EMERGING MARKET FINANCE

The Role of Multinational Banks and Microfinance

Inaugural-Dissertation
zur Erlangung des Grades
Doctor oeconomiae publicae (Dr. oec. publ.)
an der Ludwig-Maximilians-Universität München

2008

vorgelegt von

Maria Lehner

Referentin:	Prof. Dr. Monika Schnitzer
Korreferentin:	Prof. Dr. Dalia Marin
Datum der mündlichen Prüfung:	21. Januar 2009
Promotionsabschlussberatung:	04. Februar 2009

DANKSAGUNG

An dieser Stelle möchte ich mich bei all denjenigen Personen bedanken, die durch ihre Unterstützung diese Arbeit erst möglich gemacht haben.

Allen voran möchte ich meiner Erstbetreuerin, Frau Prof. Dr. Monika Schnitzer, ganz herzlich für ihre beständige Unterstützung während meiner Promotionszeit danken. Ihre Anregungen und ihr Rat, vor allem auch während der Arbeit an unserem gemeinsamen Papier, waren für meine Dissertation von unschätzbarem Wert. Sie hat mich jedoch nicht nur akademisch, sondern auch in vielerlei anderer Hinsicht inspiriert und geprägt, wofür ich ihr sehr verbunden bin.

Sehr herzlich möchte ich mich auch bei meiner Zweitgutachterin, Frau Prof. Dr. Dalia Marin, bedanken, die mich ebenfalls während meiner gesamten Promotionszeit in verschiedenster Hinsicht unterstützt hat.

Bedanken möchte ich mich auch bei Prof. Dr. Gerhard Illing, der die Rolle des Drittgutachters meiner Dissertation übernommen hat.

Ganz herzlich möchte ich mich bei Basak Akbel, Jan Philipp Bender und Tu-Lam Pham bedanken. Während unserer Research Group Treffen profitierte ich enorm von ihren Ideen und Anregungen. Des Weiteren möchte ich folgenden Personen für ihre Unterstützung und Anregungen danken: Peter Beermann, Karin Fritsch, Kira Fuchs, Christa Hainz, Hannah Hörisch, Karolina Kaiser, Joachim Klein, Michal Masika, Christian Mugele, Dirk Rösing, Richard Schmidtke, Christiane Ströh, Martin Watzinger, Sebastian Watzka sowie allen Teilnehmern des IO and Finance Seminars, des International Economics Workshops sowie des Research Strategy Seminars.

Ganz besonders möchte ich mich bei meiner Familie bedanken: Bei meinen Eltern für ihre Liebe und beständige Unterstützung und für die Werte, die sie mir mitgegeben haben; bei meinen Geschwistern für unseren engen Zusammenhalt; bei meinen Großeltern, dass sie in einer schwierigen Zeit die Grundlage für die vielen Chancen, die sich mir bieten, geschaffen haben.

Ganz herzlich möchte ich mich auch bei meinen Freundinnen Julia, Marion und Susanne bedanken, die gute und schlechte Zeiten mit mir teilen und immer für mich da sind.

Mein größter Dank jedoch gilt Tu-Lam, dem ich diese Arbeit widme.

München, 05. Februar 2009 Maria Lehner

Contents

List of Figures

Preface

"Finance is at the core of the development process. [...] *Efficient, well-functioning financial systems are crucial in channeling funds to the most productive uses and in allocating risks to those who can best bear them, thus boosting economic growth, improving opportunities and income distribution, and reducing poverty.* [...] *Lack of access to finance is often the critical mechanism behind both persistent income inequality and slow economic growth. Hence financial sector reforms that promote broader access to financial services should be at the core of the development agenda."*[1]

This is how the World Bank Report "Finance for All" (2008) highlights well-functioning financial systems and access to finance as crucial factors for development. Apart from sound financial institutions and prudential regulation, the report focuses, first, on openness along with increased competition and, second, on microfinance as two means to enhance access to finance and to promote financial development. With respect to the first point, a major role is attributed to the entry of foreign banks which bring capital, technology, and know-how. Even if foreign banks were to concentrate on lending to rather large and transparent firms, overall empirical evidence suggests that foreign bank entry improves access to finance, since domestic banks - as a result of stronger competition - are driven to serve small and medium enterprises. Second, the report discusses the role of microfinance programs. Access to microloans contributes to growth and development by unleashing the productive potential of the unbanked poor who otherwise would have no means to realize their projects and become entrepreneurs.

In this thesis, we focus on precisely these two drivers of financial development. More specifically, we analyze the role and the incentives of *banks* in the process of financial market liberalization and the market for microfinance. In the first chapter, we examine the incentives of multinational banks to expand abroad. We investigate in detail how specific characteristics of local banking markets affect a multinational bank's choice of

[1] World Bank (2008, p. 17,21)

entry mode. The second chapter addresses the impact of financial market liberalization on host countries. We study, in particular, how local banks are affected by enhanced competition and spillovers from foreign banks. Finally, in the last chapter, we discuss different lending strategies of microfinance institutions. More precisely, we analyze a microfinance institution's incentives to offer group or individual loans.

Over the last decade, banking markets in many developing and emerging markets have been liberalized on a large scale. In 2006, in roughly 40 percent of all developing countries, more than 50 percent of banks were foreign owned, up from just around 15 percent in 1995. From 1995 to 2006, the number of foreign banks rose by 173 percent in Europe and Central Asia, by 100 percent in South Asia, and by 66 percent in the Middle East and Northern Africa. Most striking has been the increase in Eastern Europe. In countries such as Albania, Estonia, Hungary, Romania, and Slovakia, more than 80 percent of banks are now foreign owned (Claessens et al. (2008)).

This enormous upheaval of banking markets gives rise to numerous interesting questions concerning both the role of multinational banks expanding abroad and the incentives of local banks as how to react to foreign entry. What determines a multinational bank's decision to grant cross border loans or to access a new market via a financial foreign direct investment? How do the development and the size of the local banking market affect this decision? How do a bank's incentives to expand abroad depend on its own efficiency? Do increased competition and spillovers from foreign to domestic banks prompt local banks to improve on their efficiency? What are the effects of banking market liberalization on social welfare?

We analyze the incentives of multinational banks to enter new markets in chapter 1. We set up a model of bank competition with banks differing in screening efficiencies. Banks may choose to grant cross border loans or to seek access to a new market via greenfield or acquisition entry. Foreign banks enjoy better refinancing conditions and are more efficient in screening borrowers than their local competitors. However, apart from entry costs, foreign banks may encounter a disadvantage relative to domestic banks, in so far that the latter hold soft information on borrowers due to prior lending relationships.

Our model combines two related strands of literature, namely trade theory and industrial organization literature. In trade theory, the decision between exports and foreign direct investments is studied, analogous to the trade-off between cross border lending and financial foreign direct investments. Papers in trade theory typically build on monopolistic competition between firms. We depart from this approach in that banks in our model compete in prices which we consider a more appropriate form of competition in the banking sector. Furthermore, instead of labor productivity we rely on a bank's screening efficiency as the central indicator of its productivity since it determines the quality of its credit portfolio.

In industrial organization literature, the trade-off between greenfield and acquisition entry is addressed. A greenfield entrant is generally presumed to produce at lower marginal costs than domestic firms. This is motivated by the foreign firm's superior production technology of which it can take full advantage when building its own production facilities from scratch. At the same time, however, this implies huge fixed market entry costs. In contrast, the acquisition of a local firm involves restructuring costs and constrains the foreign firm to the use of the target's inferior production facilities which may raise the foreign firm's marginal costs above those of domestic firms. We contribute to this literature in that we account for a key feature of banking, namely the importance of access to soft information about borrowers. We argue that the foreign banks' lack of access to soft information may imply the reversal of the pattern of marginal costs described above. Effectively, due to problems of collecting soft information in case of de novo investment, a foreign bank may find itself at a disadvantage relative to local banks. Instead, the acquisition of a local bank grants access to exactly this information and, in combination with better screening skills, allows the foreign bank to operate at lower marginal costs than domestic banks.

Our analysis shows that the entry mode pattern of banks depends on their efficiency in screening potential borrowers. If rather inefficient in screening borrowers, a bank chooses not to expand abroad. With increasing efficiency, cross border lending becomes feasible. In contrast to the typical findings in the industrial organization literature, we demonstrate that still more efficient banks opt for de novo investment whereas the most efficient banks favor the acquisition of a local bank. Moreover, in less developed host banking markets, a wider range of foreign banks opt for cross border lending and acquisition entry. In contrast, the scope for de novo investment augments in more developed banking markets. Interestingly, in larger host banking markets, a wider range of foreign banks prefer the acquisition of a local bank while de novo investment loses in attractiveness.

In chapter 2, we turn to the impact of banking market liberalization on host countries.[2] We consider two channels through which foreign banks may affect the local banking market. First, competition intensifies owing to the higher efficiency of entrant banks and - if entry occurs via de novo investment - a rise in the number of banks. Second, due to spillover effects, domestic banks may learn from their new competitors and improve on their screening skills. In that we account for spillovers and, even more so, their interaction with competition effects, we add to the scarce theoretical literature on foreign bank entry.

In our model of bank competition, foreign banks more efficiently screen borrowers than their local competitors. Foreign banks expand via de novo investment or via the acquisition of a local bank. To a certain extent, spillover effects enhance the local banks' screening efficiency. However, domestic banks must further invest in their screening technology in order to attain the efficiency level of foreign banks.

Our analysis shows that domestic banks invest less in better screening skills the larger spillovers and competition are. Domestic banks' incentives to improve on their screening efficiency are higher if foreign bank entry occurs via acquisition rather than through de novo investment. We find that the impact of foreign bank entry on social welfare in the host country is determined by the competitive environment of the host banking market, a second indicator of competition in our model. Interestingly, greenfield entry and, thus, more competitors are more likely to correlate with positive welfare effects the more competitive the market environment, whereas spillovers are less likely to have positive welfare effects the stronger competitive pressure is. Hence, competitive effects seem to reinforce each other, while spillovers and competition tend to weaken each other.

Having analyzed both the incentives of foreign banks to expand abroad and the impact of foreign bank entry on host countries, we subsequently turn to the market for microfinance that as well has the potential to enhance access to finance and to promote financial development. Microfinance has become highly popular since Muhammad Yunus was awarded the Nobel Peace Prize in 2007. According to him, "all human beings have an innate skill, [...], the survival skill. The fact that the poor are alive is clear proof of their ability. They do not need us to teach them how to survive; they already know how to do this."[3] Hence, by giving the unbanked poor access to finance,

[2] Chapter 2 is joint work with Monika Schnitzer, University of Munich and CEPR.

[3] Yunus (2007, p. 140)

their entrepreneurial potential can be unleashed. Indeed, a large body of research has found that access to microloans reduces poverty and positively affects nutrition, health and education as well as gender empowerment.

Typically, microfinance is associated with joint liability of group members. Strikingly, however, many microfinance institutions rather offer individual instead of group loans. This triggers several interesting questions. What are the underlying incentive mechanisms that play a role in individual and group lending schemes and how do they differ? What determines a microfinance institution's decision to offer group or individual loan contracts? How do individual loan programs of microfinance institutions and the individual lending technology applied by commercial banks differ?

So far, the literature has almost exclusively focused on group lending schemes. It is surprising that to date the analysis of individual lending schemes has been largely neglected despite individual loans dominating the microfinance business in many regions of the world.

With the aim to contribute to a better understanding of the different incentive mechanisms in group and individual lending programs, we set up a model of competition between microfinance institutions in chapter 3. Borrowers lack pledgeable collateral and are unable to provide hard information, because they have no documented credit history. Hence, in contrast to commercial banks, microfinance institutions cannot screen borrowers and secure loans with collateral. Instead, microfinance institutions offer either group contracts which implies a transfer of the monitoring role to borrowers or they offer individual loans. In the latter case, microfinance institutions specialize in closely monitoring borrowers. Clients are exempt from the typical costs associated with group loans such as bearing additional risk, loss of privacy or time spent on finding a group partner.

Surprisingly, our analysis shows that microfinance institutions are more likely to offer group instead of individual loans the smaller a loan is. This result contrasts several arguments brought forward in the so far rather descriptive literature on this topic. Moreover, we find that individual loans are offered when refinancing costs are low and competition between microfinance institutions is intense. Interestingly, our analysis predicts that individual loans in microfinance will gain in importance over the next years if microfinance institutions themselves continue to get better access to funds from capital markets.

Chapter 1

The Entry Mode Choice of Multinational Banks

1.1 Introduction

The last few years have seen an impressive liberalization of banking markets. While banks active in rather saturated developed financial markets looked for new investment and growth opportunities, banks in many emerging economies were in need for fresh capital in the aftermath of banking crises. The privatization process in Eastern Europe provided further opportunities for multinational banks to expand abroad. Nowadays, in around 40 percent of all developing countries, more than 50 percent of banks are foreign owned. Strikingly, this figure rises to more than 80 percent in several Eastern European countries (Claessens et al. (2008)).

This immense transformation of banking markets triggers several questions concerning both the incentives of multinational banks to enter new markets and the incentives of host countries as how to shape foreign entry. Should a multinational bank grant cross border loans or rather access a new market via de novo investment or the acquisition of a local bank? How does the development and the size of the local banking market affect a multinational bank's entry mode choice? What are the host country policy maker's preferences regarding different entry modes of foreign banks?

With the aim to address these questions, we set up a model of spatial bank competition à la Salop. Foreign banks may enter the host country via cross border lending, de novo investment or the acquisition of a domestic bank. Banks compete in interest rates for potential borrowers that engage in investment projects of uncertain return. Foreign banks have access to a better screening technology and enjoy lower refinancing costs than local banks. However, besides market entry costs, foreign banks are at a disadvantage relative to domestic banks in that the latter hold soft information on borrowers due to prior lending relationships. Furthermore, granting cross border loans implies a rather limited knowledge of the host market. Hence, when multinational banks decide about their mode of entry, they face a trade-off between the size of market entry costs and their relative disadvantage in what concerns access to soft information and their knowledge of the local market.

We demonstrate that multinational banks choose their entry mode according to their efficiency in screening potential borrowers. If a bank is rather inefficient in screening, it chooses not to expand abroad. With increasing efficiency, cross border lending becomes feasible. As soon as the better market knowledge in case of greenfield entry compared to cross border lending compensates for the larger fixed entry cost, the foreign bank shifts from cross border lending to de novo investment. Only if the screening technology of the foreign bank is powerful enough, it can drive down the acquisition price to the point that acquisition entry becomes the dominant entry mode.

A major focus of our study is to explain how a foreign bank's entry mode choice is affected by the financial development and the size of the host banking market. Indicators for the host country's level of financial development in our model are the screening efficiency and refinancing conditions of local relative to foreign banks. As a further indicator serves the importance of access to soft information as a measure of a market's transparency. A high level of competitive pressure is yet another sign for increased development. We show that in less developed host banking markets a wider range of foreign banks opt for cross border lending and acquisition entry whereas the range of foreign banks that prefer greenfield investment contracts. Interestingly, a wider range of foreign banks favors acquisition entry in smaller host banking markets whereas the attractiveness of de novo investment is enhanced in larger markets.

Our welfare analysis allows us to determine the preferences of the host country policy maker concerning foreign bank entry. The policy maker prefers a foreign bank not to enter the market when it is rather inefficient in screening borrowers. From the policy maker's point of view, cross border lending is strictly dominated by greenfield entry. Greenfield entry, in turn, is favored for intermediate screening efficiencies of foreign banks. If a foreign bank is highly efficient in screening borrowers, the policy maker prefers the foreign bank to acquire a local bank. Although the policy maker's preferences regarding foreign entry are similar to those of foreign banks, scope for regulation exists as the threshold values determining the preferred entry mode pattern of the policy maker and the foreign banks differ.

We find that the regulation of foreign bank entry is shaped as follows. Entry is permitted but to foreign banks that rather efficiently screen borrowers. Furthermore, the less competitive the market environment is, the more likely it is that foreign banks are denied entry. Cross border lending is not allowed for. Foreign banks that intend to expand via cross border lending or the acquisition of a local bank are forced to enter via de novo investment if their screening efficiency is insufficiently low.

The remainder of this chapter is organized as follows. The next section reviews the literature. Section 1.3 describes the set-up of the model. In section 1.4, we study the entry mode choice of multinational banks. Comparative statics in section 1.5 allow us to analyze the impact of the financial development as well as the size of the host banking market on the entry mode decision of foreign banks. We present the welfare analysis in section 1.6. Empirical hypotheses are stated in section 1.7. Section 1.8 concludes.

1.2 Related Literature

The expansion of multinational banks into new markets and, even more so, the banks' entry mode choice has received astonishingly little attention in the finance literature so far. Buch and Lipponer (2007) and García Herrero and Martínez Pería (2007) empirically analyze the decision of multinational banks to expand abroad via cross border lending or via a financial foreign direct investment. They find that the larger the host banking market, the more a foreign direct investment is preferred over cross border activities. Van Tassel and Vishwasrao (2007) as well as Beermann (2007) set up models to study the trade-off between greenfield and acquisition entry. Van Tassel and Vishwasrao conclude that a multinational bank generally favors acquisition over de novo entry. Beermann shows that the most efficient banks choose to expand via the acquisition of a host country bank whereas less efficient banks opt for greenfield entry.

This chapter is further related to two strands of literature, namely trade theory and industrial organization literature. Trade theory explains a firm's decision to expand abroad via exports (the equivalent to cross border lending) or a foreign direct investment (the equivalent to a financial foreign direct investment). One of the first models in trade theory to study the export versus foreign direct investment decision of firms is Brainard (1993). She points to the trade-off between fixed and variable costs. Firms choose to export in case of high fixed and low variable costs and to serve the foreign market via a foreign direct investment otherwise. Helpman, Melitz and Yeaple (2004) incorporate firm heterogeneity into this trade-off between variable and fixed costs. They show that when countries open up to trade, the least productive firms are forced to exit the market and the remaining firms engage with increasing labor productivity in exports before they start to operate in a new market via a foreign direct investment. Nocke and Yeaple (2004) theoretically analyze the decision of a firm to expand via de novo investment or the acquisition of a local firm and conclude that the most efficient firms opt for de novo investment. In a related paper, Nocke and Yeaple (2007) distinguish between exports, greenfield and acquisition entry and suggest that the entry mode choice of firms depends on whether foreign and host country firms differ in mobile or immobile capabilities.

Related articles in the industrial organization literature focus on the trade-off between greenfield and acquisition entry. Gilroy and Lukas (2006), Görg (2000), Iranzo (2003), as well as Raff et al. (2006) set up models in which a firm's decision between greenfield and acquisition entry depends on differences in the marginal costs of foreign and domestic firms. As in Eicher and Kang (2005) or Müller (2007), it is generally assumed that a greenfield entrant produces at lower marginal costs than domestic firms. This is motivated by the foreign firm's superior production technology of which it can take full advantage when building its own production facilities from scratch. At the same time, however, this implies huge fixed market entry costs. In contrast, if entry occurs via acquisition, the foreign firm is presumed to be constrained to the use of the inferior production facilities of the acquired firm and, in addition, the need to restructure the target firm. In turn, this implies higher marginal costs of the foreign compared to the domestic firm. Most of these papers conclude that rather productive firms opt for de novo investment whereas less productive firms favor the acquisition of a domestic firm.

The situation in the banking industry is different. A multinational bank that enters a new market via de novo investment faces a disadvantage relative to domestic banks in that the latter hold soft information on borrowers due to prior lending relationships. Consequently, when a foreign bank opts for greenfield entry, it may incur higher variable costs than the domestic banks. However, if a multinational bank decides to enter a new market via the acquisition of a host country bank, it gains access to the soft information held by the target. Moreover, the entrant can relatively easily implement its own superior screening technology. As a result, the entrant may operate at lower marginal costs than domestic banks.

Hence, we add to the trade and industrial organization literature with its focus on manufacturing industries in that we account for special characteristics of the banking sector. We depart from trade theory in that our model is not based on monopolistic competition. Rather, banks in our model compete in prices which we consider a more appropriate form of competition in the banking industry. Furthermore, instead of labor productivity we rely on a bank's screening efficiency as the key indicator of its productivity since it determines the quality of its credit portfolio. Moreover, we add to the industrial organization literature in that we stress that the foreign banks' lack of access to soft information may imply the reversal of the pattern of marginal costs as described above. As in the industrial organization literature, we allow for restructuring costs but emphasize that they should be of a rather fixed nature.

1.3 The Model

We consider two separated banking markets, A and B. Multinational banks are based in market A. Market B represents the host banking market. In market B, a continuum of borrowers with mass m is uniformly distributed along a circular road with circumference 1. Each borrower can engage in one investment project that requires an initial outlay of 1. Borrowers can either invest in good or in bad projects. It is common knowledge that the fraction of borrowers with good projects is γ and the fraction of borrowers with bad projects is $1-\gamma$, $0<\gamma<1$. Individual borrowers know about the quality of their own investment projects. In case the project is good it generates a return $v>0$ with certainty while a bad project always fails yielding a return of zero. The returns of the projects are observable and contractible. Borrowers are not endowed with any initial wealth and therefore need to apply for credit at the banks, the only source of finance in our model.

Before market B is opened up to the entry of a foreign bank, two identical representative banks B_j, $j=1,2$, are located equidistantly along the circular road. The location of a bank reflects its specialization in a certain credit product or industry. Banks compete in the interest rates r_{B_j} they simultaneously charge borrowers. Borrowers whose investment project yields a return of v repay their loan with interest to the bank whereas borrowers whose project fails do not repay their loan. Host country banks incur refinancing costs $i_B > 0$ per loan of size 1. They have access to an imperfect screening technology based on the evaluation of hard information provided by borrowers. It allows the local banks to identify the fraction δ_B, $0 < \delta_B < 1$, of borrowers investing in bad projects. The banks cannot distinguish between the remaining borrowers with bad projects and borrowers investing in good projects. Hence, the fraction $(1 - \delta_B)$ of bad borrowers and all good borrowers applying for credit obtain financing. Without loss of generality, we assume that screening is costless for all banks.

