. This limit on entry due to adverse selection continues to play an important role in models that soften the competition among banks.
We have been able to characterize the equilibrium with two banks, and also to show that with three banks, we never obtain an equilibrium where the smallest (in this case, the entrant) bank actually does enter the market with positive probability. But entry is primarily a dynamic issue, and while we obtain these results in a static setting, we think it warrants attention to consider these decisions in a multi-period setting. With more than one period, a potential entrant bank may have an incentive to enter even if it expects to make first period losses, since it knows that in the future it will be able to reap some benefits from the customers it already knows, and deny credit to the firms that are bad risks. This "option value" of obtaining good customers might loosen the constraint on profits that prevents entry in the one-period case, and might lead to a larger number of entrant banks. Our intuition is that this is not the case, and preliminary research in this direction seems to hint that even though banks obtain a future gain by entering, the nature of competition in the first period is such that most of these expected gains are competed away, and most banks still find entry blockaded. \(^{15}\) However, further research along these lines is necessary to adequately address these issues.

Finally, it should be clear that the basic structure of our model could easily be extended to areas other than banking markets. An example of how it could be applied to labor markets is that it might not be possible to start a law firm by raiding other law firms, because the old firms will fight to hang on to their good lawyers. This same framework could also be applied to analyze entry in the insurance market or in the managed care (HMO) market, since both of these are characterized by large amounts of informational asymmetries which would put entrant firms at risk of receiving "low quality" (high risk, high cost) customers.

\(^{15}\)In chapter 2 of this thesis I showed that if banks are differentiated by transportation costs, adverse selection still leads to a finite number of banks in equilibrium, even in the absence of any exogenous fixed costs. Moreover, he shows that in a dynamic OLG model in which banks live forever that our main results continue to hold.
3.7 Appendix

Proof of lemma 3: Suppose $F_j$ is discontinuous at $s^*$ (i.e. $\exists$ an atom in $F_j$), then banks $i$'s action of playing $s^* - \varepsilon$ strictly dominates playing $s^* + \varepsilon$, $\varepsilon > 0$. Therefore bank $i$ will not bid a free-market interest rate $S_i \in [s^*, s^* + \varepsilon)$. But then bank $j$ can raise its interest rate without losing customers and so $s^*$ cannot be an optimal action for bank $j$. Hence $F_j$ must be continuous.

To prove the second part, suppose $F_j$ is non-increasing over some interval, or in other words that $\exists$ some interval $(s_1, s_2) \subseteq (\underline{r}, R)$ for which $f_i(s) = 0 \forall s \in (s_1, s_2)$. But then $\text{prob}(S_i < S_j|S_i = s_1) = \text{prob}(S_i < S_j|S_i \in (s_1, s_2))$, but profits are strictly higher for $S_i > s_1$ (conditional on winning,) so that $i$ maximizes his payoff by playing $S_i = s_2$, and hence would never offer an interest rate in the interval $(s_1, s_2))$. But then $j$ can increase its profits by playing $S_j = s_2 - \varepsilon$ with positive probability, where $\varepsilon < s_2 - s_1$, since this will lead to strictly higher profits than any interest rate offer in a neighborhood of $s_1$. However, this contradicts the assumption that $f_j(s) \equiv 0 \forall s \in (s_1, s_2)$. □

Proof of proposition 5: We first need to establish a couple of preliminary results.

Claim 2 In any equilibrium, no two banks may have an atom at the same interest rate, i.e. $\exists s'$ such that $\mu_i(s') > 0$, $\mu_j(s') > 0$, with $i \neq j$.

Proof: Standard.

Claim 3 In any equilibrium, at least two banks must have the same lower bound to the support of their mixing distributions. More specifically, the supports of the two banks with the lowest lower bounds must coincide.

Proof: Suppose not, and assume WLOG that $r^i < r^j, r^k$. Then $i$ could unambiguously increase profits by offering a rate $r = \text{min}\{r^j, r^k\}$, and offering $r \in (r^i, \text{min}\{r^i, r^k\})$ with zero probability. □claim
Now we use these two results to prove the proposition. Suppose all 3 banks have the same lower bound to their supports: \( r^1 = r^2 = r^3 = r \). Then:

\[
\pi_1(r) = \lambda(r\bar{\theta} - 1) + \alpha_2 L(r),
\]

\[
\pi_2(r) = \lambda(r\bar{\theta} - 1) + \alpha_1 L(r),
\]

\[
\pi_3(r) = \lambda(r\bar{\theta} - 1) + \alpha_1 L(r) + \alpha_2 L(r).
\]

This implies that \( \pi_1 > \pi_2 > \pi_3 \) (A). However, at upper bound of the support,

\[
\pi_1(R) = \lambda(1 - F_2(r))(1 - F_3(R))(R\bar{\theta} - 1) + (1 - F_3(R))\alpha_2 L(R),
\]

\[
\pi_2(R) = \lambda(1 - F_1(r))(1 - F_3(R))(R\bar{\theta} - 1) + (1 - F_3(R))\alpha_1 L(R).
\]

If \( F_3(R) = 1 \), then \( \pi_1(R) = \pi_2(R) = 0 \), contradicting the ranking of profits (A) above. So we require that \( F_3(R) < 1 \). Given this, we then require that \( F_1(R), F_2(R) < 1 \) in order to obtain nonnegative profits for banks 1 and 2. By claim 2, we cannot have two banks with an atom at R. Also, to satisfy (A), we cannot have two banks i and j exiting with positive probability, since that would imply that profits for both these banks are zero. Since 0 is the lowest possible profit we can observe in equilibrium, we have that \( \sigma_3 < 1 \Rightarrow \pi_3 = 0 \). However, \( \pi_2(R) = \lambda(1 - F_1(R))\sigma_3(R\bar{\theta} - 1) + \sigma_3\alpha_1 L(R) \). If \( F_1(R) = 1 \), then \( \pi_2(R) < 0 \). If \( F_1(R) < 1 \), then, again by claim 2, \( F_2(R) = 1 \), so that \( \pi_1(R) < 0 \), a contradiction to the existence of an equilibrium of this sort. Therefore, \( \beta F_1, F_2, F_3 \), such that (A) above can be satisfied.

We then consider the possibility that all 3 banks do not have the same support. By claim 3, we need only consider combinations where any two banks tie for the lowest lower bound of their supports. (i) Suppose \( r^3 = r^2 = r < r^1 \). Then,

\[
\pi_2(r) = \lambda(r\bar{\theta} - 1) + \alpha_1 L(r),
\]

\[
\pi_3(r) = \lambda(r\bar{\theta} - 1) + \alpha_1 L(r) + \alpha_2 L(r),
\]

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which again implies that $\pi_2 > \pi_3$ (B). But at R, we can again show that we must have that in order to satisfy (B), we require that $F_3(R) < 1$, which implies that $\pi_3 = 0$, and that $F_1(R) < 1 \Rightarrow \pi_1(s) \leq 0$. We can write down the profits for bank 1 as

$$\pi_1(r^1) = \lambda(1 - F_2(r^1))(1 - F_3(r^1))(r^1\theta - 1) + (1 - F_3(r^1))\alpha_2 L(r^1) = 0.$$ 

But at $r$, we obtain $\pi_1(r) = \lambda(r\theta - 1) + \alpha_2 L(r) > \pi_3(r) \geq 0$. So we cannot have an equilibrium where $r^3 = r^2 = r < r^1$.

(ii) A similar argument shows that we cannot have an equilibrium where $r^3 = r^1 = r < r^2$.

(iii) Finally, consider the only possibility left: $r^1 = r^2 = r < r^3$.

We then require that $\pi_3(r^3) \geq 0$, as usual, and that $\pi_1(r) > \pi_2(r) \geq 0$ (C). Looking at payoff at R gives us that (C) implies $F_3(R) < 1$. However, unless $F_2(R) < 1$, we have $\pi_1(R) < 0$, a contradiction, so that $F_2(R) < 1$, and similarly for $F_1(R) < 1$. Since we require that $\pi_1 > \pi_2$, we must have that bank 2 exits with positive probability ($\Rightarrow \pi_2 = 0$), and bank 1 has an atom at R: $\mu_1(R) > 0$. Using this, we have that:

$$\pi_2(r^3) = \lambda(1 - F_1(r^3))(1 - F_3(r^3))(r^3\theta - 1) + (1 - F_3(r^3))\alpha_1 L(r^3) = 0$$

$$= \lambda(1 - F_1(r^3))(r^3\theta - 1) + \alpha_1 L(r^3) = 0$$

$$\Rightarrow (1 - F_1(r^3)) = \frac{-\alpha_1 L(r^3)}{\lambda(r^3\theta - 1)}$$

Now replace this expression into the profit equation for bank 3:

$$\pi_3(r^3) = \lambda(1 - F_1(r^3))(1 - F_2(r^3))(r^3\theta - 1) + (1 - F_1(r^3))\alpha_2 L(r^3)$$

$$+ (1 - F_2(r^3))\alpha_1 L(r^3)$$

$$= \lambda \left[ \frac{-\alpha_1 L(r^3)}{\lambda(r^3\theta - 1)} \right] (1 - F_2(r^3))(r^3\theta - 1)$$

$$+ \left[ \frac{-\alpha_1 L(r^3)}{\lambda(r^3\theta - 1)} \right] \alpha_2 L(r^3) + (1 - F_2(r^3))\alpha_1 L(r^3) \geq 0$$

80
\[ \Rightarrow \left[ \frac{-\alpha_1 L(r^3)}{\lambda(r^3 \bar{\theta} - 1)} \right] \alpha_2 L(r^3) \geq 0, \]

a contradiction, since \( L(r^3) < 0 \). Therefore, no equilibrium exists with \( \sigma_3 > 0 \). \( \square \)
3.8 Figures

![Graph showing the relationship between F and r for different values of \( \lambda \).]
Figure 3-1:
Chapter 4

Exchange Rate Volatility and International Trade: Evidence from the European Union

One main argument against flexible exchange rates has often been that exchange rate volatility could have negative effects on trade and investment. If exchange rate's movements are not fully anticipated an increase in exchange rate volatility, increasing risk, will lead risk-averse agents to reduce their import/export activity reallocating production toward domestic markets. There is also a political economy explanation that supports this view from a different perspective. In that scenario it is protectionist legislation that depresses international trade. Flexible exchange rates often lead to large and persistent deviations from PPP, these misalignments may cause large trade imbalances that determine political pressures in favor of tariffs and other forms of trade barriers.

The trade issue has also played an important role in the debate on the European Monetary System (EMS) and the European Monetary Union (EMU). The EMS was established with the intent of controlling exchange rate volatility and avoid large misalignments among European currencies. One of the purposes was to reduce exchange rate

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1Even within EU the recent exchange rate fluctuations lead to tensions between Italy and France.
uncertainty to promote intra-EU trade and investments. The discussion on the transition to EMU, and in particular the idea of a "two speed Europe, involves similar issues. One major concern is that a partial monetary union would have negative effects on the trade of left out countries. The idea is that, as for custom unions, a partial monetary union could divert trade away from non member countries. However, there is not a strong and unambiguous empirical evidence to support this view. Although there is a quite extensive literature testing the effects of exchange rate regimes on trade, the results are not always significant and they change across studies. Most papers use only cross-sectional data and just a few use bilateral data. Hooper and Kohlhagen (1978) study bilateral trade flows of the major industrial countries with US and Germany, and find no effect of exchange rate variability on trade. Bailey, Tavlas and Ulan (1986) obtain similar results for the G7 countries. Kenen and Rodrik (1986) use global rather than bilateral trade and test for more than one measure of exchange rate volatility. They find some but not conclusive evidence of a negative effect of exchange rate variability on trade. Brada and Mendez (1988) notice that countries that fixed the exchange rate are more likely to use trade restrictions to defend their trade balance. They find some evidence that countries with fixed rates trade less than countries with floating rates. They do not deny that exchange rate uncertainty depresses trade, but claim that this reversed political economy effect overwhelms the variability effect. De Grauwe (1988) finds a small, but significant, negative effect of real (but not nominal) exchange rate volatility on the trade growth rate for the ten major industrial countries. Peree and Steinherr (1989) find evidence of a negative effect with what they call a medium term variability measure. They use the range of change (max - min) of the spot exchange rate in the three years preceding the observation. Frankel and Wei (1993) find small and not always significant evidence of a negative relation between exchange rate volatility and trade for a large sample of 63 countries. The general impression from this papers is that if a systematic significant relationship between exchange rate volatility and trade exists, it is small.