When the host banking market opens up to foreign bank entry, a foreign bank based in market A is granted the permission to enter market B. Without loss of generality we abstract from relocation costs and assume that after foreign entry, banks are located equidistantly along the circular road. We assume that the foreign bank has access to a superior screening technology relative to domestic banks. Its screening technique allows the foreign bank to identify a fraction δ_A, $0 < \delta_B < \delta_A < 1$, of borrowers investing in bad projects. Furthermore, we assume lower refinancing costs of foreign banks compared to host country banks, i.e. $0 < i_A < i_B$.[4] The foreign bank may enter market B via cross border lending, de novo investment, or the acquisition of a domestic bank.

When a foreign bank enters the host country via cross border lending or de novo investment, it encounters a disadvantage relative to domestic banks in what concerns the access to soft information about borrowers. In contrast to hard information, soft information needs to be collected over time through relationships with clients (Petersen and Rajan (1994), Stein (2002)). As in Sengupta (2007), we assume that domestic banks were able to collect unobservable, i.e. soft information on their borrowers during past lending relationships. In the literature, there are different approaches to capture the soft information advantage of domestic relative to foreign banks. Dell'Ariccia et al. (1999) and Dell'Ariccia (2001) base their model on the existence of new and old borrowers so that domestic banks have an advantage over foreign banks concerning the share of old borrowers. Gormley (2008) interprets the information advantage of domestic versus foreign banks as higher per borrower screening costs of the latter. For our analysis, it is convenient to model the lack of soft information about borrowers

[4]These assumptions are confirmed by e.g. Berger (2007), Gormley (2008), and Sengupta (2007).

as a decline in the power of the foreign bank's screening technology. We assume that in case of cross border lending and greenfield entry, the quality of the foreign bank's screening technology is diminished by a factor μ, $0 < \mu < 1$. Hence, only the share $\mu\delta_A$ of borrowers with bad projects is identified. However, the acquisition of a local bank ensures access to the soft information held by the target which implies that the fraction δ_A of borrowers with bad projects is denied credit. We assume that all borrowers apply for a loan with new investment projects. Hence, although domestic banks have access to soft information about potential clients, both foreign and domestic banks need to screen borrowers.

In our model, we also consider the foreign bank's fairly limited knowledge of the host banking market if it grants cross border loans and, accordingly, has no large presence in the local banking market. We capture this limited market knowledge by an even lower quality of the foreign bank's screening technology. That is, only the share $\alpha\mu\delta_A$, $0 < \alpha < 1$, of borrowers investing in bad projects is identified in case of cross border lending.

When the foreign bank starts to operate in market B, it incurs market entry costs. Entry costs are modeled as a fixed component in case of cross border lending, F_{CBL}, and greenfield entry, F_{GR}, $F_{CBL} < F_{GR}$. Note that in case of greenfield entry the foreign bank needs to establish a new branch network, whereas with cross border lending, it may only set up a representative office which is much less costly. When a multinational bank enters a new market via the acquisition of a domestic bank, the foreign bank's entry cost consists of the endogenous takeover price and a fixed component F_{AC}, $F_{AC} < F_{GR}$. The fixed component may reflect, for instance, restructuring costs or the amortization of bad credits due to asymmetric information concerning the quality of the target's credit portfolio before the acquisition.

Banks compete in the interest rates r_A and r_{B_j} they simultaneously ask from borrowers. Borrowers base their decision at which bank to apply for credit on the interest rates offered by the banks and the transport costs they have to incur to travel to the bank. The transport costs express the preferences borrowers have for a particular type of bank. We assume that transport costs tx are proportional to the distance x between the borrower and the bank. Furthermore, we assume that the return of a good project v is high enough so that the market is covered at equilibrium prices.

Borrowers and banks are risk neutral and maximize profits. We take it as given that each bank disposes of enough funds to finance all borrowers applying for a credit.

We assume that banks can observe the location of borrowers.[5] Borrowers with bad projects that are denied credit do not apply for credit at another bank because banks can deduce from the borrowers' location that they have unsuccessfully applied for a loan at another bank.

The time structure of the game is as follows. At stage 1, market B opens up to the entry of one representative foreign bank. At stage 2, borrowers apply for credit at the banks. Banks engage in screening the borrowers. At stage 3, returns realize and all borrowers having invested in good projects pay back their loan.

1.4 Choice of Entry Mode

In this section, we study the incentives of the foreign bank to grant cross border loans or to expand via greenfield investment or the acquisition of a domestic bank.

1.4.1 Cross Border Lending

The foreign bank enters market B via cross border lending if it thereby makes positive profits in the host banking market. The profit of the foreign bank in the host banking market is given by

$$\pi_A^{CBL} = \left[\gamma\left(r_A^{CBL} - i_A\right) - (1-\gamma)(1-\alpha\mu\delta_A)(1+i_A)\right] m\phi_A^{CBL} - F_{CBL}. \tag{1.1}$$

When the foreign bank offers cross border loans, it has no access to soft information about borrowers and, in addition, a fairly limited knowledge of the local banking market. Hence, the foreign bank identifies a rather low fraction $\alpha\mu\delta_A$ of borrowers with bad projects but cannot distinguish between the remaining fraction $(1-\alpha\mu\delta_A)$ of bad borrowers and the borrowers with good projects. Accordingly, the foreign bank finances the fraction $(1-\alpha\mu\delta_A)$ of borrowers investing in bad projects as well as all borrowers with good projects applying for credit. Since bad borrowers do not make any repayments, the foreign bank incurs a cost of $1+i_A$ on this group. The fraction γ of good

[5] As e.g. in Dell'Ariccia (2001), this assumption considerably simplifies our analysis. Note that we abstract from the possibility of price discrimination of borrowers.

borrowers, however, repays the loan with interest so that the bank obtains the margin $r_A^{CBL} - i_A$ on those clients. The market share of the foreign bank is derived in the Appendix (see proof of Lemma 1.1) and is given by $m\phi_A^{CBL} = m\left(\frac{1}{3} + \frac{r_{B_1}^{CBL} + r_{B_2}^{CBL} - 2r_A^{CBL}}{2t}\right)$. Fixed entry costs amount to F_{CBL}.

Host country banks do not incur any soft information problems or fixed costs. Accordingly, their profit is given by

$$\pi_{B_j}^{CBL} = \left[\gamma\left(r_{B_j}^{CBL} - i_B\right) - (1-\gamma)(1-\delta_B)(1+i_B)\right] m\phi_{B_j}^{CBL}.^{6} \tag{1.2}$$

Banks maximize their profit with respect to the interest rates they ask from borrowers. We state the resulting equilibrium profits in Lemma 1.1:

Lemma 1.1 *If foreign bank entry takes place via cross border lending, equilibrium profits of banks are given by*

$$\pi_A^{CBL} = mt\gamma\left(\tilde{\phi}_A^{CBL}\right)^2 - F_{CBL} \tag{1.3}$$

$$\pi_{B_j}^{CBL} = mt\gamma\left(\tilde{\phi}_B^{CBL}\right)^2 \equiv \pi_B^{CBL} \ \forall \ j. \tag{1.4}$$

Proof: see Appendix.

The foreign bank enters the host banking market via cross border lending as soon as the quality of its screening technology allows it to make positive profits in market B, that is, $\pi_A^{CBL} \geq 0$. Our result is stated in Proposition 1.1.

Proposition 1.1 *The foreign bank enters the host banking market via cross border lending if its screening efficiency is higher than the threshold value δ_A^{CBL}. That is, if*

$$\delta_A \geq \ \delta_A^{CBL} = \frac{\frac{5}{2}\sqrt{\frac{t\gamma F_{CBL}}{m}} - \Delta - \frac{5}{6}t\gamma}{\alpha\mu(1-\gamma)(1+i_A)}. \tag{1.5}$$

Proof: see Appendix.

[6] In our analysis, we focus on the interaction of foreign and domestic banks and, therefore, abstract from the possible exit of domestic banks.

1.4.2 Greenfield Investment

When the foreign bank enters the host market via de novo investment, it gains a fairly good knowledge of the local market due to its large presence and branch network. Yet, it has no access to soft information about borrowers. Compared to cross border lending, the foreign bank finances a smaller fraction $(1-\mu\delta_A)$ of borrowers with bad projects. However, it incurs a larger fixed entry cost F_{GR}. The foreign bank's profit in market B is given by

$$\pi_A^{GR} = \left[\gamma\left(r_A^{GR} - i_A\right) - (1-\gamma)(1-\mu\delta_A)(1+i_A)\right] m\phi_A^{GR} - F_{GR}. \tag{1.6}$$

Profits of host country banks now amount to

$$\pi_{B_j}^{GR} = \left[\gamma\left(r_{B_j}^{GR} - i_B\right) - (1-\gamma)(1-\delta_B)(1+i_B)\right] m\phi_{B_j}^{GR}. \tag{1.7}$$

Banks maximize their profit with respect to the interest rates they ask from borrowers. The equilibrium profits of banks are stated in Lemma 1.2.

Lemma 1.2 *In case of greenfield entry, the equilibrium profits of banks are given by*

$$\pi_A^{GR} = mt\gamma\left(\widetilde{\phi}_A^{GR}\right)^2 - F_{GR} \tag{1.8}$$

$$\pi_{B_j}^{GR} = mt\gamma\left(\widetilde{\phi}_B^{GR}\right)^2 \equiv \pi_B^{GR}\ \forall j. \tag{1.9}$$

Proof: see Appendix.

We show in the Appendix (see proof of Proposition 1.2) that due to the better knowledge of the host banking market, the profit of the foreign bank rises more sharply in the screening technology δ_A in case of de novo investment than in case of cross border lending. However, the fixed entry cost is larger with greenfield entry. Hence, as soon as the better market knowledge compensates for the larger fixed entry cost, the foreign bank shifts from cross border lending to de novo investment at the threshold δ_A^{GR}, originating from $\pi_A^{GR} \geq \pi_A^{CBL}$. Note that we concentrate our analysis on the most interesting case of the richest possible entry mode pattern, i.e. we only consider $\delta_A^{GR} > \delta_A^{CBL}$.[7] Our results are given in Proposition 1.2.

[7] In principle, $\delta_A^{GR} < \delta_A^{CBL}$ is possible but in that case, cross border lending would be excluded from the entry mode pattern.

Proposition 1.2 *The foreign bank opts for greenfield entry if its screening efficiency is higher than the threshold value δ_A^{GR}. That is, if*

$$\delta_A \geq \ \delta_A^{GR} = \frac{\sqrt{X_{GR}} - \Delta - \frac{5}{6}t\gamma}{\mu\left(1+\alpha\right)\left(1-\gamma\right)\left(1+i_A\right)}. \tag{1.10}$$

Proof: see Appendix.

1.4.3 Entry via Acquisition

By acquiring a host country bank, the foreign bank gets access to all the soft information held by the target. However, it must pay the endogenous acquisition price P_{AC}. Furthermore, it incurs an additional fixed entry cost F_{AC}. This cost may originate from the restructuring of the acquired bank or the amortization of bad credits due to asymmetric information concerning the quality of the target's credit portfolio before the acquisition. Note that the acquisition of a domestic bank allows the foreign bank to capture a larger market share in comparison to all other entry modes. In addition, the foreign bank gains from less intense competition since just two banks operate in the market.[8] The profit of the foreign bank in the host banking market if it acquires a local bank is given by

$$\pi_A^{AC} = \left[\gamma\left(r_A^{AC} - i_A\right) - \left(1-\gamma\right)\left(1-\delta_A\right)\left(1+i_A\right)\right] m\phi_A^{AC} - F_{AC} - P_{AC}. \tag{1.11}$$

The profit of the remaining host country bank amounts to

$$\pi_B^{AC} = \left[\gamma\left(r_B^{AC} - i_B\right) - \left(1-\gamma\right)\left(1-\delta_B\right)\left(1+i_B\right)\right] m\phi_B^{AC}. \tag{1.12}$$

We now derive the endogenous acquisition price P_{AC}. Throughout our analysis, we will assume that bargaining power is allocated to the foreign bank. In the range of $0 < \delta_A < \delta_A^{CBL}$, the foreign bank would make losses by entering the host banking market via cross border lending or greenfield entry. Then, clearly, the acquisition price is given by the profit of the domestic bank in case of no entry, that is, $P_{AC} = \pi_B^{NE} = \frac{mt\gamma}{4}$ (for a derivation of π_B^{NE} see proof of Proposition 1.3). For $\delta_A^{CBL} \leq \delta_A < \delta_A^{GR}$, cross border lending constitutes the second best entry mode for the foreign bank. Hence,

[8] Fiercer competition in the host banking market in case of greenfield compared to acquisition entry is confirmed, for instance, by Claeys and Hainz (2006) and Maioli et al. (2006).

by threatening to enter via cross border lending, the foreign bank can drive down the acquisition price to the profit of the domestic bank if entry occurs via cross border lending, i.e., $P_{AC} = \pi_B^{CBL} = mt\gamma \left(\widetilde{\phi}_B^{CBL}\right)^2$. For $\delta_A^{GR} \leq \delta_A < 1$, greenfield entry constitutes the second best entry mode for the foreign bank. Accordingly, bank A can threaten to enter market B via greenfield entry and drive down the acquisition price to the profit of the domestic bank in case of greenfield entry, that is, $P_{AC} = \pi_B^{GR} = mt\gamma \left(\widetilde{\phi}_B^{GR}\right)^2$.

Banks maximize their profit with respect to the interest rates they ask from borrowers. Equilibrium profits of banks are stated in Lemma 1.3.

Lemma 1.3 *In case of acquisition entry, the equilibrium profits of banks are given by*

$$\pi_A^{AC} = \begin{cases} mt\gamma \left(\widetilde{\phi}_A^{AC}\right)^2 - \frac{mt\gamma}{4} - F_{AC} & for \quad 0 < \delta_A < \delta_A^{CBL} \\ mt\gamma[\left(\widetilde{\phi}_A^{AC}\right)^2 - \left(\widetilde{\phi}_B^{CBL}\right)^2] - F_{AC} & for \quad \delta_A^{CBL} \leq \delta_A < \delta_A^{GR} \\ mt\gamma[\left(\widetilde{\phi}_A^{AC}\right)^2 - \left(\widetilde{\phi}_B^{GR}\right)^2] - F_{AC} & for \quad \delta_A^{GR} \leq \delta_A < 1 \end{cases} \tag{1.13}$$

$$\pi_B^{AC} = mt\gamma \left(\widetilde{\phi}_B^{AC}\right)^2. \tag{1.14}$$

Proof: see Appendix.

In the Appendix, we show that π_A^{AC} is increasing in δ_A and jumps upwards twice due to the changing acquisition prices at δ_A^{CBL} and δ_A^{GR}. Furthermore, π_A^{AC} is steeper than both π_A^{CBL} and π_A^{GR}. Hence, the richest possible entry mode pattern emerges if π_A^{AC} intersects with π_A^{GR}, determining the threshold for acquisition entry, δ_A^{AC} with $\delta_A^{AC} \geq \delta_A^{GR}$. Our results regarding acquisition entry are stated in Proposition 1.3.

Proposition 1.3 *The foreign bank enters the host banking market via the acquisition of a domestic bank if its screening efficiency is higher than the threshold value δ_A^{AC}. That is, if*

$$\delta_A \geq \delta_A^{AC} = \frac{3t\gamma\,(5-2\mu) - 2\Delta\,(9\mu-5)}{2\,(9\mu^2-5)\,(1-\gamma)\,(1+i_A)} \left(1 - \sqrt{X_{AC}}\right). \tag{1.15}$$

Proof: see Appendix.

Hence, only if the foreign bank has access to a highly sophisticated screening technique, acquisition entry can dominate all other possible entry modes. The intuition behind this result is as follows. In case of acquisition entry, the profit of the foreign bank rises more sharply in its screening ability than it does in case of cross border lending or greenfield entry. First, this is due to the access to soft information. Second, the better the screening technology of the foreign bank, the lower is the profit of a host country bank in case of de novo entry of the foreign bank and, accordingly, the lower the acquisition price becomes.[9] Hence, only if the screening technology of the foreign bank is very powerful, it can drive down the acquisition price to the point that acquisition entry becomes the dominant entry mode.

1.4.4 Entry Mode Pattern

According to our analysis so far, the richest entry mode pattern to emerge is given as follows. If the foreign bank has access to a rather inefficient screening ability, entry is not profitable. With an increasing quality of the screening technology, cross border lending becomes feasible. As soon as the better market knowledge in case of greenfield entry compared to cross border lending compensates for the larger fixed entry cost, the foreign bank shifts from cross border lending to de novo investment. Only if the foreign bank is highly efficient in screening borrowers, it can drive down the acquisition price to the point that acquisition entry becomes the dominant entry mode.

Note that we limit our analysis to the richest entry mode pattern. Otherwise, it would be possible that one or more entry modes dropped out of the pattern. However, it is important to see that the order of the entry mode pattern can never be reversed. Our results are summarized in Proposition 1.4.

Proposition 1.4 *The richest possible entry mode pattern of foreign banks is given as follows. Banks with the lowest screening efficiencies do not expand abroad. With increasing efficiency, banks grant cross border loans. Still more efficient banks opt for de novo investment. The most efficient banks choose to acquire a host country bank.*

Hence, in line with findings by Buch and Lipponer (2007) as well as Focarelli and Pozzolo (2001) we find that the more profitable and efficient a bank is, the more likely

[9] Note that as we limit our analysis to the richest possible entry mode pattern, the acquisition price is given by π_B^{GR}.

it will expand abroad. Similar to the results in trade theory, we find that rather less efficient firms engage in cross border lending, the equivalent to exports in our model, whereas more efficient banks operate in new markets via a financial foreign direct investment. However, our results contrast those derived in the industrial organization literature with its focus on manufacturing industries in that we find that the most efficient banks engage in acquisition entry whereas less efficient banks expand abroad via de novo investment. Similar to our results, Beermann (2007) shows that the most efficient banks choose to expand via the acquisition of a local bank whereas less efficient banks opt for greenfield entry.

1.5 Comparative Statics Analysis

Our framework allows us to study how the development of the host banking market affects the foreign bank's entry mode pattern. In addition, we provide interesting insights into how the foreign bank's choice of entry mode depends on the size of the host banking market.

1.5.1 Development of the Host Banking Market

In our model, several parameters can be interpreted as indicators of financial development. First, the less banks need to rely on soft information the more transparent and developed a financial market in general is. Second, better screening abilities and lower refinancing costs of host country relative to foreign banks serve as further indicators of development. Finally, a high degree of competitive pressure in the host banking market is yet another sign of increased development.

Importance of Access to Soft Information

In more developed banking markets characterized by rather high transparency, banks should base the evaluation of borrower's projects to a lower extent on soft information. We find that when foreign banks need to rely less on soft information, i.e. μ increases, entry turns out to be profitable for foreign banks that have access to a less efficient screening technique. Furthermore, greenfield entry becomes relatively more attractive compared to cross border lending and acquisition entry. Our results are summarized in Proposition 1.5.

Proposition 1.5 *When foreign banks need to rely less on soft information, entry becomes feasible for banks that have access to a less efficient screening technique. The range of greenfield entry expand whereas the ranges of cross border lending and acquisition entry contract. That is,*

$$\frac{d\delta_A^{CBL}}{d\mu} < 0, \; \frac{d\delta_A^{GR}}{d\mu} < 0, \; \frac{d\delta_A^{AC}}{d\mu} > 0 \quad and \quad \left|\frac{d\delta_A^{CBL}}{d\mu}\right| < \left|\frac{d\delta_A^{GR}}{d\mu}\right| . \tag{1.16}$$

Proof: see Appendix.

To understand the intuition for these results, let us first look at the threshold δ_A^{CBL}, determining cross border lending. When the foreign bank depends less on the access to soft information, it can increase its market share and, in addition, less borrowers with bad projects are financed. This makes cross border lending profitable for less efficiently screening foreign banks.

Similar effects are at work when we consider the threshold δ_A^{GR}. When the foreign bank needs to rely to a lower extent on soft information, its market share increases and less bad borrowers are financed both with cross border lending and greenfield entry. However, this effect is the more pronounced, the larger the market share of the foreign bank. Since the foreign bank's market share is larger in case of a de novo investment than with cross border lending, greenfield entry becomes relatively more attractive compared to cross border lending when foreign banks depend less on soft information.

We now turn to the attractiveness of acquisition relative to greenfield entry. The acquisition of a domestic bank ensures access to the soft information held by the target. Note that the extent to which the foreign bank depends on access to soft information affects the acquisition price π_B^{GR}. The less the foreign bank needs to rely on soft information, the smaller the market share of the domestic bank is if the foreign bank enters via de novo investment. In turn, the acquisition price π_B^{GR} falls and the foreign bank's profit increases. While the fall in the acquisition price is due to a fall in the domestic bank's market share only, there are two effects at work with respect to the profit of the foreign bank if it enters via de novo investment. First, a lower information disadvantage of the foreign relative to the domestic bank implies a larger market share of the foreign bank and, second, leads to a fall in the fraction of bad borrowers financed by the foreign bank. As a consequence, the increase of the foreign bank's profit in case of greenfield entry dominates the rise in its profit in case of acquisition entry. In sum, greenfield entry becomes more attractive compared to the acquisition of a local bank when access to soft information is less important.

We conclude that foreign banks tend to enter via greenfield entry into banking markets with a higher degree of financial development. In contrast, in less developed banking markets, a wider range of foreign banks opt for cross border lending and acquisition entry.

Quality of the Screening Ability of Host Country Banks

We find that when the screening ability δ_B of host country banks increases, foreign banks must be relatively better at screening borrowers in order to profitably enter a new market. Furthermore, acquisition entry becomes relatively less attractive compared to greenfield entry. Our results are stated in Proposition 1.6.

Proposition 1.6 *An increase in the screening ability of host country banks leads to an increase in all relevant threshold levels. Consequently, foreign banks must possess a relatively better screening technology in order to profitably enter the host banking market. The range of acquisition entry contracts. That is,*

$$\frac{d\delta_A^{CBL}}{d\delta_B} > 0, \ \frac{d\delta_A^{GR}}{d\delta_B} > 0, \ \frac{d\delta_A^{AC}}{d\delta_B} > 0. \tag{1.17}$$

Proof: see Appendix.