In this paper I try to provide some more empirical evidence about the effects of
exchange rate volatility on bilateral trade among Western European countries, using a gravity model of international trade and panel data. There are various reasons to limit the scope of this study to Europe. First the theoretical foundations of the gravity model assume identical and homothetic preferences across countries and rely heavily on the concept of intra-industry trade\(^2\). European countries are relatively homogeneous in terms of technology, factors endowments and per capita income, thus the model seems particularly appropriate to this case. Moreover, as Bayoumi and Eichengreen (1995) notice, the relationship between trade and other economic characteristics might be different for industrial and developing countries. Thus restricting the sample to Western European countries we minimize problems due to heteroskedasticity. Moreover the issues related to the choice of an exchange rate regime are particularly relevant for the debate about the transition to the European Monetary Union (EMU). Thus it seems interesting to try to estimate the effects of exchange rate volatility on trade within the set of countries that would be involved in EMU. Finally limiting the scope to Western European countries increases the availability of both trade and financial data, allowing me to use panel data instead of cross-sections only. In what follows I test the effects of exchange rate volatility on trade using different measures and techniques. Particular attention is dedicated to the simultaneous causality problem that arises in this kind of studies. If central banks make an effort to stabilize the exchange rate against their main trade partners, a negative correlation between exchange rate volatility and trade would appear from the data, but it would not mean that trade reacts negatively to exchange rate instability. The use of panel data allows me to deal with this problem in a way that explicitly takes into account the behavior of the central banks.

The empirical evidence in this paper supports the view that exchange rate uncertainty depresses international trade. The results are robust with respect to the particular measures chosen to represent uncertainty. They also show that the negative correlation between exchange rate volatility and bilateral trade remains significant when we con-

control for simultaneous causality. However, I can reject the hypothesis of the absence of a simultaneity bias.

Section 2 describes the general gravity model. Section 3 discusses the problems related to the choice of a measure of exchange rate uncertainty and the simultaneous causality issue. Section 4 reports the empirical results.

4.1 The Gravity Model

The gravity model has been widely used in empirical work in international economics\(^3\). The microeconomic foundations of this model are based on the theory of trade under imperfect competition, and more specifically on intra-industry trade theory\(^4\). In a gravity model the volume of trade between two countries increases with their GDPs and decreases with their geographical distance. The idea is that economically larger countries tend to trade more in absolute terms, while distance represents a proxy for transportation costs and it should depress bilateral trade. In general a per capita income variable is included to represent specialization, richer countries tend to be more specialized, and thus they tend to have a larger volume of international trade for any given GDP level. Models often include a number of dummy variables to control for different factors that might affect transaction costs. For example, a common border, language or membership in a custom union are suppose to decrease transaction costs and promote bilateral trade. In this paper I am interested in the effects of exchange rate uncertainty on trade, thus I include a proxy to represent it. In the actual estimation this variable will take different forms: the standard deviation of the percentage change in the exchange rate or the standard deviation of the first differences of the logarithmic exchange rate, the sum of the squares of the forward errors, and the percentage difference between the maximum

\(^3\)See, for example, Bayoumi and Eichengreen (1995), Frankel (1992), Krugman (1991).

\(^4\)Helpman (1987) uses a Dixit/Stiglitz imperfect competition model to obtain the relation between gross trade and GDPs. Bergstrøm (1989) generalizes this model to include Heckscher-Ohlin trade.
and the minimum of the nominal spot rate. The final equation is:

\[
\log(TRADE_{ijt}) = \alpha_t + \beta_1 \log(GDP_i GDP_j) + \beta_2 \log(DISTANCE_{ij})
+ \beta_3 \log(pop_i pop_j) + \beta_4 \text{BORDER}_{ij} \\
+ \beta_5 \text{EU}_{ijt} + \beta_6 \text{LANG}_{ij} + \beta_7 \nu_{ijt} + \epsilon_{ijt}
\]  

(4.1)

where \(TRADE_{ijt}\) is the bilateral trade (Export + Import) between countries \(i\) and \(j\) at time \(t\). \(EU_{ijt}\) represents membership in the European Union (1 when both countries \(j\) and \(i\) are in the union at time \(t\), 0 otherwise), and \(\text{BORDER}_{ij}\) and \(\text{LANG}_{ij}\) represent respectively a common border and language. \(\nu_{ijt}\) is the proxy for uncertainty about the bilateral exchange rate between country \(i\) and \(j\) at time \(t\).

Notice that we have to allow the constant to change over time. Indeed following the model in Helpman (1987) any change in world aggregate GDP will be captured by the constant\(^5\). We are implicitly imposing a restriction on the "third country" coefficient. In other words, we are assuming, for example, that the trade between Germany and Italy reacts in the same way to a change in US income or France income. This is not necessarily true and it is one major problem with gravity models.

\(^5\)Assume two differentiated products \(X\) and \(Y\), and homothetic preferences identical in every country, then in the completely specialized case import of country \(k\) from country \(j\) will be:

\[IMP_{kj} = s_k (p_x X_j + p_y Y_j)\]

where \(s_k\) is country \(k\)'s share in world spending (and income in trade balance) and \(X_j, Y_j\) are the outputs of goods \(X\) and \(Y\) produced in country \(j\) (I omit the time index here). The symmetric is true for the import of country \(j\) from country \(k\). Thus the total gross trade is:

\[T_{kj} = s_k (p_x X_j + p_y Y_j) + s_j (p_x X_k + p_y Y_k) = s_k GDP_j + s_j GDP_k\]

rewriting we get:

\[T_{kj} = s_k s_j GDP_{world} + s_j s_k GDP_{world} = \frac{2GDP_j GDP_k}{GDP_{world}}\]

thus when we take logs any over change in world GDP goes in the constant.
4.2 A measure of exchange rate volatility

If PPP held, domestic and foreign trade would not systematically involve a different degree of uncertainty. However, exchange rates experience significant and persistent deviations from PPP\(^6\), adding an exchange risk component to import/export activities. Then an increase in exchange rate uncertainty might lead risk averse firms\(^7\) to reduce their foreign activity reallocating production toward their own domestic markets. With regard to this, the relevant type of exchange rate risk will depend on the model of exporting/importing firm we have in mind. If we imagine exporting firms that sign short term export contracts in foreign currency, assuming that costs in the firms’ own currency are known at \(t-1\), the only uncertainty arises from the nominal exchange rate: the firm does not know its revenue in domestic currency\(^8\) at \(t-1\). In this situation forward exchange rate markets represent an effective way to hedge against uncertainty. Short term contracts are available for all the major currencies and they are relatively cheap\(^9\).

On the other hand, firms might have some sort of long term commitment to the export activity. These kind of firms have to sustain sunk costs to enter particular foreign markets and are interested in the relationship between their costs and the price they can charge on those markets. In this case what matters is the real exchange rate\(^10\), firms are interested


\(^7\)This result holds under certain conditions, see De Grauwe (1988) for a discussion.

\(^8\)The expected utility from profit at time \(t-1\) for the exporting firm will be:

\[ E_{t-1}U (\Pi_t) = E_{t-1}U (\langle q_t \mid t-1 \rangle \langle p^*_t \mid t-1 \rangle \hat{e}_t - \langle C_t \mid t-1 \rangle) \]

where the price in foreign currency is fixed at time \(t-1\), and quantity and costs, assuming production occurs between \(t-1\) and \(t\) and relevant prices are \(t-1\) ones, are known at time \(t-1\).

\(^9\)Nonetheless, studies show that only a small, but increasing, part of international trade is actually hedged on forward markets. See Dornbusch and Frankel (1988), Commission of the European Communities (1990), Frankel (1995).

\(^10\)Assuming that costs are a function of domestic prices, for these firms future expected profits are a function of domestic prices, foreign prices and exchange rate, thus real profits are a function of the real exchange rate:

\[ E_0U \left( \sum_t \Pi_t (1 + r)^{-t} \right) = E_0U \left( \sum_t (p^*_t \hat{e}_t q_t - C_t (p_t)) (1 + r)^{-t} \right) \]
in the evolution of their revenues relatively to their costs. To hedge against this kind of uncertainty is much more difficult. Forward markets are not complete in terms of maturity (there are no developed markets for maturity longer than one year) and the future exchange needs might not be known precisely at the moment of the decision. Hence, real exchange rate uncertainty may play an important role in determining firms import/export choices\textsuperscript{11}.

The first problem we have in estimating the effects of exchange rate uncertainty on trade is to choose an appropriate variable to represent instability\textsuperscript{12}. The literature has used a number of measures of exchange rate volatility and variability have been used as a proxy for risk. One variable proposed is the standard deviation of the level of the nominal exchange rate\textsuperscript{13}. This measure relies on the underlying assumption that the exchange rate moves around a constant level. In the presence of a trend this index would probably overestimate exchange rate uncertainty. In that case a more satisfactory variable often used in the literature\textsuperscript{14} is the standard deviation of the percentage change of the exchange rate or the standard deviation of the first differences of the logarithmic exchange rate. This measure has the property of being zero in the presence of an exchange rate that follows a constant trend\textsuperscript{15} and it gives a larger weight to extreme observations (consistently with the standard representation of risk averse firms). Hooper and Kohlhagen (1978) consider the average absolute difference between the previous period forward rate and

\[
E_0U \left( \sum_t \frac{\Pi_t}{p_t} (1 + r)^{-t} \right) = E_0U \left( \sum_t \frac{p_t^r e_t q_t - C_t (p_t)}{p_t} (1 + r)^{-t} \right)
\]

\textsuperscript{11}For this reason I think the next step in this branch of research should be to estimate the effects of exchange rate instability on FDI.
\textsuperscript{12}For a discussion of exchange rate volatility measures see Brodsky (1984), Kenen and Rodrik (1986) and Lanyi and Suss (1982).
\textsuperscript{13}See Akhtar and Hilton (1984). Bailey et al. (1986) use the absolute value of the percentage change of the trade weighted exchange rate. Hooper and Kohlhagen (1978) use the variance of the forward rate.
\textsuperscript{14}See Brodsky (1984), Kenen and Rodrick (1986) and Frankel and Wei (1993).
\textsuperscript{15}The underlying assumption is that a constant trend would be perfectly anticipated and it would not affect uncertainty.
the current spot to be the best indicator of exchange rate risk. The advantage of this measure is that, under a target zones regime or pegged but adjustable exchange rates, it would pick the presence of a peso problem or the lack of credibility of the official parity. Preee and Steinherr (1989) stress the importance of medium run uncertainty and propose a different kind of index. They use the percentage difference between the maximum and the minimum of the nominal spot rate over the t years preceding the observation, plus a measure of exchange rate misalignment. The idea is that large changes in the past generate expected volatility.

From the review of the existing literature emerges that there is not a "right" measure of exchange rate uncertainty. It is worth to notice that the measures proposed as proxies for risk are backward looking, the assumption is that firms use past volatility to predict present risk. Then, even if we could restrict our choice to a particular measure, we would still have many options: daily, weekly or monthly changes? Which temporal window? Consequently I chose to test the model using different variables representing uncertainty, over different temporal windows, and for both real and nominal exchange rate. In particular I use the standard deviation of the percentage change in the exchange rate or the standard deviation of the first difference of the logarithmic exchange rate, the sum of the squares of the forward errors, and the percentage difference between the maximum and the minimum of the nominal spot rate\(^{16}\).

A problem of simultaneous causality arises using some of these of measures. Central banks could systematically try to stabilize the bilateral exchange rate with their most important trade partners. In this case the negative correlation between exchange rate volatility and trade would be affected by these policies and OLS would be a biased estimator. To avoid this problem we need to use an instrumental variable estimator. Frankel and Wei (1993) propose to use the standard deviation of the relative money supply as instrument for the exchange rate volatility. Their justification is that relative

\(^{16}\)All these variables are constructed using end of the period exchange rate monthly data from the IFS.
money supplies and bilateral exchange rates are highly correlated, but monetary policies are less affected by trade considerations than exchange rate policies. The problem with this solution is that for many European countries exchange rate stability has been an important determinant of the monetary policy\textsuperscript{17}. In this paper I use an alternative instrument: the forward rate error. The forward error is not a target of central banks' policies and reflects in some way exchange rate uncertainty. The sum of the squares of the forward errors (defined as the difference between the log of the three months forward rate and the log of the spot rate three months later, using monthly data) is correlated with the standard deviation of the spot rate and thus can be used as an instrument.