Again, let us first look at the threshold δ_A^{CBL}, determining cross border lending. When host country banks get access to a relatively better screening technique, the foreign bank loses in terms of market share. Obviously, entry via cross border lending is then profitable for foreign banks having access to a relatively more sophisticated screening technology only.

When the screening skills of domestic banks improve, the market share and profit of a foreign bank also falls in case of greenfield entry. However, the fall in the foreign bank's profit is larger with greenfield entry compared to cross border lending due to the beforehand larger market share. Hence, greenfield entry becomes relatively less attractive compared to cross border lending when domestic banks get better in screening potential borrowers.

We find that when host country banks get access to a better screening technology, acquisition entry becomes less attractive to foreign banks compared to a de novo investment. This is due to a fall in the market share of a foreign bank entering the host banking market via the acquisition of a domestic bank as well as an increase in the acquisition price. Due to this combined effect, the decrease in the foreign bank's profit in case of acquisition entry is larger than the fall of the foreign bank's profit in case of greenfield entry arising from a decreasing market share only. Thus, acquisition entry is less appealing compared to greenfield entry when the screening efficiency of domestic banks increases.

When we interpret an increasing screening efficiency of host country banks as a signal for higher financial development, we can state as before that the less developed a banking market is, the more foreign banks tend to enter the market via the acquisition of a domestic bank.

Size of Refinancing Costs of Host Country Banks

We find that when refinancing costs i_B of host country banks decrease, foreign banks must possess a relatively better screening technology in order to profitably enter a new market. In addition, cross border lending and acquisition entry lose in attractiveness. Our results are summarized in Proposition 1.7.

Proposition 1.7 *When refinancing costs of host country banks decrease, foreign banks must have relatively better screening skills in order to profitably enter a new market. The ranges of cross border lending and acquisition entry contract. That is,*

$$\frac{d\delta_A^{CBL}}{di_B} < 0, \ \frac{d\delta_A^{GR}}{di_B} < 0, \ \frac{d\delta_A^{AC}}{di_B} < 0, \quad \text{and} \quad \left|\frac{d\delta_A^{CBL}}{di_B}\right| > \left|\frac{d\delta_A^{GR}}{di_B}\right| \tag{1.18}$$

Proof: see Appendix.

The intuition for these results is as follows. When host country banks incur relatively lower refinancing costs, foreign banks lose in terms of market share. Obviously, entry becomes attractive only for relatively better screening foreign banks.

Since the effect of a falling market share is larger in case of greenfield entry compared to cross border lending due to the beforehand larger market share, greenfield entry becomes relatively less attractive compared to cross border lending when refinancing conditions of domestic banks improve.

When refinancing costs of host country banks decrease, acquisition entry becomes less attractive compared to greenfield entry. Note that the market share of the foreign bank in case of acquisition entry falls and, in addition, the acquisition price increases. Due to this combined effect, the fall of the profit of the foreign bank with acquisition entry is larger than the decrease of the profit in case of de novo investment originating from a declining market share only. Therefore, acquisition entry becomes less attractive compared to greenfield entry when refinancing costs of domestic banks fall.

By interpreting better refinancing conditions of host country banks as a sign of increased financial development, we again conclude that in banking markets on a lower stage of development, foreign banks tend to choose cross border lending and acquisition entry when entering the host banking market.

Degree of Competitive Pressure in the Host Banking Market

We are further interested in how the degree of competition in the host banking market influences the entry mode decision of a foreign bank. The competitive pressure in the local banking market can be expressed by the inverse of transportation cost $\frac{1}{t}$. Note that the larger the transportation cost parameter t and the more costly it becomes for borrowers to travel to a bank, the less intense price competition will be between banks. Conversely, the higher is $\frac{1}{t}$, the more competitive is the market environment.

We find that foreign banks must possess a relatively better screening technology in order to profitably enter highly competitive markets. Furthermore, acquisition entry loses in attractiveness in host banking markets characterized by rather intense competition. The effects on cross border lending and greenfield entry are ambiguous. Our results are stated in Proposition 1.8.

Proposition 1.8 *When competitive pressure in the host banking market increases, foreign banks must be relatively better at screening borrowers in order to profitably enter a new market. For* $\delta_A^{GR} < \widetilde{\delta}_A^{GR}$*, the range of cross border lending contracts whereas the range of greenfield entry expands. For* $\delta_A^{GR} > \widetilde{\delta}_A^{GR}$*, the effect of rising competition on cross border lending and greenfield entry is ambiguous. The range of acquisition entry unambiguously contracts. That is,*

$$\text{(1)} \quad \frac{d\delta_A^{CBL}}{d\left(\frac{1}{t}\right)} > 0, \; \frac{d\delta_A^{GR}}{d\left(\frac{1}{t}\right)} < 0, \; \frac{d\delta_A^{AC}}{d\left(\frac{1}{t}\right)} > 0 \;\; \text{for } \delta_A^{GR} < \frac{15(F_{GR}-F_{CBL})}{4m\mu(1-\alpha)(1-\gamma)(1+i_A)} \equiv \widetilde{\delta}_A^{GR} \tag{1.19}$$

$$\text{(2)} \quad \frac{d\delta_A^{CBL}}{d\left(\frac{1}{t}\right)} > 0, \; \frac{d\delta_A^{GR}}{d\left(\frac{1}{t}\right)} > 0, \; \frac{d\delta_A^{AC}}{d\left(\frac{1}{t}\right)} > 0 \;\; \text{for } \; \delta_A^{GR} > \widetilde{\delta}_A^{GR}. \tag{1.20}$$

Proof: see Appendix.

The intuition behind these results is as follows. Again, we first turn to the threshold δ_A^{CBL}. Increasing competitive pressure in the host banking market results in declining interest rates of all banks. It follows that in order for cross border lending to be profitable, the foreign bank must have access to a relatively better screening technology.

The effect of rising competition on the threshold δ_A^{GR} is ambiguous. Note, beforehand, that the interest rate the foreign bank charges in case of cross border lending is higher than in case of greenfield entry. In contrast, the market share of the foreign bank in case of cross border lending is smaller compared to a de novo investment. Increasing competitive pressure leads to a fall both in interest rates and market shares. Hence, the overall effect is ambiguous. We find that for $\delta_A < \widetilde{\delta}_A^{GR}$, the interest rate effect dominates so that greenfield entry gains at the expense of cross border lending. However, for $\delta_A > \widetilde{\delta}_A^{GR}$, the market share effect is the driving factor which implies that cross border lending becomes relatively more attractive compared to greenfield entry.

We now examine the impact of an increase in competitive pressure on the attractiveness of acquisition entry. Note that an increase in competition implies lower interest rates and profits both in case of greenfield and acquisition entry. In addition, the acquisition price falls. Since, however, the fall in profit is larger in case of acquisition compared to greenfield entry, the acquisition of a domestic bank is less appealing the more intense competition is.

Note that tough competition serves as an indicator of high financial development. Falling transportation costs may reflect an increased transparency in the market as well as a higher standardization of financial products implying less pronounced preferences of borrowers for a certain type of bank. Alternatively, the introduction of new information and communication technologies in banking may lead to a fall in physical transportation costs of borrowers. We conclude as before that the less developed a host banking market is, the more foreign banks opt for entry via acquisition.

1.5.2 Size of the Host Banking Market

We now turn to the impact of the size of the host banking market measured in terms of the mass of borrowers m on the entry mode choice of foreign banks. We find that the larger the host banking market, the more easily entry becomes profitable for less efficiently screening foreign banks. Furthermore, the larger the host country, the more appealing greenfield entry and the less attractive acquisition entry become. Our results are stated in Proposition 1.9.

Proposition 1.9 *The larger the host banking market, the more easily entry becomes profitable for less efficiently screening foreign banks. The range of greenfield entry expands and the range of acquisition entry contracts. That is,*

$$\frac{d\delta_A^{CBL}}{dm} < 0, \; \frac{d\delta_A^{GR}}{dm} < 0, \; \frac{d\delta_A^{AC}}{dm} > 0 \tag{1.21}$$

Proof: see Appendix.

Clearly, the profit of a foreign bank operating in the host banking market via cross border lending is the higher, the larger the host banking market. It follows that in larger markets, cross border lending becomes profitable for foreign banks with relatively lower screening skills.

The larger the host banking market, the higher a foreign bank's profit both in case of cross border lending and greenfield entry is. Again, the rise in the foreign bank's profit due to an increase in the market size is more pronounced in case of greenfield entry due to the beforehand larger market share so that a de novo investment becomes more attractive compared to cross border lending.

In case of acquisition entry, a greater market size also allows the foreign bank to serve more customers, implying an increase in its profit. However, there is a countervailing effect since the acquisition price rises, too. Overall, the increase in the profit of a foreign bank in case of greenfield entry dominates the rise in profit in case of acquisition entry. Hence, the larger the host banking market, the more appealing greenfield entry compared to acquisition entry is for a foreign bank.

We can further conclude from our analysis that foreign banks tend to prefer financial foreign direct investments, i.e. de novo investments and acquisitions, over cross border lending the more, the larger the host banking market is.

1.5.3 Empirical Evidence

In this section, we showed that in less developed banking markets, foreign banks tend to opt for cross border lending and acquisition entry. In contrast, we found a tendency towards greenfield entry in banking markets on a higher level of financial development. Empirical literature related to our comparative statics analysis is scarce. Nevertheless, our result of a trend towards cross border lending in rather low developed banking markets is confirmed by García Herrero and Martínez Pería (2007). Beermann (2007) finds that greenfield entry becomes more likely compared to acquisition entry the more developed a host banking market is.

Furthermore, we investigated how the entry mode decision of foreign banks depends on the size of the host banking market. From our analysis, we concluded that foreign banks tend to prefer financial foreign direct investments, i.e. de novo investments and acquisitions, over cross border lending the larger the host banking market is. Buch and Lipponer (2007), García Herrero and Martínez Pería (2007) and Tekin-Koru (2006) all find empirical support for this outcome. We also demonstrated that the larger a host country is, the larger the acquisition price becomes and the less attractive the acquisition of a local bank is. Hence, we found that foreign banks tend to favor acquisition entry in small host banking markets and greenfield entry in larger countries. Evidence for this result is provided by Raff et al. (2006). In addition, Correa (2008) concludes that domestic banks that are located in small countries are more likely to be acquired compared to banks operating in larger countries.

1.6 Welfare Analysis and Implications for the Regulation of Foreign Bank Entry

In this section we derive the preferred entry mode pattern of the host banking market's policy maker and compare it to the entry mode pattern favored by the foreign banks. The host country's policy maker maximizes welfare consisting of the sum of borrower rents and rents of domestic banks. Borrower rents are captured by the willingness to pay of borrowers minus the repayments of borrowers to banks and their transport costs. Bank rents comprise the revenues of banks minus their costs. Rents of foreign banks are not included in welfare. Note, however, that the policy maker may appropriate the rents of foreign banks via the introduction of a license fee. We discuss this scenario at the end of this section.

We compare the different welfare functions in case of no entry, W_{NE}, cross border lending, W_{CBL}, greenfield entry, W_{GR}, and acquisition entry, W_{AC}, in order to derive the preferred entry mode pattern of the policy maker. Our results are summarized in Proposition 1.10.

Proposition 1.10 *The policy maker prefers a foreign bank not to enter the market when it is rather inefficient in screening borrowers. Greenfield entry is favored for intermediate screening efficiencies of foreign banks. If a foreign bank is highly efficient in screening borrowers, the policy maker prefers it to acquire a local bank. That is,*

$$(1)\ W_{NE} > W_{CBL}, W_{GR}, W_{AC} \quad \text{for} \quad \delta_A < \delta_W^{GR} \tag{1.22}$$

$$(2)\ W_{GR} > W_{CBL}, W_{NE}, W_{AC} \quad \text{for} \quad \delta_W^{GR} < \delta_A < \delta_W^{AC} \tag{1.23}$$

$$(3)\ W_{AC} > W_{CBL}, W_{NE}, W_{GR} \quad \text{for} \quad \delta_W^{AC} < \delta_A \tag{1.24}$$

Proof: see Appendix.

Note, beforehand, that cross border lending is strictly dominated by greenfield entry. This result is mainly driven by the fact that interest rates of foreign banks are lower in case of greenfield entry than cross border lending due to the better knowledge of the market which benefits local borrowers.

The intuition of our results mainly rests on the impact of the foreign bank's screening ability on, first, the payments of borrowers to foreign banks and, second, costs of domestic banks. Note that the payments of borrowers to foreign banks are zero in case of no entry, of intermediate size in case of greenfield entry, and largest in case of acquisition entry. In contrast, the costs of domestic banks vary with market shares and are highest in case of no entry, lower if foreign banks enter via de novo investment, and smallest with acquisition entry.

Obviously, if no foreign bank enters the market, an increasing screening efficiency of the foreign bank has no impact on the payments of borrowers to foreign banks and costs of domestic banks. Yet, in case of greenfield entry, an increase in the quality of the foreign bank's screening technology drives down the interest rates foreign banks ask as well as the costs of domestic banks due to falling market shares. Hence, as soon as the screening ability of the foreign bank is larger than the threshold δ_W^{GR}, greenfield entry is preferred to no entry by the policy maker. Moreover, the negative effect of an increasing screening efficiency of the foreign bank on interest rates asked by foreign banks and costs of domestic banks is even larger in case of acquisition entry. Thus, for a screening ability of the foreign bank larger than δ_W^{AC}, the policy maker favors acquisition over greenfield entry. We show in the Appendix that $\delta_W^{GR} < \delta_W^{AC}$ holds (see proof of Proposition 1.10).

Note that if the transport cost parameter t is very small, $\delta_W^{GR} \leq 0$ is possible. In this case, the policy maker would strictly prefer the entry of foreign banks to no entry at all. Since foreign and domestic banks in our model differ with respect to refinancing costs, screening abilities and access to soft information, market shares are generally asymmetric resulting in increased transportation costs of borrowers compared to a symmetric set-up. Hence, it can well be that the policy maker prefers foreign banks not to enter the market. However, if transportation costs are very low due to a low value of t, the policy maker may strictly prefer foreign entry over no entry at all.

Before we turn to how the regulation of foreign bank entry is shaped, let us explain that the policy maker may face difficulties when trying to enforce greenfield entry. Greenfield entry is profitable for foreign banks if $\pi_A^{GR} \geq 0$ holds which is equivalent to $\delta_A \geq \widehat{\delta}_A^{GR}$ (see proof of Proposition 1.11). If $\widehat{\delta}_A^{GR} > \delta_W^{GR}$ holds, de novo investment is not profitable for foreign banks with screening abilities in the range $\delta_W^{GR} \leq \delta_A < \widehat{\delta}_A^{GR}$. Hence, for this parameter range, greenfield entry cannot be implemented by the policy maker.[10]

[10]In principle, the policy maker could also make a payment to the foreign bank in order to induce it to enter the market compensating for the loss of the foreign bank from operating in the host country.

However, acquisition entry can be enforced whenever the policy maker prefers this entry mode. We show in the Appendix that $\delta_W^{AC} > \delta_A^{AC}$ holds (see proof of Proposition 1.11). Clearly, for $\delta_A \geq \delta_A^{AC}$, foreign banks make profits by entering via acquisition entry as δ_A^{AC} constitutes the threshold for which foreign banks prefer acquisition entry over all other entry modes. Hence, no difficulties arise for the policy maker to enforce entry via acquisition since $\delta_W^{AC} > \delta_A^{AC}$.

Let us now look in more detail at the regulation of foreign bank entry. Although - apart from cross border lending - the policy maker's preferred entry mode pattern is similar to the one favored by the foreign banks, our model still provides interesting implications concerning the regulation of foreign bank entry. Our results from the comparison of the threshold values δ_W^{GR} and δ_W^{AC} that determine the policy maker's preferred entry mode pattern and the thresholds δ_A^{CBL}, δ_A^{GR}, and δ_A^{AC} defining the entry mode pattern preferred by the foreign banks as derived in section 1.4 are given in Proposition 1.11.

Proposition 1.11 *Entry is permitted but to foreign banks that rather efficiently screen borrowers. The more competitive the host market environment is, the lower the requirements concerning a foreign bank's screening efficiency for entry are set. Cross border lending is not allowed for. Moreover, only the most efficiently screening foreign banks are allowed to acquire a domestic bank. Foreign banks that wish to grant cross border loans or acquire a local bank are forced to enter via de novo investment if their screening skills are insufficiently low. That is,*

$$\text{(1) } \delta_A^{CBL} < \widehat{\delta}_A^{GR} < \delta_W^{GR} \tag{1.25}$$

$$\text{(2) } \delta_A^{AC} < \delta_W^{AC} \tag{1.26}$$

$$\text{(3) } \frac{d\delta_W^{GR}}{d\left(\frac{1}{t}\right)} < 0. \tag{1.27}$$

Proof: see Appendix.

Consider Figure 1.1 for our explanations. Three locations are possible for the threshold δ_W^{GR} as is shown in the three different scenarios. Note that the more competitive

Then, greenfield entry could take place within the range $\delta_W^{GR} \leq \delta_A < \widehat{\delta}_A^{GR}$. However, note that δ_W^{GR} will move a little to the right since the payments to the foreign bank let the welfare function shift downwards. Since our qualitative results do not change, we abstract from payments to foreign banks.

the host market environment is, the more δ_W^{GR} shifts to the left and the lower the policy maker sets the requirements concerning a foreign bank's screening efficiency for entry.

Let us first look at foreign banks that wish to grant cross border loans. In scenario (1), foreign banks with efficiency level $\delta_A^{CBL} \leq \delta_A < \delta_W^{GR}$ are denied entry whereas foreign banks with efficiency $\delta_W^{GR} \leq \delta_A < \delta_A^{GR}$ are forced to enter via de novo investment instead of cross border lending. Both in scenario (2) and (3), all foreign banks that want to operate via cross border lending are denied entry.

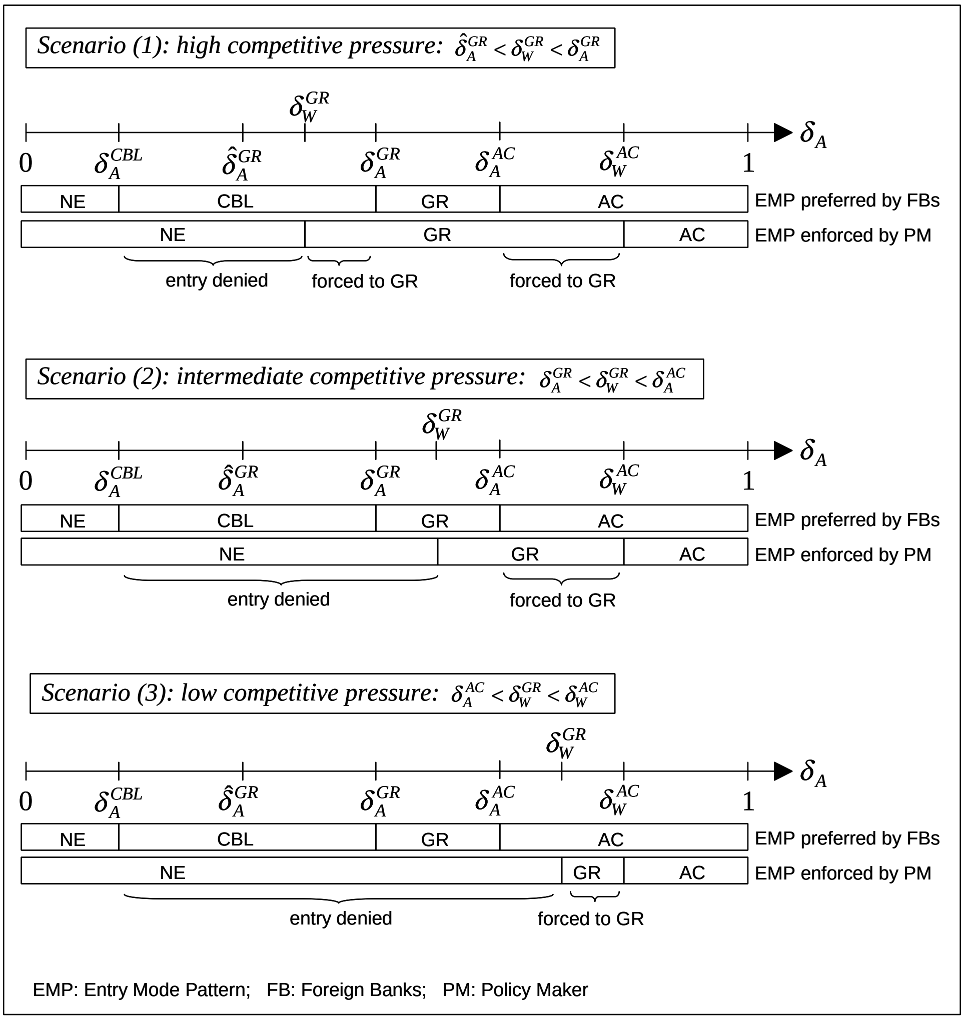

Figure 1.1: Regulation of Foreign Bank Entry

Second, consider foreign banks that favor entry via de novo investment. Depending on the location of δ_W^{GR}, these banks may either enter via their preferred entry mode in scenario (1) or be denied entry in scenario (3). In scenario (2), banks with a screening efficiency in the range of $\delta_A^{GR} \leq \delta_A < \delta_W^{GR}$ are not granted an entry permit whereas banks with screening efficiency $\delta_W^{GR} \leq \delta_A < \delta_A^{AC}$ are allowed to enter via de novo investment.

Finally, let us examine the situation of foreign banks that prefer to acquire a domestic bank. Foreign banks with a screening efficiency larger than δ_W^{AC} are in all three scenarios allowed to acquire a local bank. In scenario (1) and (2), banks with screening efficiency $\delta_A^{AC} \leq \delta_A < \delta_W^{AC}$ are forced to enter via de novo investment. In scenario (3), banks with a screening efficiency in the range $\delta_A^{AC} \leq \delta_A < \delta_W^{GR}$ are denied entry and banks with a screening efficiency in the range $\delta_W^{GR} \leq \delta_A < \delta_W^{AC}$ are forced to enter via de novo investment.