In this paper the use of panel data allows me to try a different approach to solve the simultaneous causality problem. The idea behind the simultaneity bias is that central banks try to stabilize the bilateral exchange rate against their country's main trade partners. In this case the exchange rate volatility becomes a function of the share of the bilateral trade over the total trade of the two countries:

$$v_{ijt} = \lambda_{ijt} - \beta \left( \frac{T_{ijt}}{T_{i,t}} \right) - \gamma \left( \frac{T_{ijt}}{T_{j,t}} \right) + \eta_{ijt}$$

where the $\beta$ and $\gamma$ terms represent the stabilization effort of the two countries central banks. If the bilateral trade shares were constant over time, taking the first differences we would get:

$$\Delta v_{ijt} = \Delta \lambda_{ijt} + \Delta \eta_{ijt}$$

eliminating the central bank effect and the simultaneous causality problem. We can imagine central banks following a more general and less accurate rule in which the stabilization effort depends on the order of magnitude of the bilateral shares and not on the exact value of the share. In such a case we would not need trade shares perfectly constant, but only shares more or less stable over time. This is actually the case for our sample: trade shares are not strictly constant over time, but for every country the

\textsuperscript{17}This is specially true for the countries participating in the ERM.
relative dimension of its trade partners remains more or less the same over the period considered\textsuperscript{18}. Thus taking first differences our equation becomes:

\[
\Delta \log(TRADE_{ijt}) = \Delta \alpha_t + \beta_1 \Delta \log(GDP_tGDP_{jt}) + \beta_2 \Delta \log(pop_i pop_{jt}) \\
\beta_3 \Delta EU_{ijt} + \beta_4 \Delta v_{ijt} + \varepsilon_{ijt}
\] (4.2)

where all the terms that are constant over time are eliminated and the simultaneous causality problem is solved.

It could be argued that not only the absolute volatility of the exchange rate, but also the relative volatility should be used in this analysis. Consider a country \(i\) trading with countries \(j\) and \(k\). Assume that exchange rate variability increases for country \(i\) against the currencies of both \(j\) and \(k\). If the increase is larger for country \(k\), the relative risk of trading with country \(j\) decreases. This effect could imply a reallocation of trade for country \(i\) from country \(k\) to country \(j\). In other words, changes in the bilateral exchange rate volatility might have not only trade creation, but also trade diversion effects. This third country effect issue is particularly relevant for Europe. In the debate on monetary union a "two speed" process has been proposed: "virtuous" countries would join from the beginning, while other countries would join later. As for custom unions, a monetary union will benefit the member countries, but it might hurt the non members. If the third country effect is important, a partial monetary union could divert trade flows away from the left out countries. In this paper I try to estimate the third country effect using a variable representing, for each pair of countries, the volatility of the exchange rate with the all the other countries.

\textsuperscript{18}See Graphs at the end of the paper. The only big change is the share of Spain in Portugal's trade.
4.3 Empirical Evidence

The sample period covers 20 years from 1975 to 1994. The countries included are the actual 14 EU countries (with Belgium and Luxembourg taken as a whole)\(^{19}\) and Switzerland, for a total of 2100 observations. The source for the trade data is the OECD database: bilateral data for both import and export flows are available. The GDP data are from the OECD as well. The original data were expressed in current prices and different currencies. In order to be used in a multi-period gravity model they had to be deflated and converted to a common currency\(^{20}\). There were two possible ways to proceed: we could first convert the data into a common currency and then use the deflator for that currency to express the data in constant prices. Alternatively we could first deflate the data with each country deflator and then convert them to a common currency. If PPP applies the two procedures are equivalent. However, given PPP often fails, I chose to use the second procedure that in my view minimizes the bias introduced by deviations from PPP. This was also the main reason for which I chose to use only export data\(^{21}\). The available deflators for import and export are based on a basket that reflects a country’s total import or export (these are IFS data). However, with our data the correct deflator would use baskets reflecting the bilateral flows between each pair of countries. It seems reasonable to assume that the bias introduced by using the wrong deflator is smaller for export data than for import data. The idea is that, for each country, the goods exported to different countries are more homogenous than the goods imported from different countries. Distances are represented by air distances between capital cities\(^{22}\). I use different proxies to represent the exchange rate uncertainty: the standard deviation of the first differences of the logarithm of the monthly average bilateral spot rate, the sum of the squares of the forward errors, and the percentage difference between the maximum and

\(^{19}\) Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, UK.

\(^{20}\) I used PPP from the OECD series, I also obtained very similar results using US dollars.

\(^{21}\) Note that, at least in theory, country j import from country k is equal to country k export to country j, thus we could use import and/or export data to compute the bilateral gross trade.

\(^{22}\) Exceptions are Frankfurt for Germany and Milan for Italy, the source is Alitalia.
the minimum of the nominal spot rate. Exchange rate data are end of the month observations and the source is the IFS. Analogous measures are used for the real rate, that is constructed using CPI indexes from the IFS\textsuperscript{23}. The dummy EU is included to control for the progressive enlargement of the union: this variable has value one for country pairs and years for which both countries are EU members. An additional dummy Language represents country pairs with a common language.

Table one describes the results of regression (1) using various measures of exchange rate uncertainty. I allowed the constant to change over time and controlled for heteroskedasticity and autocorrelation (FGLS). All coefficients have the expected sign and are significant at the 1\% level. Moreover the results seem to be robust. Most coefficients are similar for the different regressions, suggesting that the four measures of exchange rate uncertainty are in some way equivalent (the regression using the sum of the squares of the forward errors as exchange rate volatility measure is on a sub sample of countries that does not include Portugal). It is worth to notice the relative importance of having a common language in determining trade flows. Even after controlling for GDPs, populations, membership in the EU and a border in common, countries that speak the same language trade between each other 24\% more than the average. The exchange rate volatility coefficient is small, but not irrelevant. From the nominal exchange rate standard deviation coefficient a total elimination of exchange rate volatility in 1994 would have determined a 12\% increase in trade\textsuperscript{24}, a 13\% increase using the real exchange rate measure, and a 10\% increase using the forward error. It is interesting to notice that the results for nominal exchange rate volatility are very close to the results for real volatility. This result is not surprising given in our sample there is a strong correlation between nominal and real exchange rate volatility (see figure 1).