Hence, the regulation of foreign bank entry is shaped as follows. Entry is permitted but to foreign banks that rather efficiently screen borrowers. The more competitive the host market environment is, the lower the policy maker sets the requirements concerning a foreign bank's screening efficiency for entry. Hence, the less competitive the market environment is, the more likely it is that foreign banks are denied entry. The policy maker does not allow for cross border lending. Moreover, regulators grant a permit to acquire a domestic bank only to the most efficiently screening foreign banks. Foreign banks that intend to expand via cross border lending or the acquisition of a local bank are forced to enter via de novo investment if their screening skills are insufficiently low.

Note that although the policy maker may not perfectly observe the screening efficiency of a foreign bank, the quality of its screening technology may be proxied by the size of loan loss provisions or the rating of the bank. Moreover, as has been found by Berger (2007) and Köhler (2008), the regulation of acquisition entry not only takes place explicitly via restrictions on ownership shares but also implicitly via, for instance, the delay of licensing procedures.

García Herrero and Martínez Pería (2007) provide support for our finding that cross border lending is least liked by the policy maker of the host country. However, their argument is somewhat different. They suggest that cross border lending implies a greater volatility in capital flows and is therefore often impeded by taxes or capital controls on foreign loans. Peek and Rosengren (2000) point to the problem that cross border lending is more difficult for the host country supervisors to monitor or influence.

Although a large part of foreign bank entry into Latin American and transition countries occurred via the acquisition of domestic banks, this was often due to the need to recapitalize domestic banks in the aftermath of banking crises in Latin America (Martínez Pería and Mody (2004)) as well as due to large privatization programs in transition economies (Vo Thi and Vencappa (2007)). In fact, the literature generally points to the extensive regulation of acquisition compared to greenfield entry. Examples are Berger et al. (2008), Majnoni et al. (2003), and Peek and Rosengren (2000).

Let us now briefly discuss a further possible scenario in which the policy maker appropriates the rents of foreign banks via the introduction of a license fee. As a consequence, the different welfare functions would shift upwards equal to the amount of foreign banks' profits in the host banking market. First, this implies that δ_W^{GR} moves to the left meaning that the policy maker now allows for the entry of less efficient foreign banks. Second, cross border lending may now emerge as an entry mode preferred by the policy maker for some parameter range $\delta_A < \delta_A^{GR}$. Note that for $\delta_A < \delta_A^{GR}$ it holds that $\pi_A^{CBL} > \pi_A^{GR}$. Hence, since W_{CBL} shifts upward more than W_{GR} it becomes possible that cross border lending is preferred over greenfield entry by the policy maker. However, for $\delta_A > \delta_A^{GR}$, $\pi_A^{CBL} < \pi_A^{GR}$ holds so that W_{GR} shifts upward more than W_{CBL} which results in an even stricter dominance of greenfield entry over cross border lending. Third, δ_W^{AC} will move to the left. This is due to the fact that $\delta_W^{AC} > \delta_A^{AC}$. Accordingly, at δ_W^{AC} it must hold that $\pi_A^{AC} > \pi_A^{GR}$. Then, as W_{AC} shifts upward more than W_{GR}, the policy maker prefers acquisition entry for less efficient foreign banks.

1.7 Empirical Hypotheses

Our model gives rise to several testable hypotheses concerning both the entry mode decision of multinational banks and the regulation of foreign bank entry. We state our first hypothesis with respect to the entry mode pattern favored by foreign banks.

Hypothesis 1.1 *In a given banking market, banks with the lowest screening efficiencies do not expand abroad. With increasing efficiency, banks grant cross border loans. Still more efficient banks opt for de novo investment. The most efficient banks choose to access a new market via the acquisition of a local bank.*

We further analyzed how the multinational banks' entry mode choice is affected by the financial development of host countries. Based on our results, we formulate our second testable prediction.

Hypothesis 1.2 *The less developed a host banking market is, the wider the range of foreign banks that opt for cross border lending and acquisition entry. In more developed banking markets a trend towards de novo investment exists.*

Our findings concerning the impact of the size of host countries on the entry mode choice of foreign banks gives rise to our third hypothesis.

Hypothesis 1.3 *The larger a host banking market is, the wider the range of foreign banks that expand via a financial foreign direct investment compared to cross border lending. More specifically, foreign banks tend to favor the acquisition of a domestic bank when they enter rather small countries and de novo investment when they commence to operate in rather large banking markets.*

We formulate our last testable prediction with respect to our findings regarding the regulation of foreign bank entry.

Hypothesis 1.4 *Foreign banks present in a given host banking market are rather efficient in screening borrowers. The more competitive the market environment, the lower the requirements concerning a foreign bank's screening efficiency for entry are and, accordingly, the lower the average screening efficiency of foreign banks is expected to be. Cross border lending tends to be most strictly regulated. The most efficient foreign banks in the market tend to be those that have acquired a domestic bank.*

A test of our first three hypotheses requires data on the *home* markets of multinational banks. Only then one can account for a certain range of banks actually not expanding abroad. With respect to our second and third hypothesis, additional information on the financial development and the size of the host markets of multinational banks are needed. Moreover, a test of our first three hypotheses should be based on rather little regulated host banking markets. Clearly, a test of our last prediction requires data on *host* countries of foreign banks where regulation of foreign bank entry indeed takes places.

Throughout the empirical analysis, the screening efficiency of foreign and host country banks could be proxied by the size of loan loss provisions or the rating of a bank. Soft information problems may be captured by the physical, cultural, legal or economic distance between foreign and host banking markets. The soft information variable needs to be interacted with a dummy variable that captures entry via cross border lending or greenfield investment on the one hand and acquisition of a domestic bank on the other hand. Competitive pressure may be proxied by the degree of product differentiation or by the degree of transparency in the banking market.

1.8 Conclusions

In this chapter, we analyzed a foreign bank's trade-off between cross border lending and a financial foreign direct investment, i.e. greenfield or acquisition entry. We showed that if foreign banks are rather inefficient in screening borrowers, they choose not to expand abroad. With increasing efficiency, banks grant cross border loans. Still more efficient banks opt for de novo investment whereas the most efficient banks favor the acquisition of a local bank.

Moreover, we investigated how the entry mode choice of foreign banks is affected by the host country's development and size. We found that the less developed a banking market is, the wider the range of foreign banks that opt for cross border lending and acquisition entry and the smaller the range of foreign banks that expand via de novo investment. Moreover, the smaller the host banking market, the larger the range of foreign banks that prefer the acquisition of a domestic bank and the smaller the range of foreign banks that favor greenfield entry.

Finally, we studied the regulation of foreign bank entry. We showed that entry is permitted but to foreign banks that rather efficiently screen borrowers. Furthermore, the less competitive the market environment is, the more likely it is that foreign banks are denied entry. Cross border lending is not allowed for. Foreign banks that intend to expand via cross border lending or the acquisition of a local bank are forced to enter via de novo investment if their screening efficiency is insufficiently low.

Our model set-up allows for several interesting extensions. First, we might not only consider the influence of the host country's development but also the impact of the development of a foreign bank's home country on its entry mode choice. If we interpret a foreign bank's screening efficiency as an indicator of its home market's development, our model implies the following results. Banks based in the most developed countries would tend to expand via acquisitions. Banks from less developed countries would opt for de novo investment. Banks based in still less developed countries would prefer to grant cross border loans whereas banks located in the least developed countries would not expand abroad.

Furthermore, it would be interesting to allow for asymmetries in domestic banks. If local banks differed in their screening abilities, the incentives of foreign banks to acquire a domestic bank would depend on a trade-off as follows. A lower efficiency would imply a smaller acquisition price. However, costs related to restructuring processes or the amortization of bad credits might be much higher for less efficient local banks.

Note that - in order to keep our model tractable - we constrained our analysis to the entry of one representative foreign bank only. In the next chapter, we lift this restriction and study how the entry of a large number of foreign banks affects host banking markets.

Chapter 2

Entry of Foreign Banks and Their Impact on Host Countries*

2.1 Introduction

One of the most striking developments in the banking sector in transition and emerging market economies has been the sharp increase of foreign bank entry during the last decade. For instance, the market share of foreign banks in Eastern Europe has gone up from on average around 11 percent in 1995 to around 65 percent in 2003 (Claeys and Hainz, 2006). The situation looks similar in Latin America, and foreign bank entry is likewise on the rise in other emerging economies in Asia, Africa and the Middle East, albeit at a lower pace (Clarke et al, 2003).

Governments liberalize their banking markets with the intention to attract new capital and to promote the restructuring of their often rather inefficient banking systems. One possible channel for how foreign banks may foster such a restructuring process is spillover effects from foreign to domestic banks; another possible channel could be the increase in competition (Goldberg, 2007). However, the opening up of banking markets can also entail large risks since domestic banks need to undertake huge investments to become competitive against foreign banks.

The aim of this chapter is to analyze the impact of foreign bank entry on host countries, emphasizing the transition and emerging market context. We study two

*This chapter is joint work with Monika Schnitzer, University of Munich and CEPR.

channels through which foreign banks may influence the domestic banking market, namely spillovers and an increase in competition. We ask in particular how the two channels interact, i.e. whether or not they reinforce each other. We determine how foreign banks affect the domestic banks' incentives to improve on their efficiency and the host countries' social welfare. We also investigate how different modes of foreign bank entry differ in their impact on the domestic banking market.

For this purpose, we set up a model of spatial bank competition à la Salop. Banks compete in prices for potential borrowers that engage in investment projects of uncertain return. In our model, banks differ with respect to screening abilities. Foreign banks have perfect screening ability while, for simplicity, domestic banks in the closed economy are assumed not to have access to a screening technology. When the domestic banking market opens up, foreign banks are given the possibility to enter the market, either via acquisition of a domestic bank or through a greenfield investment. Due to spillover effects from foreign to domestic banks, domestic banks gain access to a screening technology, albeit not as sophisticated as that of foreign banks. Domestic banks then have the choice to undertake an investment in order to obtain the perfect screening technology corresponding to that of the foreign banks.

Our first focus is on the implications of spillover effects on the efficiency of liberalizing banking markets. We find that with rising spillovers the incentives of domestic banks to invest in the perfect screening technology fall because the higher the spillover effects, the less a bank gains by investing in screening. Thus, we identify a trade-off between two regimes. High spillover effects result in a market in which just a few banks invest in perfect screening ability, while a large number of domestic banks know how to screen fairly well due to the spillover effects. In contrast, low spillovers imply a situation in which a lot of domestic banks invest in the perfect screening technology but some domestic banks screen only very imperfectly.

A second major issue we study is the role of competition in terms of the number of banks operating in the market. Since the number of banks in the economy increases in case of de novo investments but stays constant with acquisition entry, greenfield entry corresponds to a more competitive market environment. Hence, analyzing the effect of competition allows us to draw some conclusions concerning the different implications of acquisition and de novo entry for liberalizing banking markets. We find that a larger number of banks operating in the market leads to declining repayment rates as well as to smaller market shares and, thus, tends to decrease the incentives of domestic banks to invest in screening. We conclude that investment incentives for domestic banks are higher in the case of acquisition than in the case of greenfield entry.

A major focus of our analysis constitutes the interaction of spillovers and competition. We find that spillovers and competition reinforce each other in their negative impact on the number of domestic banks investing in screening. Thus, the different implications of acquisition and greenfield entry widen when spillovers rise.

From a social welfare point of view, the impact of spillovers and an increase in the number of banks is ambiguous and depends on the competitive environment in the domestic banking market. When competition is low, welfare increases with spillovers and decreases with the number of banks operating in the market, pointing to acquisition as the preferable mode of entry. By contrast, in situations with high competitive pressure, lower spillovers as well as a larger number of banks and, thus, greenfield entry, is to be preferred.

Our major conclusions from the welfare analysis are thus as follows: both modes of competition work as complements. In particular, a larger number of banks operating in the market and thus greenfield entry can, in general, only be welfare enhancing in rather competitive banking markets. Hence, one channel of competition is not sufficient in order to raise welfare, but rather a high level of both competition effects is necessary for enhancing welfare. In contrast, we find that spillovers constitute a form of substitute relative to either channel of competition, i.e. potential positive welfare effects of spillovers are lower the stronger is competition.

The remainder of this chapter is organized as follows. We provide an overview of related literature in the next section. Section 2.3 describes the set-up of the model. In section 2.4 we study the equilibrium in the banking market. Section 2.5 analyzes the comparative statics of spillover effects and competitive pressure on the efficiency of the domestic banking market. We present the welfare analysis in section 2.6. Section 2.7 discusses empirical hypotheses that can be derived from our theoretical analysis. Section 2.8 concludes.

2.2 Related Literature

Foreign bank entry has received surprisingly little attention in the literature so far. Goldberg (2007) raises the issue by comparing foreign direct investments in the financial and the manufacturing sector, focusing on the implications for emerging market economies. Attempts to analyze foreign bank entry in a theoretical framework have been scarce. Dell'Ariccia et al. (1999) point to the problem potential entrant banks may face in distinguishing good from bad borrowers that have already been rejected by incumbent banks. In line with this approach, Dell'Ariccia and Marquez (2004) analyze the trade-off between superior information of host country banks and lower refinancing costs of foreign banks entering the market. Buch (2003) sets up a theoretical model of foreign bank entry and finds empirical support for the hypothesis that large information barriers discourage entry of foreign banks. Hauswald and Marquez (2003) consider the possibility of information spillovers from incumbent host country banks to potential entrants and show that, as a result, interest rates and bank profits decrease. Kaas (2004) presents a model of spatial loan competition and arrives at the conclusion that foreign bank entry is generally too low compared to the social optimum. Claeys and Hainz (2006) as well as Van Tassel and Vishwasrao (2007) look at how different entry modes of foreign banks affect competition in a liberalized banking market. Both approaches indicate that greenfield entry leads to more competition and thus lower interest rates in the host banking market. The issue of different market entry modes of foreign banks has also been addressed by De Haas and van Lelyveld (2006). Their study implies that the credit supply of foreign banks remains stable during crisis periods in the host country and that this effect is mainly driven by greenfield foreign banks.

We contribute to this strand of literature by introducing spillover effects into a model of spatial bank competition. In this respect, our analysis corresponds to theoretical approaches examining the effect of spillovers on R&D investment and cost reduction. Negative effects of spillovers on R&D incentives and cost reduction effort are stated by Spence (1984). In contrast, Cohen and Levinthal (1989) as well as Levin and Reiss (1988) both find theoretical and empirical support for the hypothesis that intra-industry spillovers may lead to an increase in R&D investment.

Görg and Strobl (2001) find that empirical evidence on spillovers is mixed and point to the role of the underlying econometric framework. Coe and Helpman (1995) and Coe et al. (1997) suggest that foreign R&D via international trade entails spillovers in the sense that total factor productivity rises both in developed and in developing countries. Similarly, Beck et al. (2000) conclude that financial intermediary development raises total factor productivity growth. Blomström and Kokko (1998) also support this view. In their survey of literature on spillovers from multinational corporations to host country firms they find evidence that the effect of spillovers is positive and increases with the degree of competition in the host country. Ceccagnoli (2005) indicates that spillovers increase R&D effort when the number of innovating firms is small.

In addition to the impact of spillovers, we study the effect of competition on the incentives of host country banks to invest in better screening skills. Our model relates to a strand of theoretical literature on the influence of competition on innovation incentives. Vives (2004) shows that an increasing number of firms in the market imply lower R&D investment while rising competition in terms of increasing product substitutability encourages R&D incentives. Raith (2003) investigates the effect of mounting competition on cost reducing effort in a principal agent setting and concludes that both an increasing number of firms in the market and rising product substitutability increase the incentives to invest in cost reduction. In contrast, Boot and Marinč (2006) find that fiercer competition in terms of an increasing number of banks operating in the market reduces banks' efforts to invest in better monitoring technologies. Schnitzer (1999) studies the impact of competition on the efficiency of credit allocation. She finds that screening incentives rise with the number of informed banks and that increasing competition raises the likelihood of bad loans. Hauswald and Marquez (2006) present a model of spatial bank competition in which banks can invest in strategic information acquisition about the quality of borrowers' investment projects and find that rising competition decreases investment in screening. Similarly, Broecker (1990) and Sharpe (1990) show that increasing competition decreases the quality of a bank's loan portfolio.

There are a number of empirical papers investigating increasing competition in the light of foreign bank entry. Claessens et al. (2001) suggest that higher competitive pressure due to foreign bank entry implies an increase in the efficiency of host country banks and, thus, higher welfare in economies liberalizing their banking markets. Clarke et al. (2006) find evidence that foreign bank presence implies lower financing obstacles for all firms in a market. De Haas and Naaborg (2006) conclude that due to increased competition in the market for large corporations, foreign banks increased their lending activities in the segment of small and medium enterprises and in retail banking. Fries and Taci (2005) study the cost efficiency of banks in Eastern European Countries and find that the costs of all banks are lower when the presence of foreign banks in a country is high. These results are confirmed by Bhaumik and Dimova (2004). However, Sabi (1996) finds support for the hypothesis that foreign bank entry does not help to improve the performance of domestic banks. Martínez Pería and Mody (2004) distinguish between acquisition and greenfield entry in the context of Latin America. They find that the interest rate spread of foreign banks entering via a de novo investment is lower than that of banks entering via the acquisition of a host country bank. Moreover, their analysis suggests that a higher presence of foreign banks leads to lower costs of all banks operating in the market.

2.3 The Model

Consider a continuum of borrowers with mass m that are uniformly distributed along a circular road with circumference 1. Each borrower can engage in one investment project that requires an initial outlay of i, $i > 0$. Borrowers are not endowed with any initial wealth and therefore need to apply for credit at the banks, the only source of finance in our model. Borrowers have either good or bad projects. It is common knowledge that the fraction of borrowers with good projects is γ and the fraction of borrowers with bad projects is $1-\gamma$, $0 < \gamma < 1$. Individual borrowers know about the quality of their own investment projects. In case the project is good, it generates a return $v > 0$ with certainty while a bad project always fails, yielding a return of zero. The returns of the projects are observable and contractible.

The banking sector consists of n banks that are located equidistantly along the circular road.[11] Banks compete in the repayments r_j, $j = 1, ..., n$ which they simultaneously ask from the borrowers. Borrowers whose investment projects yield a return of v must repay r_j to the bank whereas borrowers whose projects fail do not repay their loan. We assume that banks in the closed domestic banking market do not have access to a screening technology so that all borrowers are offered a loan of size i because we assume $\gamma v > i$.[12] We take it as given that each bank disposes of enough funds to finance all borrowers applying for a loan. We assume that banks can observe

[11] For our analysis to be interesting we assume that the number of banks n in the market is not too small.

[12] Think for instance of the transition countries where, due to the planning of the economy, no screening took place during the communist era.

the location of borrowers.[13] Borrowers base their decision at which bank to apply for credit on the repayments r_j asked by the banks and the transport costs they have to incur to travel to the bank. We assume that transport costs tx are proportional to the distance x between the borrower and the bank. Furthermore, we assume that the return of a good project v is high enough so that the market is covered at equilibrium prices. Borrowers and banks are risk neutral and maximize profits.

We consider the situation where the domestic banking market is opened up to a number l of foreign banks.[14] We distinguish between two entry modes. Foreign banks can enter either via a greenfield investment or via the acquisition of a domestic bank. When banks enter via a de novo investment a foreign subsidiary is established in the domestic banking market and so the number of banks operating in the market increases.[15] In contrast, entry via acquisition leaves the number of banks constant since we consider an acquired domestic bank as a foreign bank. As a matter of simplicity, we assume that there are no costs of entry. Banks locate equidistantly along the circular road. We assume that foreign banks possess perfect screening ability.[16] Consequently, foreign banks finance all borrowers with good projects that ask for credit whereas a borrower with a bad project is never offered a loan.

Note that our model set-up allows us to distinguish between two channels of competition. First, competition can be measured by the number of banks active in the market. Second, the competitive pressure of the market environment expressed by the inverse of transportation costs $\frac{1}{t}$ acts as a further indicator of competition in our model: the larger the transportation costs t, i.e. the more costly it becomes for borrowers to travel to a bank, the less intense price competition will be between banks. Conversely, the higher is $\frac{1}{t}$, the more competitive is the market environment. The important role of transportation costs for the pricing of loans has been confirmed empirically by Degryse and Ongena (2005).[17]

[13] As e.g. in Dell'Ariccia (2001), this assumption considerably simplifies our analysis. Note that we abstract from the possibility of price discrimination of borrowers.

[14] For our analysis to be interesting we assume that there is a sufficiently large number of domestic banks that can be affected by foreign bank entry, i.e. $\frac{l}{n}$ is not close to 1.

[15] Note that we abstract from explicitly modeling supervisory issues so that the foreign bank's choice between establishing a branch or subsidiary in the host country is of no importance for our results.

[16] The assumption of foreign banks disposing of perfect screening ability considerably simplifies our analysis. However, the relaxation of this assumption is further discussed in footnote 25.

[17] Alternatively, $\frac{1}{t}$ could be interpreted as the degree of product differentiation in the banking market. In that case, the location of a bank would signify its specialization in a certain credit product or industry and transport costs would express the preferences borrowers have for a particular

We assume that with foreign banks entering the domestic banking market spillover effects occur. Spillovers may materialize through various channels. Authors such as Blomström and Kokko (1998) and Saggi (2002) point to the importance of the host country's labor market for the occurrence of spillovers. As it has been empirically confirmed by Görg and Strobl (2005), spillovers may occur when domestic banks get their staff trained abroad or when domestic staff that has been employed and trained by foreign banks fluctuates to domestic banks. The replication of high quality financial services offered by foreign banks may constitute a further channel for spillovers. In addition, spillovers may be realized through the implementation of better risk management techniques, superior forms of organization or better data processing technologies. Moreover, foreign banks are likely to press for an improved regulatory supervision of the banking markets they enter.