The results of table 1 are statistically significant and seemingly do not depend on

\textsuperscript{23}There is no monthly price index for Ireland. The monthly real exchange rate is constructed using the quarterly price index and assuming that the inflation rate is constant within the quarter.

\textsuperscript{24}The average standard deviation of the monthly nominal exchange rate change in 1994 was about 0.55\%.
the variable chosen to represent exchange rate uncertainty. Nonetheless the validity of these results could be questioned for the presence of simultaneity bias in regression (1) when using! the standard deviation of the exchange rate change. Central banks are likely to try to stabilize the exchange rate vis a vis their main trade partners. In this case, even if exchange rate uncertainty did not have a negative effect on trade flows, we would get a negative correlation between exchange rate volatility and trade at a bilateral level. To solve this problem we can use the forward error as an instrument for exchange rate volatility: in particular the sum of the squares of the three month logarithmic forward error as an instrument for the standard deviation of the first differences of the logarithmic spot rate. This variable is not controlled by central banks and it is positively correlated with our measure of exchange rate volatility (see figure 2).

Notice that the forward exchange rate was not available for Portugal, thus the regression with instrumental variables uses only a sub-sample of 14 countries (1820 observations). Also here I allowed the constant to change over time and corrected for heteroskedasticity and autocorrelation. Table 2 describes the results of the regression using instrumental variables (two stages generalized least squares) and the results of FGLS on the same countries (without Portugal). The coefficients still have the right sign and they are all significant at the 1% level. The size of the coefficients does not change respect to the results of table 1. For the instrumental variable estimation the results are more or less the same, suggesting that the negative correlation between exchange rate volatility and trade is not determined solely by the simultaneous causality bias. In other words, the negative correlation between exchange rate variability and trade does not depend, or at least does not depend entirely, on central banks policies. It is possible to test the hypothesis of the absence of simultaneous causality using a Hausman specification test. If the hypothesis is verified FGLS are unbiased and consistent, but they are biased in the presence of simultaneous causality, while the IV estimator is unbiased and consistent.

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25 For all the other countries it was possible to construct a forward rate using short term interest rates, the source was the IFS.
under both the null and the alternative hypothesis. From the results of the Hausman test I can reject at the 10% level the hypothesis that the FGLS estimator is unbiased. This result is thus consistent with the presence of a simultaneity bias. Nevertheless, the results obtained with the instrumental variable estimation are still valid and confirm the existence of a negative relation between bilateral exchange rate volatility and trade flows. To further test the robustness of these findings we can use the simple model proposed in the previous section. Notice that we need the time-stability of the trade shares in order to use this method properly\textsuperscript{26}. The "central bank effect" has to be fixed over time in order to be eliminated taking first differences. In this regression all the variables that are constant over time do not appear. Table 3 reports the results of regression 3. As before, also in regression (3) I allowed for a time varying constant and controlled for autocorrelation and heteroskedasticity. In this case the sample is complete set of 15 countries for the first two columns and the subset without Portugal for the regression with the forward errors. These results seem to confirm our previous findings. The GDP coefficient has the right sign and it is still positive at the 1% level with all three measures of exchange rate volatility. This means that the GDP growth rate has a significant positive effect on the gross trade growth rate. The population coefficient is never significant in this regression. The EU dummy has a positive and statistically significant coefficient, meaning that the decision of entering the Union has a positive impact on trade dynamics. This is an important result, to become member of the EU increases the trade growth rate, while we have already seen that EU membership significantly increases trade levels. The exchange rate volatility coefficient is still negative. It is significant at the 5% level for the standard deviation of the differences in the logarithmic real exchange rate, and at the 10% level for the nominal rate. It is not significant if we measure exchange rate uncertainty using the forward error variable. These results are consistent with the idea that a negative correlation between exchange rate volatility and trade exists and that at

\textsuperscript{26}This is more or less true for our sample. The only big change is in Spain/Portugal share. See graphs at the end.
least a part of it is not spurious correlation cause by central banks' stabilization policies. However, with the regression with the forward errors we cannot exclude that the central bank effect plays the main role. In order to test the efficacy of this method in eliminating simultaneous causality, I used again the Hausman test. In this case the instrumental variable is represented by the first differences of forward error measure. In this case I cannot reject the hypothesis of unbiasedness of FGLS, this is consistent with the idea that the central bank's factor is stable over time and is eliminated using first differences.

As noted before there is no "right" measure to represent the exchange rate volatility. For this reason I wanted to further test the robustness of the previous results using a different time window for my measures. Table 4 reports the results of regression 1 using a two year window to compute the various exchange rate volatility variables. The results are consistent with the previous ones, confirming a negative effect of volatility on trade. Notice that I used instrumental variables estimation given the rejection of FGLS unbiasedness from the Hausman test on the previous results. All coefficients have the expected sign and are significant at the 1% level.

The evidence in this section shows a negative correlation between exchange rate volatility and trade flows. With the results presented here we can reject the hypothesis that central banks' behavior has no role in determining the negative correlation between volatility and trade. However, the results of estimations that are robust to simultaneous causality bias support the hypothesis that firms, reacting negatively to volatility on foreign currencies markets, determine a decrease in the volume of international trade when the exchange rate becomes more volatile.

4.4 The ERM effect

Most observers viewed the 1992/93 crisis of the EMS (more precisely of the Exchange Rate Mechanism) as a stop in the process of economic integration of the European countries. The EMS purpose was to reduce exchange rate volatility among member currencies
to promote trade and economic convergence and the ERM was actually successful in reducing both nominal and real exchange rate volatility\footnote{See figure 3. For a detailed analysis see De Grauwe and Verfaille (1987)} (this is specially true for the period 1987-1992). Thus following the results from the previous section the ERM should have had a positive effect on the bilateral trade among EU member countries. Moreover we should be concerned for the future negative effects of the 1992 crisis. If the end of the ERM meant a diminished exchange rate stability, we should expect a reduction in intra-EU trade. In this section I used the framework presented above to try to estimate the effects of the ERM on trade. I constructed a dummy equal to 1 when both countries are members of the ERM and 0 otherwise\footnote{This approach has the advantage of avoiding the simultaneous causality problem. The decision to enter the ERM concerns more a country's general policy than simply its trade policy.}. The resulting equation is:

\[
\log(TRADE_{ijt}) = \alpha_t + \beta_1 \log(GDP_{it}GDP_{jt}) + \beta_2 \log(DISTANCE_{ij}) \\
+\beta_3 \log(pop_{it}pop_{jt}) + \beta_4 BORDER_{ij} \\
+\beta_5 LANG_{ij} + \beta_6 EU_{ijt} + \beta_7 ERM_{ijt} + \epsilon_{ijt}
\]

In this way the ERM dummy captures the stabilizing role that the Exchange Rate Mechanism had on the currencies of member countries. On the other hand we might be interested in the effect that the ERM had per se and not only through the reduction of exchange rate volatility. Then the equation becomes:

\[
\log(TRADE_{ijt}) = \alpha_t + \beta_1 \log(GDP_{it}GDP_{jt}) + \beta_2 \log(DISTANCE_{ij}) \\
+\beta_3 \log(pop_{it}pop_{jt}) + \beta_4 BORDER_{ij} + \beta_5 LANG_{ij} \\
+\beta_6 EU_{ijt} + \beta_7 ERM_{ijt} + \epsilon_{ijt}
\]

A negative sign on the ERM coefficient would mean that the mechanism's role in re-
ducing uncertainty went beyond the induced reduction in volatility. The results of both regressions are presented in table 5. As before I used an instrumental variable estimator adjusted for heteroskedasticity and autocorrelation and I allowed the constant to change over time. All the usual coefficient keep having the right sign and are still significant. The ERM coefficient has the right sign and is significant at the 5% level when we use ERM as a proxy for exchange rate stability. However, if we control for exchange rate volatility the ERM coefficient has the wrong sign. It is significant at the 5% level using the standard deviation of the change in the exchange rate and it is not significant if we control using the forward error measure. This result seems surprising and it apparently conflicts with the findings in the previous section. ERM membership should decrease uncertainty and thus increase trade. On the other hand a large literature addressed the issue of the credibility of the ERM and rejected the full credibility hypothesis for most cases.\textsuperscript{29} The result in this section is consistent with that evidence. If for most of the periods and the countries the exchange rate target zones were not credible, we should not expect a significant effect of the ERM dummy on trade flows. At the same time a non credible ERM would generate expectations of relatively large realignments, to which agents may react in a particularly negative way.\textsuperscript{30} With regard to this, it is interesting to notice that the ERM coefficient is not significant when we use the forward error measure to represent uncertainty. The forward error in someway includes that kind of expectations, in the presence of a ”peso problem” with fixed but adjustable parities, the forward error would pick the presence of uncertainty, while the standard deviation of the exchange rate change would not. An alternative, not very appealing, explanation is provided by political economy. Brada and Mendez (1988) suggest that countries with fixed exchange rate regimes are more likely to use trade restrictions to defend their trade balance. They


\textsuperscript{30}A way to address this issue might be to control for the credibility of the bilateral target zones and construct a ”credible ERM” dummy. First we would have to define a measure of credibility. Then we could construct a variable taking value 1 when the commitment to the bilateral parity is credible, and 0 otherwise. The quoted literature relies on Svensson (1991) test based on forward rates (or interest rates differentials). If the forward rate is outside the band, the target zone cannot be fully credible.
find some evidence that countries with fixed rates trade less than countries with floating rates. However, in our context this effect seems very unlikely because most countries in the sample (all countries in the ERM) are EU members.

4.5 The Third Country Effect

The effects of bilateral exchange rate volatility on trade have been extensively tested in this paper. Bilateral trade is negatively affected by a volatile bilateral exchange rate. From this point of view a monetary union, eliminating altogether nominal variability, and largely reducing real variability\(^{31}\), would facilitate intra-EU trade. In our estimations we considered third country effects only in an indirect way. Any change in world income is captured by the constant without geographical distinction. As I said before this is an implicit restriction on the third country effect coefficients. The other implicit assumption is that for any countries \(k\) and \(j\) any change in exchange rate volatility with currencies other than their own has zero effect on the bilateral trade. However, theoretically a reduction in the exchange rate volatility between countries \(k\) and \(j\) could reduce the gross trade of this two countries with a third one. In other words, a partial monetary union could be "trade diverting". This assumption has important implications for the transition to EMU. The parallel with the analysis of custom unions is immediate. A monetary union could increase trade among its member countries and, at the same time, divert trade from the countries left out. Here I am not interested in estimating the net welfare effects, but only in estimating the importance of the "third country" effect. This issue is relevant for the debate on the hypothesis of a "two speed" monetary union. The concern is for the "bad" countries that would join EMU only in a second stage. To estimate this effect I include a variable representing the exchange rate volatility of the two currencies with all the others. Consider the following regression:

\(^{31}\)Nominal and real exchange rate variability are very correlated. The results from our sample confirm Mussa’s findings.
\[
\log(TRADE_{ijt}) = \alpha_t + \beta_1 \log(GDP_t GDP_{jt}) + \beta_2 \log(DISTANCE_{ij}) \\
+\beta_3 \log(pop_t pop_{jt}) + \beta_4 BORDER_{ij} \\
+\beta_5 EU_{ijt} + \beta_6 LANG_{ij} + \beta_7 \nu_{ijt} + \beta_8 m_{ijt} + \epsilon_{ijt}
\]

(4.3)

where

\[
m_{ijt} = \sum_{i\neq j} v_{ijt} w_{ijt} + \sum_{j\neq i} v_{ijt} w_{ijt}
\]

with weights represented by relative GDPs. The trade shares of country \(i\) and \(j\) could represent a more appropriate system of weights. However, these weights would introduce a bias because trade shares are also a function of exchange rate volatility\(^{32}\). If the trade diversion hypothesis is valid we should obtain a negative sign for \(\beta_8\). Table 6 reports the results for regression 4 with real and nominal exchange rate volatility. Most coefficients have more or less the same values as in regression (1). However, for both cases there is probably a multicollinearity problem. The correlation between the bilateral exchange rate volatility and the volatility with the rest of the countries in the sample is above 0.9. Then it is not possible to determine the contribution of the two variables separately. Indeed the bilateral volatility coefficient is no longer significant and is very small. The third country effect coefficient is significant but it has the wrong sign. An increase in the exchange volatility with third countries decreases bilateral trade. From this result a two speed monetary union with "good" countries switching first at EURO and "bad" ones following later should not be opposed, at least not on the basis of trade considerations. However, the evident multicollinearity problem suggests that more empirical evidence should be collected before reaching any conclusion.