Spillover effects are modeled as follows. With the entry of foreign banks domestic banks obtain access to an imperfect screening technology. Domestic banks can therefore identify the fraction $1-\alpha$, $0 < \alpha < 1$, of borrowers investing in bad projects but cannot distinguish between the remaining fraction α of borrowers with bad projects and the borrowers with good projects. Accordingly, domestic banks finance the fraction α of borrowers investing in bad projects as well as all borrowers with good projects applying for credit. However, the fraction $1-\alpha$ of borrowers with bad projects is denied credit. Hence, the higher is the spillover effect, the better is the quality of the screening technology the domestic banks obtain and the lower is the fraction α of borrowers with bad projects financed in the banking market opened to foreign banks.[18] Without loss of generality, we assume that there are no per borrower screening costs for all banks.

Domestic banks have the possibility to invest a fixed cost $F > 0$ in order to obtain the perfect screening technology.[19] This decision is taken simultaneously by all domestic banks. Hence, domestic banks need to weigh the size of the fixed cost against the costs associated with the financing of borrowers with bad projects in case they do not invest in the perfect screening technology. As a result, the situation in the open domestic banking market looks as follows. Three types of banks can operate in this

type of bank. Models in the banking literature based on a Salop approach referring to product differentiation in the financial sector are, for instance, Besanko and Thakor (1992), Chiappori et al. (1995), Dell'Ariccia (2001), or Economides et al. (1996).

[18] In this chapter, we abstract from domestic banks having access to soft information. Note that our results would remain qualitatively unaffected if we introduced soft information advantages of domestic banks as long as we ensured that foreign banks are still better in distinguishing bad from good borrowers.

[19] Our qualitative results would remain unaffected if we introduced the size of the fixed cost to vary with the degree of spillovers.

market: foreign banks, domestic banks that possess the perfect screening technology, and domestic banks that only screen imperfectly.

When borrowers apply for credit at the banks, banks engage in screening the borrowers. Banks that have access to the perfect screening technology make credit offers only to borrowers with good projects whereas banks not having invested in screening offer a loan to borrowers investing in good projects and the fraction α of borrowers with bad projects. Borrowers with bad projects that are denied credit do not apply for credit at another bank because banks can deduce from the borrowers' location that they have unsuccessfully applied for a loan at another bank.

The time structure of the model is as follows. At stage 1, the domestic banking market is opened up to foreign banks and spillover effects occur. At stage 2, domestic banks have the possibility to invest in the perfect screening technology. At stage 3, banks simultaneously set repayment rates. At stage 4, borrowers apply for credit and banks engage in screening borrowers. Borrowers that have successfully passed the screening procedure are offered a loan. At stage 5, returns realize and all borrowers investing in good projects pay back their loan. We solve the game by backward induction.

2.4 Equilibrium in the Banking Market

In this section, we study the equilibrium in the domestic banking market with foreign bank entry.[20] We first calculate the equilibrium repayments that different types of banks ask from the borrowers for a given number k of domestic banks that invest in perfect screening. Then, we derive the equilibrium number of domestic banks k^* that invest in the perfect screening technology. We assume that all banks are randomly but equidistantly allocated along the circle, so that each location is equally likely for each bank. Thus, we can define the probability that the neighboring bank of a perfectly screening bank also has access to the perfect screening technology as $q \equiv \frac{l+k-1}{n-1}$.[21]

[20] Note that in our model, all domestic banks either stay in the market when covering a positive market share or they leave the market when foreign banks charge such low interest rates that all borrowers would apply for credit at foreign banks. Since we are interested in how foreign entry affects the domestic banks' incentive to invest in more efficient screening technologies, we restrict our presentation to the second case.

[21] Note that banks can only build expectations about whether their neighbors invest in screening or not and, accordingly, charge high or low repayments. This assumption is used as a modeling

Proposition 2.1 *In equilibrium, banks with perfect screening technology charge a repayment* r_L*, whereas banks with imperfect screening technology charge a repayment* $r_H > r_L$*, where*

$$r_L = i + \frac{t}{n} + \frac{\alpha i\,(1-\gamma)}{\gamma}\frac{1-q}{2} \tag{2.1}$$

$$r_H = i + \frac{t}{n} + \frac{\alpha i\,(1-\gamma)}{\gamma}\left(1-\frac{q}{2}\right). \tag{2.2}$$

Proof: see Appendix.

The equilibrium prices described in Proposition 2.1 result in the following equilibrium profits of foreign banks, π_{FB}, of domestic banks that invest in the perfect screening technology, $\pi_{DB,L}$, and of domestic banks that do not invest in screening, $\pi_{DB,H}$:

$$\pi_{FB} = \frac{\gamma m}{t}[\frac{1}{2}\,(1-q)\,\frac{\alpha i\,(1-\gamma)}{\gamma} + \frac{t}{n}]^2 \tag{2.3}$$

$$\pi_{DB,L} = \frac{\gamma m}{t}[\frac{1}{2}\,(1-q)\,\frac{\alpha i\,(1-\gamma)}{\gamma} + \frac{t}{n}]^2 - F \tag{2.4}$$

$$\pi_{DB,H} = \frac{\gamma m}{t}[-\frac{q}{2}\frac{\alpha i\,(1-\gamma)}{\gamma} + \frac{t}{n}]^2 \tag{2.5}$$

Note that the profits of all banks depend negatively on the share of perfectly screening banks in the market. The intuition behind this is that first, the more banks operate in the market that screen perfectly, the lower will be the expected market share for any individual bank in the market because the likelihood that it needs to share its market with a perfectly screening bank increases. Second, a higher fraction of perfectly screening banks in the market leads to lower repayments which both types of banks can ask from the borrowers in equilibrium; this, in turn, decreases profits for all banks. However, the profits of banks that have access to the perfect screening technology fall by more than those of imperfectly screening banks. On the one hand, this is due to the fact that the reduction in the size of the repayment is weighed by a larger expected market share covered by these banks compared to the banks which screen imperfectly. On the other hand, the more banks operate in the market that screen perfectly, the lower are the costs arising from borrowers with bad projects if a bank does not invest in the screening technology. This is due to the fall in the expected market share and

device in order to avoid asymmetric equilibria and keep the model tractable. We refer to Aghion and Schankerman (2004) for further justifications of this assumption.

hence the smaller number of borrowers with bad projects asking for a loan.

Next, we derive the equilibrium number k^* of domestic banks that invest in the perfect screening technology. When deciding about whether to invest in screening or not, a domestic bank weighs the required fixed cost against the costs associated with the financing of borrowers with bad projects if it does not invest in screening. Proposition 2.2 characterizes the three different kinds of equilibria we get for low, medium and high fixed costs for the perfect screening technology.

Proposition 2.2 *There exist values of fixed costs $\underline{F}$ and $\overline{F}$, with $\underline{F} < \overline{F}$, such that*
(1) for low values of the fixed cost $F \leq \underline{F}$, all domestic banks invest in the perfect screening technology;
(2) for high values of the fixed cost $F \geq \overline{F}$, no domestic bank invests in the perfect screening technology;
(3) for intermediate values of the fixed cost in the range $\underline{F} < F < \overline{F}$ a number k^*, $1 \leq k^* \leq n - l$, of domestic banks invests in the perfect screening technology. The number k^* is the integer number that lies between

$$\underline{k} = \frac{n}{2} - l - \frac{2t\gamma\,(n-1)}{\alpha i\,(1-\gamma)}[\frac{F}{m\alpha i\,(1-\gamma)}\frac{(n-1)}{(n-2)} - \frac{1}{n}] \tag{2.6}$$

and

$$\overline{k} = \underline{k} + 1. \tag{2.7}$$

Proof: see Appendix.

The decision of a domestic bank to invest in screening or not clearly depends on what all other domestic banks do. The higher the number of domestic banks that invest in screening the less attractive it becomes for a bank to spend the fixed cost. This is due to the fact that with a rising fraction of perfectly screening banks in the market, the profit of a bank that has access to the perfect screening technology decreases by more than the profit of a bank screening imperfectly as explained above. If the fixed cost is very low, however, the investment incentives are so large that it pays for a domestic bank to invest in the screening technology even if all other domestic banks also invest in screening. If, instead, the fixed cost is very large then it does not pay for a domestic bank to spend the fixed cost even if all other domestic banks do not invest in the screening technology, either. For intermediate ranges of the fixed cost these two extreme equilibrium outcomes are not feasible.

We can show that for intermediate values of the fixed cost an equilibrium exists in which exactly k^* domestic banks invest in the screening technology whereas the remainder of domestic banks does not invest in screening. Such an equilibrium is stable if $\pi_{DB,L}(k = k^*) \geq \pi_{DB,H}(k = k^* - 1)$ and $\pi_{DB,H}(k = k^*) \geq \pi_{DB,L}(k = k^* + 1)$. The value k^* that satisfies these two conditions is described in Proposition 2.2. Note that in equilibrium, banks are not indifferent between investing and not investing in screening since the profit of banks that screen perfectly lies slightly above the profit of banks screening imperfectly. Given k^*, however, no domestic bank has an incentive to deviate because that would imply even lower profits.

2.5 Impact of Spillovers and Competition on the Efficiency of the Domestic Banking Market

In this section we study the impact of spillovers as well as competition on the efficiency of the domestic banking market. In a first step, we analyze how spillovers on the one hand and competition in the number of banks on the other hand affect the equilibrium number of domestic banks investing in screening, k^*. Second, we concentrate on how the interaction of these two effects influences the domestic banks' incentive to invest in screening. Finally, we are interested in how the competitive pressure prevailing in the domestic banking market, as measured by the inverse of transportation costs, influences the strength of spillover effects and competition in the number of banks in their impact on the domestic banking market's efficiency. Yet, before investigating these interdependencies and in order to clarify the analysis, we give an intuition on how the number of domestic banks investing in screening k^* depends on $\frac{1}{t}$. In the remainder we focus on the case of intermediate fixed costs of screening in which k^* domestic banks invest in the perfect screening technology.

The following Proposition characterizes how k^* is influenced by spillover effects. We use $(-\alpha)$ to capture the size of the spillovers. The larger $(-\alpha)$, i.e. the smaller α, the larger are the spillover effects.

Proposition 2.3 *The equilibrium number of domestic banks that invest in perfect screening is a decreasing and concave function of the size of the spillover effect. That is,*

$$\frac{dk^*}{d(-\alpha)} < 0 \quad \textit{and} \quad \frac{d^2k^*}{d(-\alpha)^2} < 0. \tag{2.8}$$

Proof: see Appendix.

The intuition behind this result is as follows: with rising spillover effects even those domestic banks that do not invest in perfect screening are able to identify a larger fraction of borrowers with bad projects. This, in turn, allows the banks to become more competitive in the sense that they can decrease the repayment they ask from the borrowers because the negative effect of an increasing market share, i.e. losses from bad projects, is reduced.

Consequently, banks investing in the perfect screening technology also need to lower their repayment offers and, in addition, their expected market share will fall. Thus, domestic banks that do not invest in the perfect screening technology obtain larger profits whereas profits of banks with perfect screening ability decrease. Hence, the incentives to invest in the perfect screening technology and, accordingly, the number of domestic banks investing in screening falls when spillovers rise.

Note, however, that spillover effects have a positive influence on the overall efficiency of the domestic banking market in the sense that the domestic banks that did not screen at all in the closed banking market obtain access to an imperfect screening technology. Consequently, we identify a clear trade-off: with low spillover effects a large number of perfectly screening domestic banks operates in the market but there are also a few banks that screen very imperfectly. The situation is different with high spillovers: the number of domestic banks screening perfectly is rather low but all other domestic banks not investing in screening operate quite efficiently due to the large spillovers.

Next, we analyze the impact of competition in terms of the number of banks operating in the market n on the equilibrium number of domestic banks that invest in screening.[22] Thereby, we capture the impact of the different entry modes on the investment incentives of domestic banks. Note that when banks enter via de novo investment

[22] We treat the number of banks in the market as exogenous. Note that entry during the early liberalization period in transition countries was in general heavily regulated. Hence, we think of the number of banks in the market as a policy makers' decision variable and will derive the welfare maximizing policy regarding n later on.

a foreign subsidiary is established in the domestic banking market and so the number of banks operating in the market increases.[23] In contrast, entry via acquisition leaves the number of banks operating in the economy constant since only the ownership of a domestic bank that is acquired by a foreign bank changes. Proposition 2.4 characterizes how competition as measured by the number of banks affects k^*.

Proposition 2.4 *The number of domestic banks that invest in perfect screening is a decreasing and concave function of the overall number of banks in the market. That is,*

$$\frac{dk^*}{dn} < 0 \quad \text{and} \quad \frac{d^2k^*}{dn^2} < 0. \tag{2.9}$$

Proof: see Appendix.

The intuition here is as follows: an increasing number of banks lead to lower equilibrium repayment rates as well as to lower market shares for all banks. However, domestic banks not investing in screening lose relatively less since a falling market share also means a smaller number of bad borrowers financed.

Proposition 2.4 further implies that entry via greenfield investment will decrease the equilibrium number of domestic banks investing in screening by more than entry via acquisition.

We now turn to the interaction of spillovers and competition in the number of banks operating in the market. Our results are summarized in Proposition 2.5.

Proposition 2.5 *Spillovers and competition in the number of banks operating in the market reinforce each other in their negative impact on the number of domestic banks investing in screening, k^*. That is,*

$$\frac{\partial^2 k^*}{\partial(-\alpha)\,\partial n} < 0. \tag{2.10}$$

Proof: see Appendix.

[23] Thereby, we account for the major difference between greenfield and acquisition entry, namely the higher competitiveness prevailing in a market when entry occurs via de novo investment.

We find that the larger the spillovers the higher is the absolute marginal negative impact of an increasing number of banks operating in the market on the incentives of domestic banks to invest in screening and vice versa. Hence, spillovers and competition reinforce each other in their negative impact on the number of perfectly screening domestic banks. We conclude that spillovers and competition work as complements with respect to the investment incentives of domestic banks.

The intuition for this result is as follows. Higher spillovers entail larger market shares of domestic banks not investing in screening. Thus, higher spillovers imply that an increase in the number of banks operating in the market results in a loss of relatively more borrowers with bad projects. Hence, the negative impact of an increasing number of banks on the investment incentives of domestic banks is reinforced with larger spillovers.

It is interesting to see that contrary to the often claimed positive role of spillovers and competition for financial development we arrive at the opposite result.[24] Even more, in our model one effect cannot substitute for the other; instead, both effects reinforce each other in their negative impact on the incentives of domestic banks to invest in screening.

Note also that the higher the spillovers, the more distinct the implications of de novo and acquisition entry. This is due to the fact that with larger spillovers the negative impact of de novo investments on the equilibrium number of domestic banks investing in screening becomes stronger.[25]

For our policy conclusions it is important to know how the strength of the spillover and competition effects just described depends on the competitive environment in the domestic banking market as measured by the inverse of transportation costs. Before we address this issue in more detail, we first give an intuition of how competitive

[24] In our model, higher spillovers and more competition through bank entry make domestic banks invest less in the perfect screening technology.

[25] Throughout our analysis, we assume that foreign banks can perfectly screen borrowers which considerably simplifies our analysis. If we allowed for an imperfect but still more efficient screening technology of foreign compared to domestic banks, our results would change as follows. The advantage of foreign over domestic banks in screening borrowers would be lower. Our calculations show that allowing for an imperfect screening technology for foreign banks results in a lower equilibrium number of domestic banks investing in screening. Furthermore, we arrive at even stronger results concerning our comparative statics analysis: the negative impact of spillovers as well as the number of domestic banks on the equilibrium number of domestic banks investing in screening is reinforced. Moreover, spillovers and the number of banks in the market more strongly reinforce each other in their negative impact on the incentives of domestic banks to invest in screening.

pressure $\frac{1}{t}$ affects the incentives of domestic banks to invest in screening. Our results are summarized in Proposition 2.6.

Proposition 2.6 *In the case of $l < \frac{n-2}{2}$, there exists a fixed cost F_1 such that the number of domestic banks that invest in perfect screening is a decreasing and convex function of competitive pressure $\frac{1}{t}$ for low values of the fixed cost F, i.e. $F < F_1$, and an increasing and concave function of competitive pressure $\frac{1}{t}$ for high values of F, i.e. $F > F_1$. In the case of $l > \frac{n-2}{2}$, the number of domestic banks that invest in perfect screening is a decreasing and convex function of competitive pressure $\frac{1}{t}$ independent of the size of the fixed cost F. That is,*

(1) if $l < \frac{n-2}{2}$:

$$\text{for } F < F_1, \qquad \frac{dk^*}{d\left(\frac{1}{t}\right)} < 0 \text{ and } \frac{d^2k^*}{d\left(\frac{1}{t}\right)^2} > 0 \tag{2.11}$$

$$\text{for } F > F_1, \qquad \frac{dk^*}{d\left(\frac{1}{t}\right)} > 0 \text{ and } \frac{d^2k^*}{d\left(\frac{1}{t}\right)^2} < 0; \tag{2.12}$$

(2) if $l > \frac{n-2}{2}$:

$$\frac{dk^*}{d\left(\frac{1}{t}\right)} < 0 \text{ and } \frac{d^2k^*}{d\left(\frac{1}{t}\right)^2} > 0. \tag{2.13}$$

Proof: see Appendix.

Here, we identify two countervailing effects, a price effect and a market share effect. On the one hand, with higher competitive pressure $\frac{1}{t}$ all banks need to lower the repayments they charge the borrowers. As a consequence, profits of all banks fall. However, the profit of banks investing in screening decreases by more than that of banks not investing in screening since the former cover a larger expected market share. Thus, this negative price effect works against investment incentives of domestic banks. On the other hand, increasing competitive pressure $\frac{1}{t}$ implies higher market shares of perfectly screening and lower market shares of imperfectly screening banks. The resulting higher asymmetry of banks with respect to their market shares leads to an increase in the profits of banks investing in screening and a decrease in the profits of banks not investing. Hence, the driving factor implying higher screening incentives when competitive pressure rises is the higher asymmetry of banks in market shares.

The overall outcome depends on whether the market share effect outweighs the price effect or vice versa. The rising asymmetry in market shares is the dominating effect when the number of perfectly screening banks in the market is rather small. For this to be true it must hold that the share of foreign banks in the market is not too large, i.e. $l < \frac{n-2}{2}$, and that the fixed cost for the screening technology takes on rather high values, i.e. $F > F_1$, ensuring rather low incentives to invest in better screening. Then, with increasing competitive pressure $\frac{1}{t}$ the difference in the market shares of investing and not investing banks widens and, thus, a bank can gain a lot when investing in the screening technology. For $F < F_1$, instead, the negative price effect dominates the positive market share effect. In this case, a rise in competitive pressure $\frac{1}{t}$ has a negative impact on the number of domestic banks investing in screening. Note that when foreign banks dominate roughly more than one half of the banking market, i.e. $l > \frac{n-2}{2}$, the negative price effect always outweighs the positive market share effect, independent of the size of the fixed cost F. In that case, increasing competitive pressure always has a negative impact on investment incentives.

It is interesting to observe that a rising number of banks operating in the market and higher competitive pressure $\frac{1}{t}$ can have the opposite effect on the incentives of domestic banks to invest in screening. This is due to the fact that both channels of competition in our model work in quite different ways. In the first case, the decisive effect leading to a fall in screening incentives is the smaller fraction of bad borrowers financed by imperfectly screening banks while in the second case, the higher investment incentives are driven by a larger asymmetry of banks in market shares.

We now turn to the impact of the competitive pressure $\frac{1}{t}$ in a market on the strength of the spillover and competition effects. Our findings are summarized in Proposition 2.7.

Proposition 2.7 *Increasing competitive pressure $\frac{1}{t}$ decreases the absolute marginal negative influence of spillovers and competition in the number of banks on the incentives of domestic banks to invest in perfect screening. That is,*

$$\frac{\partial^2 k^*}{\partial(-\alpha)\,\partial\left(\frac{1}{t}\right)} > 0 \tag{2.14}$$

$$\frac{\partial^2 k^*}{\partial n \partial\left(\frac{1}{t}\right)} > 0. \tag{2.15}$$

Proof: see Appendix.

Hence, increasing competitive pressure $\frac{1}{t}$ mitigates the negative impact of spillovers and competition in the number of banks on the incentives of domestic banks to invest in screening. Accordingly, the more competitive the market environment, the less pronounced is the effect of the different entry modes on the investment incentives of domestic banks.

The intuition for this result is as follows. Higher competitive pressure $\frac{1}{t}$ corresponds to smaller market shares of imperfectly screening domestic banks. Thus, larger competitive pressure $\frac{1}{t}$ implies that an increase in spillovers or the number of banks in the market results in a smaller loss of borrowers with bad projects. Hence, the negative impact of rising spillovers and competition in the number of banks on the incentives to invest in screening is dampened with rising competitive pressure.

We conclude that both channels of competition work as substitutes with respect to the incentives of domestic banks to invest in screening. Interestingly, spillovers and the competitive pressure of the market environment constitute substitutes whereas spillovers and the number of banks in the market behave as complements regarding the investment incentives of domestic banks.

2.6 Impact of Spillovers and Competition on Welfare

In this section, we analyze the effects of spillovers and competition on welfare, W. Welfare consists of the sum of borrower rents and bank rents. Borrower rents are captured by the willingness to pay of borrowers minus the repayments of borrowers to banks and their transport costs. Bank rents include the revenues of banks minus their costs. We could consider two possible welfare functions. The first possibility is to include the profits of foreign banks in the welfare function. This approach could be justified by assuming that in case of acquisition entry, the price paid to acquire a domestic bank equals all future expected profits of the foreign bank merged with the domestic bank. In case of greenfield entry, a foreign bank may be forced to buy a license equal to all future expected profits of the bank in order to be allowed to enter the market. Alternatively, we could exclude the profits of foreign banks from welfare in the domestic economy. However, since the results of both set-ups turn out to be fairly similar we will restrict our presentation to the first approach.[26]

[26] In order to analytically solve for the welfare implications, we focus on the following parameter ranges throughout section 2.6. We assume that the share of borrowers with good projects is larger

In what follows, we study the impact of spillovers as well as the number of banks in the market and, thus, the entry mode on welfare. Our analysis will show that the influence of both effects on welfare is ambiguous and depends on the degree of competitive pressure as measured by $\frac{1}{t}$. Therefore, we will first give an intuition for the implications of the degree of competitive pressure $\frac{1}{t}$ on welfare. Our findings are summarized in Proposition 2.8.