\(^{32}\)An alternative measure is the standard deviation of changes in the effective real exchange rate. See Lanyi and Suss (1982) for a discussion on these measures.
4.6 Conclusions

In this paper the relationship between exchange rate uncertainty and trade has been tested with data from Western European countries. Different variables have been used as proxies for uncertainty, and all gave consistent results. I found evidence of a small but significant negative effect of bilateral volatility on trade. The problem of a possible simultaneity bias was addressed in two different ways, and both instrumental variables and fixed effects over time gave results consistent with the hypothesis of a negative effect of exchange rate uncertainty on trade. Nevertheless, a Hausman specification test rejected the hypothesis that no simultaneity bias exists. The issue of the "third country" effect was analyzed. I found significant evidence of a negative effect of "third country" exchange rate volatility on bilateral trade. Thus from this point of view a partial monetary union, the so called "two speed Europe" should not be obstructed. Nonetheless, I want to recommend caution with the interpretation of this result.

Further research in this area should look at more disaggregated data. It is more difficult to find financial instruments to hedge against exchange rate risk when the time horizon becomes longer. Then EMU might have a different impact across industries. In sectors where the export activity requires large investments, trade should prove more sensitive to exchange rate volatility than in sectors characterized by "short term" export. For the same reasons exchange rate stability should result more important for FDI than for trade flows.
4.7 EU/EMS Chronology

- 1951 Apr. European Coal and Steel Community - Treaty of Paris

- 1957 Mar. European Economic Community - Treaty of Rome (6 countries)

- 1971 Aug. End of the Bretton Wood System

- 1972 Mar. Introduction of the Snake (Belgium, France, Germany, Italy, Netherlands)

- 1972 May Denmark, UK and Norway join the Snake.


- 1973 Jan. Denmark, Ireland and UK become members of EEC

- 1973 Feb. Italy exits the Snake.


- 1979 Mar. EMS starts (Belgium, Denmark, France, Germany, Ireland and Netherlands with 2.25% margins, Italy with 6%).


- 1986 Jan. Portugal and Spain join EEC.

- 1989 Jun. Spain joins the EMS with 6% margins.

- 1990 Jan. The margin for the Italian Lira is narrowed to 2.25%
• 1990 Oct. Unification of Germany. UK joins the ERM with 6% margins.


• 1992 Apr. Portugal joins ERM with 6% margins.

• 1992 Sep. Italy and UK suspend participation in the ERM.


• 1993 Aug. ERM margins widened to 15%.

• 1995 Jan. Austria, Finland and Sweden join the EU.
### 4.9 Tables and Figures

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All coefficients significant at the 1% level
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* sign. at the 1% level, ** sign. at the 5% level, *** sign. at the 10% level
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<td>EU</td>
<td>0.29*</td>
<td>0.30*</td>
<td>0.35*</td>
<td>0.29*</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.020)</td>
<td>(0.020)</td>
<td>(0.018)</td>
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<tr>
<td>Ex. rate Volatility</td>
<td>-22.84*</td>
<td>-24.15*</td>
<td>-0.75*</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(2.590)</td>
<td>(2.740)</td>
<td>(0.084)</td>
<td>-</td>
</tr>
<tr>
<td>ERM</td>
<td>-0.05**</td>
<td>-0.07**</td>
<td>-0.02</td>
<td>0.04**</td>
</tr>
<tr>
<td></td>
<td>(0.024)</td>
<td>(0.026)</td>
<td>(0.022)</td>
<td>(0.021)</td>
</tr>
</tbody>
</table>

* sign. at the 1% level, ** sign. at the 5% level, *** sign. at the 10% level
<table>
<thead>
<tr>
<th>variable</th>
<th>nominal IV</th>
<th>real IV</th>
</tr>
</thead>
<tbody>
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<td>GDP</td>
<td>1.02* (0.034)</td>
<td>0.94* (0.034)</td>
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<tr>
<td>Population</td>
<td>-0.30* (0.036)</td>
<td>-0.25* (0.036)</td>
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<td>Distance</td>
<td>-0.34* (0.032)</td>
<td>-0.35* (0.031)</td>
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<tr>
<td>Border</td>
<td>0.25* (0.020)</td>
<td>0.25* (0.020)</td>
</tr>
<tr>
<td>Language</td>
<td>0.25* (0.024)</td>
<td>0.25* (0.024)</td>
</tr>
<tr>
<td>EU</td>
<td>0.25* (0.016)</td>
<td>0.25* (0.016)</td>
</tr>
<tr>
<td>Bilateral Volatility</td>
<td>-4.75 (8.613)</td>
<td>7.17 (9.867)</td>
</tr>
<tr>
<td>Third Country</td>
<td>-23.64** (9.753)</td>
<td>-40.24* (11.232)</td>
</tr>
</tbody>
</table>

* sign. at the 1% level, ** sign. at the 5% level, *** sign. at the 10% level
Figure 4-1: Nominal and real exchange rate volatility
Figure 4-2: Real volatility and forward error squares for the Lira/DM exchange rate
Figure 4-3: Average Exchange Rate Volatility in the EU

![Graph showing volatility in the EU with years from 1975 to 1995 and values on the y-axis ranging from 0.071193 to 0.263156.]

Figure 4-4: Trade Shares by Country

![Graph showing trade shares by country with a focus on Austria. The x-axis represents years from 1975 to 1993, and the y-axis ranges from 0 to 0.6. Various countries are represented by different markers and lines, with Austria showing a slight increase in trade shares over time.]

Austria

- Belgium
- Denmark
- Finland
- France
- Germany
- Greece
- Ireland
- Italy
- Netherland
- Portugal
- Spain
- Sweden
- Switzerland
- UK
Figure 4-5:

Figure 4-6:
Figure 4-7:

Figure 4-8:
Figure 4-9:

Figure 4-10:
Figure 4-13:

Figure 4-14:
Bibliography