Proposition 2.8 *Increasing competitive pressure $\frac{1}{t}$ unambiguously increases welfare. That is,*

$$\frac{\partial W}{\partial \left(\frac{1}{t}\right)} > 0. \tag{2.16}$$

Proof: see Appendix.

As stated in Proposition 2.8, rising competition unambiguously increases welfare. This is mainly due to the fact that borrowers incur lower costs when traveling to a bank. In addition, mounting competitive pressure leads to larger market shares of perfectly and to smaller market shares of imperfectly screening banks entailing less financing of bad borrowers.

Note that according to our previous analysis the strength of the spillover and competition effects decreases with increasing competitive pressure $\frac{1}{t}$. Hence, surprisingly, welfare is the higher the lower is the marginal impact of spillovers and competition in the number of banks. We conclude that in a highly competitive market, the often mentioned importance of spillovers and the number of banks operating in a market for financial development may be overestimated.

We will now study the influence of the size of spillovers and competition in terms of the number of banks on welfare. Both effects depend on the competitive pressure $\frac{1}{t}$ prevailing in the market as well as the size of the fixed cost F. First, we look at the effect of spillovers on welfare. Our results are summarized in Proposition 2.9.

than one half and not arbitrarily close to its boundary values, and that spillovers are not too large i.e. $1-\alpha < 0.75$.

Proposition 2.9 *There exists a threshold F_2 for fixed costs and three thresholds T_1, T_2 and T_3, $T_1 < T_2 < T_3$, for the level of competitive pressure $\frac{1}{t}$ with the following properties:*

(1) suppose $F < F_2$, then

(i) $$\frac{\partial W}{\partial(-\alpha)} < 0 \quad if \quad \frac{1}{t} < T_1 \tag{2.17}$$

(ii) $$\frac{\partial W}{\partial(-\alpha)} > 0 \quad if \quad T_1 < \frac{1}{t} < T_2 \tag{2.18}$$

(iii) $$\frac{\partial W}{\partial(-\alpha)} < 0 \quad if \quad \frac{1}{t} > T_2; \tag{2.19}$$

(2) suppose $F > F_2$, then

(i) $$\frac{\partial W}{\partial(-\alpha)} > 0 \quad if \quad \frac{1}{t} < T_3 \tag{2.20}$$

(ii) $$\frac{\partial W}{\partial(-\alpha)} < 0 \quad if \quad \frac{1}{t} > T_3. \tag{2.21}$$

Proof: see Appendix.

Abstracting from the case of low fixed costs combined with low competitive pressure, welfare increases in spillovers when competitive pressure $\frac{1}{t}$ is rather small and decreases in spillovers when the competitive pressure $\frac{1}{t}$ of the market environment is rather large. Hence, in general, spillovers and competitive pressure $\frac{1}{t}$ tend to work as substitutes with respect to welfare. This corresponds to our previous findings of spillovers and competitive pressure $\frac{1}{t}$ behaving as substitutes with respect to the incentives of domestic banks to invest in screening.

Intuitively, these results can be explained as follows. Consider a situation of rather low competitive pressure $\frac{1}{t}$. In the case of low fixed costs, the incentives of domestic banks to invest in screening are high and rise further when spillovers fall. In contrast, for rather large values of the fixed cost, a small number of domestic banks invest in screening and rising spillovers lower the investment incentives even more. As a result, in both cases, the composition of the banking market becomes more homogeneous in the sense that either perfectly or imperfectly screening banks dominate the market. It follows that transport costs paid in the economy fall and, in turn, welfare increases.

However, in the presence of rather high competitive pressure $\frac{1}{t}$, investment incentives of domestic banks cease to vary a lot with the level of spillovers. For sufficiently large competitive pressure, it is welfare optimal to limit spillover effects, independent of the size of the fixed cost. As a consequence, market shares of domestic banks not investing in screening fall whereas the market shares of perfectly screening banks rise entailing a decrease in the number of bad borrowers financed and, in turn, an increase in welfare.

From Proposition 2.9 it can be inferred that, in general, it is welfare optimal to foster spillover effects when competitive pressure $\frac{1}{t}$ is rather low. For instance, the host country's policy maker could encourage spillovers by supporting domestic banks in getting their staff trained abroad or by imposing regulations on foreign banks implying that a certain fraction of their staff must be of the host country's nationality. However, Proposition 2.9 also entails the limitation of spillovers in the presence of relatively large competitive pressure. In that case, the host country's policy maker may abstain from implementing measures that foster spillovers.

Now, we turn to the impact of competition in terms of the number of banks operating in the market and, thus, the entry mode of foreign banks on welfare. Our results are stated in Proposition 2.10.

Proposition 2.10 *There exists a threshold F_3 for fixed costs and three thresholds T_4, T_5 and T_6, $T_4 < T_5 < T_6$, for the level of competitive pressure $\frac{1}{t}$ with the following properties:*

(1) suppose $F < F_3$, then

$$(i) \quad \frac{\partial W}{\partial n} < 0 \quad if \quad \frac{1}{t} < T_6 \tag{2.22}$$

$$(ii) \quad \frac{\partial W}{\partial n} > 0 \quad if \quad \frac{1}{t} > T_6; \tag{2.23}$$

(2) suppose $F > F_3$, then

$$(i) \quad \frac{\partial W}{\partial n} > 0 \quad if \quad \frac{1}{t} < T_4 \tag{2.24}$$

$$(ii) \quad \frac{\partial W}{\partial n} < 0 \quad if \quad T_4 < \frac{1}{t} < T_5 \tag{2.25}$$

$$(iii) \quad \frac{\partial W}{\partial n} > 0 \quad if \quad \frac{1}{t} > T_5. \tag{2.26}$$

Proof: see Appendix.

Foreign banks should enter the domestic banking market via de novo investment if an increase in the number of banks operating in the market raises welfare. Abstracting from the case of large fixed costs combined with very low competitive pressure, greenfield entry is to be preferred from a welfare perspective when competitive pressure $\frac{1}{t}$ is rather large whereas acquisition entry is considered welfare optimal in the presence of rather low competitive pressure. It follows that both channels of competition in our model tend to work as complements with respect to welfare.

The intuition for these results corresponds to the previous reasoning regarding spillover effects. Consider a situation of rather low competitive pressure $\frac{1}{t}$. In the case of low fixed costs, the incentives of domestic banks to invest in screening are high and rise further when the number of banks operating in the market falls. In contrast, for large fixed costs, a small number of domestic banks invest in screening and a rising number of banks in the market lowers the investment incentives even more. Again, the composition of the banking market becomes more homogeneous, leading to a fall in the transport costs paid in the economy and, in turn, an increase in welfare.

Yet, with rising competitive pressure $\frac{1}{t}$, investment incentives of domestic banks cease to vary a lot with the number of banks operating in the market. Then, for sufficiently high competitive pressure $\frac{1}{t}$, an increase in the number of banks operating in the market is welfare improving, independent of the size of the fixed costs. Due to the fall in the market shares of all banks less borrowers with bad projects obtain financing and welfare rises.

It is interesting to see that both rising spillovers and competition in the number of banks operating in the market have a clear-cut negative effect on the incentives of domestic banks to invest in screening whereas their impact on welfare is ambiguous. In contrast, although the influence of competitive pressure $\frac{1}{t}$ on the incentives of domestic banks to invest in screening is ambiguous, its effect on welfare is clearly positive.

Our main results from the welfare analysis can be summarized as follows. First, increasing competitive pressure $\frac{1}{t}$ clearly raises welfare. Second, both modes of competition work as complements when looking at welfare. In particular, a larger number of banks operating in the market and thus greenfield entry can, in general, only be welfare increasing when competitive pressure $\frac{1}{t}$ is also sufficiently large. In that case, one sole channel of competition cannot be welfare enhancing, but rather high levels of both modes of competitive pressure are necessary for raising welfare. Third, we conclude that spillovers constitute a type of substitute relative to the competitive pressure of the market environment, i.e. potential positive welfare effects of spillovers are higher the lower is competition.

2.7 Empirical Hypotheses

Our model gives rise to several testable hypotheses concerning the impact of spillovers and competition on the incentives of domestic banks to invest in screening.

We find that the incentives of domestic banks to invest in a better screening technology fall with rising spillovers. Hence, we state our first testable prediction as follows.

Hypothesis 2.1 *The larger the spillover effects from foreign to domestic banks, the fewer domestic banks are expected to invest in better screening.*

Similarly, we concluded that the investment incentives of domestic banks fall with the number of banks active in the market. Due to greenfield entry leading to a larger number of banks in the market than acquisition entry, we formulate the following hypothesis:

Hypothesis 2.2 *The number of domestic banks that invest in better screening technologies tends to be lower in the case of greenfield entry as compared to entry via acquisition.*

Moreover, we found that spillovers and competition in the number of banks in the market reinforce each other in their negative effect on the incentives of domestic banks to invest in better screening, as is stated in hypothesis 2.3.

Hypothesis 2.3 *The negative impact of spillovers on the number of domestic banks investing in screening tends to be larger in the case of greenfield as compared to acquisition entry.*

In addition, we concluded that the competitive pressure of the market environment mitigates the negative impact of spillovers and competition in terms of the number of banks on domestic banks' investment incentives. This gives rise to our fourth hypothesis.

Hypothesis 2.4 *The higher the competitive pressure of the market environment, the less severe the negative impact of spillovers and greenfield entry tends to be on the number of domestic banks that invest in screening.*

Furthermore, we found that the impact of the competitive pressure of the market environment on domestic banks' incentives to invest in screening depends on the extent of foreign bank entry as well as the costs of acquiring a better screening technology. We state the following prediction:

Hypothesis 2.5 *The number of domestic banks that invest in screening*

a) increases in the competitive pressure of the market environment when few foreign banks are present and investment in screening is costly;

b) decreases in the competitive pressure of the market environment when investment in screening is cheap or many foreign banks are present.

Stylized facts often stated in the context of foreign bank entry into transition countries point to the positive role of spillovers and competition for raising domestic banks' efficiency and overall welfare (Claessens (2006), Levine (1996)). Our analysis confirms the often mentioned positive role of the competitive pressure of the market environment for welfare. However, we demonstrate that spillovers and competition in the number of banks active in a market may just as well have a negative impact on the incentives of domestic banks to invest in superior screening technologies and, thus, their efficiency. Furthermore, we point to possible interactions of spillovers and competition, an aspect that has been largely neglected in the literature so far.

Claessens et al. (2001) and Fries and Taci (2005) find empirical support for the hypothesis that higher competitive pressure due to foreign bank entry increases the cost efficiency of host country banks. Sabi (1996) contrasts these findings and concludes that foreign bank entry does not help to improve the performance of domestic banks. Our analysis shows that a rising number of banks in the market may even entail lower incentives of domestic banks to invest in screening. Moreover, we demonstrate that increasing competitive pressure in the market environment, e.g. through lower transportation costs or less product differentiation, may have ambiguous effects on the efficiency of domestic banks, depending both on the extent of foreign bank entry and the costs of acquiring a better screening technology. Hence, we provide a framework in which the different effects competition may have on bank efficiency can be tested. In addition, our analysis gives rise to some testable predictions pointing to the role of spillovers for the efficiency of liberalizing banking markets. So far, no empirical study has addressed this issue in detail.

In order to test our hypotheses, panel data for transition countries on a bank level basis are needed since the effects of competition and spillovers may only be realized over time. An obvious challenge is to test for the impact of spillovers. Here, as a proxy one might think of the extent to which fluctuations of domestic workers between foreign and domestic banks take place, the amount of workers being trained abroad, or disclosure requirements imposed on foreign banks that facilitate the replication of sophisticated financial services. Competitive pressure of the market environment could be proxied by the distance between banks and their customers, the degree of product differentiation, or the degree of transparency in the banking market.

2.8 Conclusions

We have set up a model of spatial bank competition to analyze the impact of foreign bank entry on a liberalized banking market. In particular, we studied how the interaction of spillovers and competition affect both the incentives of domestic banks to invest in screening and welfare.

We found that spillovers and competition in the number of banks reinforce each other in their negative impact on the incentives of domestic banks to invest in screening but that the strength of both effects is mitigated in a highly competitive market environment. With respect to welfare, however, spillovers and either channel of competition tend to work as substitutes whereas both modes of competitive pressure behave as complements.

We conclude our analysis with some policy conclusions based on the results from our welfare analysis. Consider e.g. different values of the fixed cost spent in order to obtain the perfect screening technology as corresponding to different stages of development in countries liberalizing their banking markets. Very underdeveloped countries would thus be characterized by larger costs for investing in screening than emerging economies on a higher development stage. This could be due to higher costs related to the development of human capital, necessary restructuring processes or the upgrading of technical facilities. Then, when the competitive pressure of the market environment is weak, it would be considered welfare optimal for very underdeveloped countries to let foreign banks enter their markets via greenfield investments whereas emerging markets characterized by a higher level of development should open up for foreign banks via acquisition. However, in banking markets characterized by high competitiveness, greenfield entry constitutes the favored entry mode independent of the development status of countries.

We could also apply our model to a dynamic liberalization process by assuming that shortly after the opening up of a banking market the fixed costs spent to attain better screening skills are larger than during later periods of liberalization. In addition, we could think of transportation costs to be falling over time. On the one hand, this could result from an increasing transparency of the banking market or a mounting standardization of financial products which could make preferences of borrowers for a certain type of bank less pronounced. On the other hand, by the introduction of new information and communication technologies, physical transportation costs of borrowers may fall alike (Petersen and Rajan (2002)). Hence, we could state that a country liberalizing its banking market shifts from a situation of high fixed costs and high transportation costs to an environment of low fixed costs and low transportation costs. A policy maker should then try to restrict the entry mode of foreign banks to de novo investments in the early stages of liberalization. Then, after allowing for acquisition entry in an environment of intermediate competitive pressure, in later periods of liberalization the policy maker should try to shift back to greenfield entry again.

Chapter 3

Group Lending versus Individual Lending in Microfinance

3.1 Introduction

In 2006, the Nobel Peace Prize was awarded to Mohammad Yunus. Since he founded the Grameen Bank in Bangladesh in the late 1970s, microfinance has experienced an impressive growth. This is largely due to the many positive effects attributed to microfinance programs. Microfinance schemes have been found to reduce poverty and to positively affect nutrition, health and education as well as gender empowerment (Littlefield et al. (2003)). In 2006, microfinance institutions reached around 130 million customers around the world (Daley-Harris (2007)).

Typically, microfinance is associated with joint liability lending. When borrowers form groups and are held liable for each other, lending to the poor can be profitable even if borrowers do not possess any collateral and lack a credit history. Interestingly, however, a large part of microfinance institutions does not offer group but individual loans. This gives rise to several questions: what are the incentive mechanisms that play a role in individual and group lending schemes and how do they differ? Under which circumstances do microfinance institutions offer group or individual loan contracts? What are the differences between individual lending programs of microfinance institutions and the individual lending technology applied by commercial banks?

According to Giné and Karlan (2006), the different features of group and individual lending schemes have not yet been studied in detail "despite being a question of first-order importance".[27] With the aim to contribute to a theoretical foundation of this topic, we set up a model of spatial competition between microfinance institutions. Microfinance institutions offer either group or individual loans and compete in the repayments they charge their clients. Borrowers differ in their success probabilities and lack pledgeable collateral. As borrowers have no documented credit history, they are unable to provide hard information.

Consequently, in contrast to commercial banks, microfinance institutions cannot screen borrowers and secure loans with collateral. Screening borrowers is feasible only when a relatively standardized evaluation procedure based on the analysis of hard information such as balance sheet data is applicable. In addition, any lending strategy pursued by microfinance institutions must ensure monitoring of borrowers in order to prevent the diversion of loans to urgent consumption needs.

When a microfinance institution opts for the group lending technology, it transfers the monitoring role to borrowers. Joint liability ensures strong incentives of group members to monitor each other in order to make their peers succeed. Furthermore, self-selection of borrowers into different credit contracts can be achieved.

In case it grants individual loans, the microfinance institution specializes in closely monitoring clients. Borrowers are offered a pooling contract. However, borrowers are exempt from negative effects of group lending schemes such as bearing additional risk, loss of privacy from disclosing their financial situation and investment projects to potential peers, or time spent on group meetings.

Our first focus of interest lies on how the decision of a microfinance institution to offer either group or individual loans depends on the size of a loan. Controversial arguments are brought forward in the so far rather descriptive literature on this topic. For instance, Kota (2007) and Harper (2007) state that microfinance institutions offer individual contracts if clients are in need for larger loans. In contrast, Giné and Karlan (2006) advocate precisely the reverse correlation. Our analysis aims to contribute to a theoretical foundation of this discussion.

Another major focus of our study is to investigate how the choice of lending technology depends on refinancing conditions and competitive pressure in the microfinance market. According to Isern and Porteous (2005) as well as Reddy and Rhyne (2006),

[27] Giné and Karlan (2006, p. 3)

the world of microfinance currently changes substantially in both these respects. The emergence of rating agencies specializing in the microfinance business and the growing awareness regarding the potential of the microfinance industry makes investors channel more and more funds into this market. Enhanced access to capital markets, in turn, implies improved refinancing conditions for microfinance institutions. In addition, competition among microfinance banks steadily intensifies. Our analysis provides a theoretical framework that allows us to study in detail how changes in refinancing conditions and competition affect a microfinance institution's lending strategy.

Interestingly, our results show that microfinance institutions decide to offer individual loans when the loan size is rather small. Moreover, microfinance institutions favor individual over group contracts when refinancing costs are low and when competition is intense. Hence, our analysis allows for some interesting predictions concerning the future shape of the microfinance industry. Given that access to capital markets continues to improve and competition between microfinance institutions rises further, our results imply that individual loan contracts in the microfinance market will gain in importance over the next years.

The remainder of this chapter is organized as follows. The next section reviews the literature. Section 3.3 describes the set-up of the model. In section 3.4, we study the choice of lending technology of microfinance institutions. We present our comparative statics analysis in section 3.5. Empirical hypotheses are stated in section 3.6. Section 3.7 concludes.

3.2 Related Literature

Although individual loans account for a large portion of microfinance loans, the literature is heavily biased towards an analysis of group loan contracts. Individual lending schemes have only very recently attracted the interest of researchers.

Numerous theoretical papers have addressed the positive effects of group lending mechanisms. Ghatak and Guinnane (1999), Ghatak (2000) as well as Van Tassel (1999) show that group lending achieves self-selection of borrowers and acts as a screening device. Armendáriz de Aghion and Gollier (2000) find that even if borrowers do not know each other's type, group lending may be feasible due to lower interest rates as a result of cross subsidization of borrowers. Stiglitz (1990) outlines the role of peer-monitoring in group lending schemes, which transfers the monitoring role from the bank to the borrowers and acts as an incentive device. Armendáriz de Aghion (1999) demonstrates that the benefits from peer monitoring are largest when risks are positively correlated among borrowers. Laffont and N'Guessan (2000) conclude that social connections facilitate the monitoring and enforcement of joint liability loan contracts. This result has been confirmed in an empirical study by Karlan (2007). Furthermore, Armendáriz de Aghion and Morduch (2000) point to a fall in transaction costs when - instead of individual visits of clients - group meetings are held. In addition, the contact with banks to which poor borrowers typically are not used to is facilitated.

However, certain drawbacks of group lending exist. Giné and Karlan (2006) state that the demand for credit within a group may change over time, forcing clients with small loans to be liable for larger loans of their peers. Furthermore, the growth of group lending programs may slow down when new borrowers with looser social ties enter and, consequently, the group lending technology loses some of its power. Besley and Coate (1995) stress negative welfare effects if the group as a whole defaults even if some members had repaid under individual lending. In a case study, Montgomery (1996) outlines the unnecessary social costs of repayment pressure. Stiglitz (1990) points to the higher risk borrowers assume when they are not only liable for themselves but also for their group partners.

The so far rather descriptive literature on individual lending schemes typically focuses on the crucial role of closely monitoring borrowers. Navajas et al. (2003), Armendáriz de Aghion and Morduch (2005) as well as Giné et al. (2006) describe the problem that poor borrowers may divert a loan, at least partly, to urgent consumption needs. In order to ensure the use of the loan for the agreed upon investment project, Champagne et al. (2007) as well as Zeitinger (1996) stress the importance of regularly visiting clients. In a theoretical analysis of individual lending schemes by Gangopadhyay and Lensink (2007), the monitoring of borrowers by informal lenders plays a central role. Armendáriz de Aghion and Morduch (2000) as well as Dellien et al. (2005) also point to the importance of monitoring borrowers in individual lending schemes.

Only recently, researchers have been interested in comparing group lending programs to individual lending schemes. Giné and Karlan (2006) conduct a field experiment in the Philippines. They find that by offering individual loans, a microfinance institution can attract relatively more new clients. Yet, both lending schemes do not differ in repayment rates. In a recent empirical study, Ahlin and Townsend (2007) find a U-shaped relationship between joint liability contracts relative to individual contracts and a borrower's wealth. Furthermore, they conclude that higher correlation across projects makes group lending contracts more likely relative to individual contracts. In her theoretical analysis, Madajewicz (2008) shows that, in general, borrowers prefer individual loans the wealthier they are. Nevertheless, she demonstrates that for very low levels of borrower wealth, group loans are larger than individual loans. Moreover, she finds that businesses funded with individual loans grow more than those funded with group loans.

3.3 The Model

Consider a continuum of borrowers with mass 2 that is uniformly distributed along a straigt line of length 1. Each borrower can engage in one investment project that requires an initial outlay of $i,\ i > 0$. Borrowers are not endowed with any initial wealth and therefore need to apply for credit at a microfinance institution, the only source of finance in our model. Borrowers have either safe or risky projects. It is common knowledge that the fraction of borrowers with safe projects is γ and the fraction of borrowers with risky projects is $1 - \gamma$, $0 < \gamma < 1$. We assume that borrowers with safe and risky projects are distributed with density 2γ and $2(1-\gamma)$ along the Hotelling line, respectively. As a result, two borrowers of the same type are located at a certain point of the Hotelling street. As will be explained in more detail later on, this assumption ensures costless formation of groups. Individual borrowers know about the type of their own and the other borrowers' investment projects. In case a project is successful it generates a return of $v > 0$ and zero otherwise. The success probability of safe and risky projects is given by p_S and p_R, respectively, with $0 < p_R < p_S < 1$. The returns of the projects are observable and contractible. We assume that borrowers must be monitored closely in order to prevent the diversion of the loan to consumption needs.[28]

The financial sector serving the borrowers consists of two representative microfi-

[28] We could as well assume that borrowers divert a certain part of their loans for household needs if not monitored. As a result, borrowers could only afford low quality inputs for their investment projects implying returns too low to pay back their loans.

nance institutions A and B that are located at the two ends of the Hotelling line. In our model, both microfinance institutions are profitable and compete with each other. Note that the profitability of microfinance institutions has risen considerably over the last few years (Christen and Cook (2001)). Some microfinance institutions are now even listed at stock exchanges, such as Compartamos in Mexico or Equity Bank in Kenya. Furthermore, due to the immense growth of the microfinance industry, in many countries, there is now fierce competition between microfinance institutions (Fernando (2007), McIntosh et al. (2005), and Christen and Rhyne (1999)).

Microfinance institutions A and B compete in the repayments they simultaneously ask from borrowers. Microfinance institutions incur refinancing costs $c > 0$ per loan of size i. We take it as given that each microfinance institution disposes of enough funds to finance all borrowers applying for a loan. Microfinance institutions do not know whether borrowers have safe or risky projects.

A microfinance institution may choose to offer either group or individual loans. We abstract from the possibility that a bank offers both group and individual contracts. In fact, most microfinance institutions offer either one or the other type of loan as is pointed out in Ahlin and Townsend (2007), Giné and Karlan (2006) as well as Madajewicz (2008).

If a microfinance institution opts for the group lending technology, loans are offered to groups consisting of two borrowers each. Note that limiting the group size to two borrowers is a standard assumption in the literature and greatly simplifies our analysis (see, for instance, Ghatak (2000) or Laffont and N'Guessan (2000)). Group contracts imply a transfer of the monitoring role to the group members. Due to joint liability, group members have a strong incentive to monitor each other in order to ensure the correct investment of the loan and to make their partners succeed. We assume that due to close social ties between group members, borrowers monitor each other at zero cost.[29] The size of a loan a group receives is $2i$ so that each borrower receives an amount i of the loan. In case both group members are successful, the loan is fully paid back with interest. If both partners fail, no repayments are made. In the case that only one of the two group members is successful, the successful borrower pays back her part of the loan plus interest and, in addition, the loan share of her peer with interest,

[29] One might argue that borrowers incur costs of monitoring. However, the monitoring costs should clearly be lower for borrowers than for banks due to strong social ties between borrowers (Karlan (2007)). By normalizing monitoring costs of borrowers to zero, our results remain qualitatively unaffected.

weighed by a joint liability parameter $\lambda > 0$. The joint liability parameter expresses the degree of joint liability to which group members stand in for each other. Microfinance institutions compete both in interest rates and the joint liability parameters. Microfinance institutions can induce self-selection of borrowers by offering two different contracts. A contract with a low interest rate r_S and a high degree of joint liability λ_S will attract safe borrowers whereas risky borrowers prefer a contract with a high interest rate r_R and a low joint liability factor λ_R.[30] Borrowers incur some disutility d from group lending. The disutility d captures drawbacks of group loans such as time spent on finding a partner and group meetings (Armendáriz de Aghion and Morduch (2000)), the higher risk borrowers bear due to joint liability (Stiglitz (1990)) or social costs of repayment pressure (Montgomery (1996)). Borrowers may also suffer from reduced privacy when disclosing details of their investment project or their financial situation to their peers (Harper (2007)).

In the case a microfinance institution decides to offer individual loans, it has no mechanism at hand to assess a borrower's type. Note, first, that a collateralized contract cannot be offered since borrowers lack any pledgeable assets. Second, screening borrowers is not an option as potential clients are unable to provide hard information. Hence, microfinance institutions offer a pooling contract with repayment rate r_{SR} per credit of size i. In order to prevent the diversion of the loan for consumption needs once it is received, microfinance institutions need to closely monitor clients. This imposes a per borrower cost of k on the microfinance institution.[31] The crucial role of closely monitoring clients in individual lending programs has been stressed, for instance, by Champagne et al. (2007) as well as Zeitinger (1996). Armendáriz de Aghion and Morduch (2000) and Dellien et al. (2005) confirm the importance of regularly visiting clients in individual lending schemes.

Borrowers base their decision at which microfinance institution to apply for credit on the repayments r^j, $j = A, B$, and the joint liability factors λ^j asked by the microfinance institutions as well as on the transport costs they incur by travelling to a microfinance institution. We assume that transport costs tx are proportional to the distance x between the borrower and the microfinance institution. If borrowers apply for a group contract, transportation costs arise for both group members. Furthermore, we assume that the return of a project v is high enough so that the market is covered at equilibrium

[30] See Ghatak (2000), Stiglitz (1990) or Van Tassel (1999) for a similar set-up.

[31] Evidence for larger costs per loan in case of individual compared to group lending schemes is provided by Giné and Karlan (2006). They find that credit officers spend more time per borrower when individual contracts are offered.

prices. Borrowers and microfinance institutions are risk neutral and maximize profits.

The time structure of the game is as follows. At stage 1, microfinance institutions decide which lending technology to apply and simultaneously set interest rates and joint liability parameters. At stage 2, borrowers decide at which institution to apply for credit and form groups when applying for a group contract. At stage 3, returns realize and borrowers make repayments if they have been successful. We solve the game by backward induction.

3.4 Choice of Lending Technology

In this section, we derive the choice of lending technology of microfinance institutions. Both institutions can pursue the lending strategy "group loans" (G) or "individual loans" (I). In order to solve the game we compare the profit of a microfinance institution in case it offers group loans to the case it grants individual loans given that its competitor, firstly, offers group loans and, secondly, concedes individual loans.

Both Microfinance Institutions Offer Group Loans

If both microfinance institutions offer group contracts, borrowers form groups of two borrowers each in order to apply for a loan. Before we turn to the profits of microfinance institutions when they both offer group loans, we show that a borrower group always consists of borrowers of the same type.

Consider, first, a safe borrower forming a group with another safe borrower. Any contract with interest rate r and degree of joint liability λ gives the borrower a utility

$$U_{S,S} = i + p_S^2[v - (1+r)\,i] + p_S\,(1-p_S)\,[v - (1+r)\,i - \lambda\,(1+r)\,i] - tx - d. \quad (3.1)$$

That is, the safe borrower receives her part of the credit, i. With probability p_S^2 both group members are successful so that the borrower receives return v and pays back her part of the loan with interest $(1+r)\,i$. With probability $p_S\,(1-p_S)$ the borrower is successful but her group partner is not. Then, the borrower pays back her part of the loan with interest $(1+r)\,i$ and also stands in for her group partner with the amount

$\lambda(1+r)i$. If the borrower is unsuccessful, her return is zero and she does not make any repayments to the microfinance institution. The borrower's utility is reduced by the costs for travelling to the microfinance institution tx and the disutility related to group contracts d.

When the safe borrower has a risky partner, her utility from any contract with interest rate r and degree of joint liability λ is given by

$$U_{S,R} = i + p_S p_R[v - (1+r)i] + p_S(1-p_R)[v - (1+r)i - \lambda(1+r)i] - tx - d. \quad (3.2)$$

Now, both group members are successful with probability $p_S p_R$. Then, the safe borrower receives return v and pays back her part of the loan with interest $(1+r)i$. With probability $p_S(1-p_R)$, the safe borrower is successful but her risky partner is not. In that case, the safe borrower pays back her part of the loan with interest $(1+r)i$ and, in addition, the amount $\lambda(1+r)i$ in lieu of her risky partner.

The difference in a safe borrower's utility stemming from the formation of a group with a safe versus a risky borrower is given by $U_{S,S} - U_{S,R} = \lambda p_S(p_S - p_R)(1+r)i$. This expression is clearly positive. Hence, a safe borrower always prefers to be part of a group with a borrower of her own type.

Second, let us look at the preferences of a risky borrower concerning her partner. The utility of a risky borrower when having a risky peer amounts to

$$U_{R,R} = i + p_R^2[v - (1+r)i] + p_R(1-p_R)[v - (1+r)i - \lambda(1+r)i] - tx - d. \quad (3.3)$$

With probability p_R^2 both group members are successful. The borrower receives return v and pays back her part of the loan with interest $(1+r)i$. With probability $p_R(1-p_R)$ the borrower is successful but her partner is not. Then, the borrower pays back her part of the loan with interest $(1+r)i$ and, in addition, she stands in for her peer with the amount $\lambda(1+r)i$.

When a risky borrower forms a group with a safe borrower, she attains the utility level

$$U_{R,S} = i + p_R p_S[v - (1+r)i] + p_R(1-p_S)[v - (1+r)i - \lambda(1+r)i] - tx - d. \quad (3.4)$$

Now, projects of both borrowers turn out to be successful with probability $p_R p_S$.

In that case, the risky borrower pays back her part of the loan with interest $(1+r)\,i$. With probability $p_R\,(1-p_S)$, only the risky borrower is successful. Then, the risky borrower pays back her part of the loan with interest $(1+r)\,i$ and, in addition, the amount $\lambda\,(1+r)\,i$ for her partner.

The difference in the utility of a risky borrower when being part of a group with a risky versus a safe borrower amounts to $U_{R,R}-U_{R,S}=-\lambda p_R\,(p_S-p_R)\,(1+r)\,i$. As this expression is negative, a risky borrower clearly prefers to have a safe borrower as her partner. However, as safe borrowers prefer to form groups with safe borrowers, risky borrowers will not find a safe borrower willing to form a group with them. As a consequence, risky borrowers form groups with partners of their own type as well. Note that our assumption concerning the density of the borrowers' distribution along the Hotelling line ensures that two borrowers of the same type are located at a certain point of the Hotelling street. Since we have shown that borrowers form groups with borrowers of their own type, we can abstract from costs related to the formation of groups such as costs of searching for a partner.

Let us now turn to the profits microfinance institutions achieve when they both offer group contracts. Microfinance institutions can induce self-selection of borrowers according to their types into two different kinds of contracts. Safe borrower will accept a contract defined by a low interest rate r_S and a high degree of joint liability λ_S. In contrast, risky borrowers prefer a loan contract based on a high interest rate r_R and a low joint liability factor λ_R. Both interest rates and the joint liability factors are set endogenously. In the Appendix we show that contracts indeed exist that achieve self-selection of borrowers (see proof of Lemma 3.1).[32]

When borrowers decide about where to apply for credit, they compare the utility they obtain when borrowing from microfinance institution A to the utility level they achieve when accepting a loan from microfinance institution B. The resulting marginal borrowers in the segment of safe and risky borrowers $x_S\,(G,G)$ and $x_R\,(G,G)$, respectively, determine the microfinance institutions' profits as given below. Note that throughout this chapter, the first letter in brackets stands for the strategy pursued by microfinance institution A and the second letter for the strategy followed by microfinance institution B.

[32] In the Appendix, we show that an equilibrium in which no self-selection of borrowers is achieved also exists. However, in our analysis, we focus on separating equilibria. It seems realistic to assume that the generation of information about borrowers is always beneficial to banks. For instance, information about borrowers may be valuable for additional products offered to borrowers or in a dynamic model set-up.

$$\pi^A(G,G) = \gamma x_S(G,G)[2p_S^2(1+r_S^A) + 2p_S(1-p_S)(1+\lambda_S^A)(1+r_S^A) - 2(1+c)]i+$$
$$(1-\gamma)x_R(G,G)[2p_R^2(1+r_R^A) + 2p_R(1-p_R)(1+\lambda_R^A)(1+r_R^A) - 2(1+c)]i \qquad (3.5)$$

$$\pi^B(G,G) = \gamma[1-x_S(G,G)][2p_S^2(1+r_S^B) + 2p_S(1-p_S)(1+\lambda_S^B)(1+r_S^B) - 2(1+c)]i+$$
$$(1-\gamma)[1-x_R(G,G)][2p_R^2(1+r_R^B) + 2p_R(1-p_R)(1+\lambda_R^B)(1+r_R^B) - 2(1+c)]i. \qquad (3.6)$$

Due to our assumption concerning the distribution of borrowers, in the case of group lending, a certain point on the Hotelling line represents a group consisting of two borrowers. Hence, microfinance institution A serves $\gamma x_S\left(G,G\right)$ safe and $\left(1-\gamma\right)x_R\left(G,G\right)$ risky clients. With probability p_S^2, both members of a group of safe borrowers succeed so that the microfinance institution receives $2\left(1+r_S^A\right)i$. With probability $2p_S\left(1-p_S\right)$, the project of only one group member turns out to be successful. Then, the successful borrower stands in for her partner and repays the amount $\left(1+\lambda_S^A\right)\left(1+r_S^A\right)i$. No repayments are made if both group members fail which happens with probability $\left(1-p_S\right)^2$. Microfinance institutions incur refinancing costs $2\left(1+c\right)i$ per group of borrowers. Similar considerations hold for the market share the microfinance institution holds in the segment of risky borrowers. The profit of microfinance institution B is derived analogously.

Both microfinance institutions maximize their profit with respect to the interest rates and the degree of joint liability they demand from the two types of borrowers. The resulting equilibrium profits are stated in Lemma 3.1.

Lemma 3.1 *If both microfinance institutions offer group loan contracts, equilibrium profits of microfinance institutions are given by*

$$\pi^A\left(G,G\right) = \pi^B\left(G,G\right) = t. \qquad (3.7)$$

Proof: see Appendix.

Both Microfinance Institutions Offer Individual Loans

We now analyze the situation in which both microfinance institutions offer individual loans. Borrowers compare the utility they achieve when borrowing from microfinance institution A to the utility they obtain when funded by microfinance institution B. The resulting marginal borrowers in the segment of safe and risky borrowers $x_S(I,I)$ and $x_R(I,I)$, respectively, determine the profits of microfinance institutions given as follows:

$$\begin{aligned}\pi^A(I,I) = {} & 2\gamma x_S(I,I)\left[p_S\left(1+r_{SR}^A\right)i-(1+c)\,i-k\right]+ \\ & 2(1-\gamma)\,x_R(I,I)\left[p_R\left(1+r_{SR}^A\right)i-(1+c)\,i-k\right]\end{aligned} \tag{3.8}$$

$$\begin{aligned}\pi^B(I,I) = {} & 2\gamma[1-x_S(I,I)][p_S\left(1+r_{SR}^B\right)i-(1+c)\,i-k]+ \\ & 2(1-\gamma)\,[1-x_R(I,I)][p_R\left(1+r_{SR}^B\right)i-(1+c)\,i-k].\end{aligned} \tag{3.9}$$

Due to our assumptions concerning the borrowers' distribution, a certain point on the Hotelling line represents two borrowers in the case of individual lending. Hence, microfinance institution A serves $2\gamma x_S(I,I)$ safe and $2(1-\gamma)\,x_R(I,I)$ risky borrowers. Microfinance institution A charges the pooled lending rate r_{SR}^A to both safe and risky clients. It receives the amount $\left(1+r_{SR}^A\right)i$ from safe borrowers with probability p_S and from risky borrowers with probability p_R. Monitoring clients amounts to a per borrower cost of k. Microfinance institutions incur refinancing costs of $(1+c)\,i$ per client. The profit of microfinance institution B is derived analogously.

Both microfinance institutions maximize their profit with respect to the interest rates they charge borrowers. Our results are stated in Lemma 3.2.

Lemma 3.2 *If both microfinance institutions offer individual loan contracts, equilibrium profits of microfinance institutions are given by*

$$\pi^A(I,I)=\pi^B(I,I)=\frac{t[\gamma p_S+p_R(1-\gamma)]^2-\gamma(p_S-p_R)^2(1-\gamma)[k+(1+c)i]}{\gamma p_S^2+(1-\gamma)p_R^2}. \tag{3.10}$$

Proof: see Appendix.

Microfinance Institution A Offers Individual Loans and Microfinance Institution B Offers Group Loans

Let us now turn to the situation in which microfinance institution A offers individual loan contracts and microfinance institution B offers group loans. The marginal borrowers in the safe and risky market segment $x_S(I,G)$ and $x_R(I,G)$, respectively, determine the profits of microfinance institutions. Analogous to our reasoning above, profits of both microfinance institutions are now given as follows:

$$\pi^A(I,G) = 2\gamma x_S(I,G)[p_S(1+r_{SR}^A)i - (1+c)i - k] + \\ 2(1-\gamma)x_R(I,G)[p_R(1+r_{SR}^A)i - (1+c)i - k] \tag{3.11}$$

$$\pi^B(I,G) = \gamma[1-x_S(I,G)][2p_S^2(1+r_S^B) + 2p_S(1-p_S)(1+\lambda_S^B)(1+r_S^B) - 2(1+c)]i + \\ (1-\gamma)[1-x_R(I,G)][2p_R^2(1+r_R^B) + 2p_R(1-p_R)(1+\lambda_R^B)(1+r_R^B) - 2(1+c)]i. \tag{3.12}$$

Both microfinance institutions set interest rates and microfinance institution B, in addition, the joint liability factors in order to maximize profit. The resulting equilibrium profits are stated in Lemma 3.3.

Lemma 3.3 *If microfinance institution A offers individual loan contracts and microfinance institution B offers group loans, equilibrium profits of both microfinance institutions are given by*

$$\pi^A(I,G) = \frac{2[\gamma p_S + p_R(1-\gamma)]^2(d-k+3t)^2 - 9\gamma(p_S-p_R)^2(1-\gamma)[k+(1+c)i][d+3t+(1+c)i]}{18t[\gamma p_S^2 + (1-\gamma)p_R^2]} \tag{3.13}$$

$$\pi^B(I,G) = \frac{4[\gamma p_S + p_R(1-\gamma)]^2(d-k-3t)^2 + 9\gamma(p_S-p_R)^2(1-\gamma)[d-t+(1+c)i]^2}{36t[\gamma p_S^2 + (1-\gamma)p_R^2]}. \tag{3.14}$$

Proof: see Appendix.

Microfinance Institution A Offers Group Loans and Microfinance Institution B Offers Individual Loans

Clearly, this case is symmetric to the situation described before. For the sake of completeness, the equilibrium profits of both microfinance institutions are stated in Lemma 3.4.

Lemma 3.4 *If microfinance institution A offers group contracts and microfinance institution B offers individual loans, equilibrium profits of both microfinance institutions are given by*

$$\pi^A(G,I) = \frac{4[\gamma p_S + p_R(1-\gamma)]^2(d-k-3t)^2 + 9\gamma(p_S-p_R)^2(1-\gamma)[d-t+(1+c)i]^2}{36t[\gamma p_S^2+(1-\gamma)p_R^2]} \tag{3.15}$$

$$\pi^B(G,I) = \frac{2[\gamma p_S + p_R(1-\gamma)]^2(d-k+3t)^2 - 9\gamma(p_S-p_R)^2(1-\gamma)[k+(1+c)i][d+3t+(1+c)i]}{18t[\gamma p_S^2+(1-\gamma)p_R^2]}. \tag{3.16}$$

Proof: analogous to proof of Lemma 3.3.

Nash Equilibrium

We now turn to the Nash equilibrium in this market. We determine microfinance institution A's best response both given that microfinance institution B offers group loans and individual contracts. With respect to microfinance institution B, we proceed analogously. Due to reasons of symmetry, we limit our exposition to the point of view of microfinance institution A. The matrix of the game is given in Figure 3.1.

		B	
		Group Loans	Individual Loans
A	Group Loans	$\pi^A(G,G), \pi^B(G,G)$	$\pi^A(G,I), \pi^B(G,I)$
	Individual Loans	$\pi^A(I,G), \pi^B(I,G)$	$\pi^A(I,I), \pi^B(I,I)$

Figure 3.1: Matrix of the Game

Given that microfinance institution B offers group loans, microfinance institution A offers individual contracts if $\pi^A(I,G) - \pi^A(G,G) > 0$ holds. Our results are stated in Proposition 3.1.

Proposition 3.1 *Given that microfinance institution B offers group loans, microfinance institution A offers individual loan contracts if $\pi^A(I,G) - \pi^A(G,G) > 0$ holds. That is, if*

$$\begin{aligned} &9\gamma\left(p_S - p_R\right)^2 (1-\gamma)\left[(k+i+ci)(d+i+ci) + (3k+2t+3i+3ci)\,t\right] - \\ &2\left(p_R + \gamma p_S - \gamma p_R\right)^2 (d-k)(d-k+6t) < 0. \end{aligned} \tag{3.17}$$

Proof: straight forward.

Given that microfinance institution B offers individual loans, microfinance institution A offers individual contracts if $\pi^A(I,I) - \pi^A(G,I) > 0$ holds. Our results are given in Proposition 3.2.

Proposition 3.2 *Given that microfinance institution B offers individual loans, microfinance institution A offers individual contracts if $\pi^A(I,I) - \pi^A(G,I) > 0$ holds. That is, if*

$$\begin{aligned} &9\gamma\left(p_S - p_R\right)^2 (1-\gamma)\left[(d+i+ci)^2 + (4k-2d+t+2i+2ci)\,t\right] - \\ &4\left(p_R + \gamma p_S - \gamma p_R\right)^2 (6t-d+k)(d-k) < 0. \end{aligned} \tag{3.18}$$

Proof: straight forward.

We cannot unambiguously determine whether the above two expressions are positive or negative. That is why we now turn to a comparative statics analysis. In doing so, we gain interesting insights in how the choice of lending technology is influenced by the size of credit, the refinancing conditions of microfinance institutions and the competitive pressure of the market environment.

3.5 Comparative Statics Analysis

The first focus of our comparative statics analysis lies on the impact of the loan size for a microfinance institution's decision to grant individual or group loans. Controversial arguments are brought forward in the so far rather descriptive literature on this topic. For instance, Kota (2007) and Harper (2007) state that microfinance institutions offer individual contracts if clients are in need for larger loans. In contrast, Giné and Karlan (2006) advocate precisely the reverse correlation. Our analysis aims to contribute to a theoretical foundation of this discussion.

We are further interested in how a microfinance institution's choice of lending technology depends on refinancing conditions and competitive pressure in the microfinance market. According to Isern and Porteous (2005) as well as Reddy and Rhyne (2006), the world of microfinance currently changes substantially in both these respects. Microfinance institutions get increasingly better access to capital markets which should transform into improved refinancing conditions. In addition, competition among microfinance banks steadily intensifies, in large part due to the enormous growth of the industry. Our analysis provides a theoretical framework that allows us to study in detail how changes in refinancing conditions and competition affect a microfinance institution's lending strategy.

3.5.1 Size of Credit

When we look at the role of the loan size, interestingly, we find that a microfinance institution prefers to offer individual contracts when the size of credit is rather small, irrespective of whether its competitor grants individual or group loans. Conversely, when a loan is relatively large, microfinance institutions favor the group lending technology. Our results are stated in Proposition 3.3.

Proposition 3.3 *Microfinance institutions offer individual contracts when a loan is rather small. Group contracts are preferred by microfinance institutions when a loan is rather large. That is,*

$$\pi^A(I,G) - \pi^A(G,G) > 0 \ \text{ if } \ i < i_1 \ \text{ and } \ \pi^A(I,G) - \pi^A(G,G) < 0 \ \text{ if } \ i > i_1 \quad (3.19)$$

$$\pi^A(I,I) - \pi^A(G,I) > 0 \ \text{ if } \ i < i_2 \ \text{ and } \ \pi^A(I,I) - \pi^A(G,I) < 0 \ \text{ if } \ i > i_2 \quad (3.20)$$

$$\pi^B(G,I) - \pi^B(G,G) > 0 \ \text{ if } \ i < i_1 \ \text{ and } \ \pi^B(G,I) - \pi^B(G,G) < 0 \ \text{ if } \ i > i_1 \quad (3.21)$$

$$\pi^B(I,I) - \pi^B(I,G) > 0 \ \text{ if } \ i < i_2 \ \text{ and } \ \pi^B(I,I) - \pi^B(I,G) < 0 \ \text{ if } \ i > i_2. \quad (3.22)$$

Proof: see Appendix.

Hence, given that microfinance institution B offers group loans, the incentives of microfinance institution A to offer individual instead of group loans will be the smaller, the larger the loan size. Note that by granting individual loans, microfinance institution A suffers more from a borrower's default than by offering group loans due to the lack of joint liability. The larger a loan is, the relatively more microfinance institution A suffers from defaulting borrowers when conceding individual instead of group loans. Hence, given that the competing microfinance institution engages in group lending, offering individual contracts only pays up to a certain amount of the loan size.

The situation of microfinance institution A given that microfinance institution B offers individual loans is similar. The relative loss from a borrower's default when offering individual compared to group contracts becomes the larger, the larger a loan is. Hence, the larger the loan size, the higher a microfinance institution's incentives are to offer group instead of individual loans given that its competitor grants individual loans.

Consequently, irrespective of whether microfinance institution B offers group or individual loans, the group lending technology becomes more attractive for microfinance institution A with an increasing loan size. Analogous arguments hold for microfinance institution B. Accordingly, a Nash equilibrium in which both microfinance institutions offer group contracts tends to emerge when the size of a credit is rather large. With a rather small loan size, an equilibrium in which both microfinance institutions offer individual loans is more likely to result.

Our findings contradict the point of view of authors such as Kota (2007) and Harper (2007). In a theoretical analysis, Madajewicz (2008) shows that individual loans tend to be larger than group loans. However, her result only holds for borrowers that already have accumulated a certain level of wealth. For low levels of individual wealth, she demonstrates that group loans are larger than individual loans. In line with our results, Giné and Karlan (2006) conclude from their empirical study that the loan size is smaller for individual than for group contracts. However, their argument is somewhat different. They state that when credit officers concede individual loans, they alone assume the monitoring role and, thus, bear a higher responsibility. This is why they argue that credit officers may be stricter on the size of individual loans.

3.5.2 Refinancing Conditions

We now turn to the impact of refinancing conditions on a microfinance institution's choice of lending technology. We find that when refinancing costs are relatively low, a microfinance institution favors individual over group contracts, irrespective of the behavior of its competitor. Conversely, group loans tend to be preferred when refinancing costs are rather high. Our results are stated in Proposition 3.4.

Proposition 3.4 *Microfinance institutions offer individual contracts when refinancing costs are rather low. Group loans are preferred in the presence of rather high refinancing costs. That is,*

$$\pi^A(I,G) - \pi^A(G,G) > 0 \text{ if } c < c_1 \text{ and } \pi^A(I,G) - \pi^A(G,G) < 0 \text{ if } c > c_1 \quad (3.23)$$

$$\pi^A(I,I) - \pi^A(G,I) > 0 \text{ if } c < c_2 \text{ and } \pi^A(I,I) - \pi^A(G,I) < 0 \text{ if } c > c_2 \quad (3.24)$$

$$\pi^B(G,I) - \pi^B(G,G) > 0 \text{ if } c < c_1 \text{ and } \pi^B(G,I) - \pi^B(G,G) < 0 \text{ if } c > c_1 \quad (3.25)$$

$$\pi^B(I,I) - \pi^B(I,G) > 0 \text{ if } c < c_2 \text{ and } \pi^B(I,I) - \pi^B(I,G) < 0 \text{ if } c > c_2. \quad (3.26)$$

Proof: see Appendix.

Given that microfinance institution B offers group loans, microfinance institution A's incentives to offer individual instead of group loans will be the smaller, the higher refinancing costs are. Similar to above, the larger refinancing costs are, the relatively more microfinance institution A suffers from a borrower's default when granting individual instead of group loans due to the lack of joint liability. Hence, offering individual loans given that the competing microfinance institution offers group loans is feasible only in the presence of rather low refinancing costs.

The same reasoning applies to the situation of microfinance institution A given that microfinance institution B offers individual loans. The relative losses from a borrower's default when individual instead of group loans are offered become the larger, the higher refinancing costs are. Hence, a microfinance institution favors group over individual loans in the presence of rather high refinancing costs, given that its competitor offers individual loans.

Consequently, irrespective of whether microfinance institution B offers group or individual loans, the group lending technology becomes more attractive for microfinance institution A when refinancing costs increase. Clearly, the same arguments apply to microfinance institution B. Thus, a Nash equilibrium in which both microfinance institutions offer group contracts tends to emerge in the presence of rather high refinancing costs. When refinancing costs are rather low, an equilibrium in which both microfinance institutions offer individual loans is more likely to result.

The emergence of rating agencies specialized in the evaluation of microfinance institutions and the growing awareness of the industry's potential makes investors channel more and more funds into this market. By now, some microfinance institutions are listed at stock exchanges, such as Compartamos in Mexico or Equity Bank in Kenya. Clearly, enhanced access to capital markets implies reduced refinancing costs. Given a continuation of this trend, interestingly, our model predicts that individual lending schemes in microfinance will gain in importance in the future.

3.5.3 Competitive Pressure

Finally, we analyze the influence of competition on a microfinance institution's choice of lending technology. The competitive pressure of the market environment can be expressed by the inverse of transportation cost, $\frac{1}{t}$. Note that the larger the transportation cost parameter t and the more costly it becomes for borrowers to travel to a microfinance institution, the less intense price competition will be between microfinance institutions. Conversely, the lower t is, the stronger is competition.

We find that with increasing competitive pressure, a microfinance institution prefers to offer individual contracts, irrespective of whether its competitor grants individual or group loans. Conversely, the less intense competition is, the more attractive group lending becomes for microfinance institutions. Our results are stated in Proposition 3.5.

Proposition 3.5 *If the market environment is rather competitive, microfinance institutions prefer to grant individual loans. Group loans are offered if competitive pressure is rather low. That is,*

$$\pi^A(I,G) - \pi^A(G,G) > 0 \text{ if } t < t_1 \text{ and } \pi^A(I,G) - \pi^A(G,G) < 0 \text{ if } t > t_1 \quad (3.27)$$

$$\pi^A(I,I) - \pi^A(G,I) > 0 \text{ if } t < t_2 \text{ and } \pi^A(I,I) - \pi^A(G,I) < 0 \text{ if } t > t_2 \quad (3.28)$$

$$\pi^B(G,I) - \pi^B(G,G) > 0 \text{ if } t < t_1 \text{ and } \pi^B(G,I) - \pi^B(G,G) < 0 \text{ if } t > t_1 \quad (3.29)$$

$$\pi^B(I,I) - \pi^B(I,G) > 0 \text{ if } t < t_2 \text{ and } \pi^B(I,I) - \pi^B(I,G) < 0 \text{ if } t > t_2. \quad (3.30)$$

Proof: see Appendix.

The intuition of this result is as follows. Consider, first, the situation of microfinance institution A given that microfinance institution B offers group contracts. If microfinance institution A offers individual loans, the pooled interest rate it charges decreases with increasing competition. The repayments asked by microfinance institution B also decline when competition becomes stronger. However, the fall in the repayments is more pronounced for risky than for safe borrowers. Hence, microfinance institution B loses in attractiveness for safe borrowers whereas microfinance institution A becomes relatively more attractive for this borrower segment. Accordingly, the quality of microfinance institution A's borrower pool will improve. As a consequence, the more competitive the market environment is, the larger the incentives for a microfinance institution are to offer individual loans given that its competitor offers group loans.

Now, look at the case in which microfinance institution A offers group loans given that microfinance institution B offers individual loans. If competitive pressure increases, analogous to above, microfinance institution B becomes relatively more and microfinance institution A relatively less attractive for safe borrowers. Since, however, microfinance institution A receives larger overall repayments from safe than from risky borrowers, the incentives of microfinance institution A to offer individual loans increase with rising competition. Thus, the more intense competition is, the larger the incentives for a microfinance institution are to offer individual loans given that its competitor grants individual loans.

Consequently, irrespective of whether microfinance institution B offers group or individual loans, the individual lending technology becomes more attractive for microfinance institution A when competition toughens. Analogous considerations hold for microfinance institution B. Hence, a Nash equilibrium in which both microfinance institutions offer individual contracts tends to emerge when competition is intense. In contrast, in markets characterized by rather low competitive pressure, an equilibrium in which both microfinance institutions offer group loans is more likely to result.

According to Fernando (2007), McIntosh et al. (2005) and Christen and Rhyne (1999), markets for microfinance are often no more characterized by local monopolies of microfinance banks. Instead, due to the immense growth of the microfinance industry, there is now fierce competition between microfinance institutions in many countries. Given a continuation of this trend, interestingly, our analysis again predicts that individual lending techniques will play a more important role in the future. This hypothesis is in line with Dellien et al. (2005) who argue that due to rising competition, individual lending schemes already gained in importance over the last few years.

Summing up our findings from the comparative statics analysis, we conclude that a Nash equilibrium in which both microfinance institutions apply the group lending technology is the more likely to emerge when loans are rather large, refinancing costs are relatively high and competitive pressure is rather low. Otherwise, microfinance institutions favor individual loan contracts. Our results predict that when refinancing conditions continue to improve and competition rises further, individual lending schemes in microfinance will become more important in the future.

3.6 Empirical Hypotheses

Our model gives rise to several testable hypotheses concerning a microfinance institution's choice of lending technology.

We found that the smaller the loan size, the more likely it is that microfinance institutions offer individual loans. Hence, our first hypothesis is stated as follows.

Hypothesis 3.1 *Microfinance institutions are more likely to grant individual loans the smaller the size of a loan. The larger the amount of credit is, the more likely it is that microfinance institutions offer group loans.*

Next, we demonstrated that the lower refinancing costs are, the more microfinance institutions prefer to offer individual loans. This gives rise to our second hypothesis.

Hypothesis 3.2 *The higher refinancing costs are, the more likely it is that microfinance institutions offer group contracts. The lower refinancing costs are, the more likely microfinance institutions are to grant individual loans.*

Third, we showed that the more intense competition is, the more microfinance institutions tend to offer individual instead of group contracts. Based on this result, we formulate our third testable prediction.

Hypothesis 3.3 *Microfinance institutions are more likely to offer individual loans the stronger competition is. The lower the competitive pressure, the more microfinance institutions tend to offer group contracts.*

Data best suited for testing our hypotheses concerning a microfinance institution's lending strategy are cross country data. In that case, cultural effects that may influence a microfinance institution's choice of lending technology could be controlled for. Furthermore, panel data would render possible an analysis of how the relative importance of group and individual loans altered following past changes in refinancing conditions and competitive pressure in the market for microfinance.

3.7 Conclusions

In this chapter, we have set up a model of competition between microfinance institutions in order to study a microfinance bank's choice of lending technology. We found that microfinance institutions tend to prefer individual loans over group loans when the size of a loan is small, refinancing costs are low, and competition is intense.

Currently, microfinance institutions obtain increasingly better access to capital markets. Moreover, competition among microfinance institutions increases steadily. Given a continuation of these trends, our analysis predicts that individual lending schemes will become more important in the microfinance industry in the future.

Interestingly, when we interpret our results in the context of a recent trend in microfinance, namely upscaling and downscaling, we can give further predictions about future trends in the market for microfinance. On the one hand, microfinance institutions increasingly start to invest in traditional banking technologies such as screening techniques, a process called upscaling. On the other hand, commercial banks begin to downscale, i.e. to invest in microfinance technologies.

As mentioned earlier, microfinance banks typically offer either group or individual loans. Even more so, very often either group or individual loans dominate the market for microfinance in a given country or region (Madajewicz (2008)). Let us first consider an environment in which microfinance banks primarily offer group loans. Then, a microfinance bank would only have an incentive to invest in screening if this technique were better in terms of assessing a borrower's type than the group lending technology. Analogously, commercial banks would have an incentive to invest in group lending only if this technology would ensure a better evaluation of a borrower's type. Hence, in such a setting, upscaling and downscaling would constitute a form of substitutes.

Second, consider an environment characterized by microfinance banks granting individual loans. In such a situation, upscaling would allow a microfinance institution to (more or less effectively) assess a borrower's type through screening in addition to the realization of high repayment rates by using the microfinance monitoring technology. Similarly, a commercial bank would gain from downscaling since in addition to assessing a borrower's type via screening, it can ensure higher repayment rates due to the microfinance monitoring technology. Hence, in such a setting, upscaling and downscaling tend to work as a form of complements. As a consequence, the gains from upscaling and downscaling should be much higher in an environment where individual instead of group lending dominates the market for microfinance.

Coming back to our model, if due to rising competition and better access to capital markets individual loan contracts in microfinance will become more important in the future, this development may at the same time boost upscaling of microfinance institutions and downscaling of commercial banks.

Appendix to Chapter 1

Proof of Lemma 1.1:

The marginal borrower between bank A and B_1 and bank A and B_2 is given by

$x_{A,B_1}^{CBL} = \frac{1}{6} + \frac{r_{B_1}^{CBL} - r_A^{CBL}}{2t}$ and $x_{A,B_2}^{CBL} = \frac{1}{6} + \frac{r_{B_2}^{CBL} - r_A^{CBL}}{2t}$.

It follows that the market share of banks can be expressed by $m\phi_A^{CBL}$, $m\phi_{B_1}^{CBL}$ and $m\phi_{B_2}^{CBL}$ with $\phi_A^{CBL} \equiv \frac{1}{3} + \frac{r_{B_1}^{CBL} + r_{B_2}^{CBL} - 2r_A^{CBL}}{2t}$, $\phi_{B_1}^{CBL} \equiv \frac{1}{3} + \frac{r_A^{CBL} + r_{B_2}^{CBL} - 2r_{B_1}^{CBL}}{2t}$ and $\phi_{B_2}^{CBL} \equiv \frac{1}{3} + \frac{r_A^{CBL} + r_{B_1}^{CBL} - 2r_{B_2}^{CBL}}{2t}$.

Hence, banks' profit functions are given by

$$\pi_A^{CBL} = \left[\gamma \left(r_A^{CBL} - i_A\right) - (1-\gamma)(1-\alpha\mu\delta_A)(1+i_A)\right] m\phi_A^{CBL} - F_{CBL}$$
$$\pi_{B_j}^{CBL} = \left[\gamma \left(r_{B_j}^{CBL} - i_B\right) - (1-\gamma)(1-\delta_B)(1+i_B)\right] m\phi_{B_j}^{CBL}.$$

$\frac{d\pi_A^{CBL}}{dr_A^{CBL}} \overset{!}{=} 0$, $\frac{d\pi_{B_1}^{CBL}}{dr_{B_1}^{CBL}} \overset{!}{=} 0$, and $\frac{d\pi_{B_2}^{CBL}}{dr_{B_2}^{CBL}} \overset{!}{=} 0$ implies

$$\widetilde{r}_A^{CBL} = \frac{1}{5\gamma}\left\{\frac{5}{3}t\gamma + 2i_B + 3i_A + (1-\gamma)\left[5 - 2\delta_B(1+i_B) - 3\alpha\mu\delta_A(1+i_A)\right]\right\}$$
$$\widetilde{r}_{B_1}^{CBL} = r_{B_2}^{CBL} = \frac{1}{5\gamma}\left\{\frac{5}{3}t\gamma + 4i_B + i_A + (1-\gamma)\left[5 - 4\delta_B(1+i_B) - \alpha\mu\delta_A(1+i_A)\right]\right\} \equiv r_B^{CBL}$$

$$\pi_A^{CBL} = mt\gamma\left(\widetilde{\phi}_A^{CBL}\right)^2 - F_{CBL}$$
$$\pi_{B_1}^{CBL} = \pi_{B_2}^{CBL} = mt\gamma\left(\widetilde{\phi}_B^{CBL}\right)^2 \equiv \pi_B^{CBL}$$

with market shares $\widetilde{\phi}_A^{CBL} \equiv \frac{2}{5t\gamma}\left[\frac{5}{6}t\gamma + \Delta + \alpha\mu(1-\gamma)(1+i_A)\delta_A\right]$ and $\widetilde{\phi}_{B_1}^{CBL} = \widetilde{\phi}_{B_2}^{CBL} = \frac{1}{5t\gamma}\left[\frac{5}{3}t\gamma - \Delta - \alpha\mu(1-\gamma)(1+i_A)\delta_A\right] \equiv \widetilde{\phi}_B^{CBL}$ and $\Delta \equiv i_B - i_A - (1-\gamma)(1+i_B)\delta_B$.

Proof of Proposition 1.1:

Note that $\frac{d\pi_A^{CBL}}{d\delta_A} = \frac{4m\alpha\mu(1-\gamma)(1+i_A)}{5}\widetilde{\phi}_A^{CBL} > 0$ and $\frac{d^2\pi_A^{CBL}}{d\delta_A^2} = \frac{2m}{t\gamma}[\frac{2}{5}\alpha\mu\,(1-\gamma)\,(1+i_A)]^2 > 0$ so that π_A^{CBL} is increasing and convex in δ_A. Cross border lending is feasible for bank A if $\pi_A^{CBL} \geq 0$. Solving for bank A's screening ability yields

$$\delta_A \geq \frac{\frac{5}{2}\sqrt{\frac{t\gamma F_{CBL}}{m}}-\Delta-\frac{5}{6}t\gamma}{\alpha\mu(1-\gamma)(1+i_A)} \equiv \delta_A^{CBL}.$$

Note that since π_A^{CBL} is increasing and convex in δ_A it follows that $\arg\min_{\delta_A\in\mathbb{R}}\{\pi_A^{CBL}\} = -\frac{\frac{5}{6}t\gamma+\Delta}{\alpha\mu(1-\gamma)(1+i_A)} < 0$. Hence, $\frac{5}{6}t\gamma + \Delta > 0$ must hold. We will refer to this condition as

Condition (1): $\frac{5}{6}t\gamma + \Delta > 0.$

Proof of Lemma 1.2:

The marginal borrower between bank A and B_1 and bank A and B_2 is given by

$$x_{A,B_1}^{GR} = \frac{1}{6} + \frac{r_{B_1}^{GR}-r_A^{GR}}{2t} \text{ and } x_{A,B_2}^{GR} = \frac{1}{6} + \frac{r_{B_2}^{GR}-r_A^{GR}}{2t}.$$

It follows that the market shares of banks can be expressed by $m\phi_A^{GR}$, $m\phi_{B_1}^{GR}$ and $m\phi_{B_2}^{GR}$ with $\phi_A^{GR} \equiv \frac{1}{3} + \frac{r_{B_1}^{GR}+r_{B_2}^{GR}-2r_A^{GR}}{2t}$, $\phi_{B_1}^{GR} \equiv \frac{1}{3} + \frac{r_A^{GR}+r_{B_2}^{GR}-2r_{B_1}^{GR}}{2t}$ and $\phi_{B_2}^{GR} \equiv \frac{1}{3} + \frac{r_A^{GR}+r_{B_1}^{GR}-2r_{B_2}^{GR}}{2t}$.

Hence, banks' profit functions are given by

$$\pi_A^{GR} = \left[\gamma\left(r_A^{GR}-i_A\right) - (1-\gamma)\,(1-\mu\delta_A)\,(1+i_A)\right] m\phi_A^{GR} - F_{GR}$$
$$\pi_{B_j}^{GR} = \left[\gamma\left(r_{B_j}^{GR}-i_B\right) - (1-\gamma)\,(1-\delta_B)\,(1+i_B)\right] m\phi_{B_j}^{GR}.$$

$\frac{d\pi_A^{GR}}{dr_A^{GR}} \stackrel{!}{=} 0$, $\frac{d\pi_{B_1}^{GR}}{dr_{B_1}^{GR}} \stackrel{!}{=} 0$, and $\frac{d\pi_{B_2}^{GR}}{dr_{B_2}^{GR}} \stackrel{!}{=} 0$ implies

$$\widetilde{r}_A^{GR} = \frac{1}{5\gamma}\{\frac{5}{3}t\gamma + 2i_B + 3i_A + (1-\gamma)\,[5 - 2\delta_B\,(1+i_B) - 3\mu\delta_A\,(1+i_A)]\}$$
$$\widetilde{r}_{B_1}^{GR} = r_{B_2}^{GR} = \frac{1}{5\gamma}\{\frac{5}{3}t\gamma + 4i_B + i_A + (1-\gamma)\,[5 - 4\delta_B\,(1+i_B) - \mu\delta_A\,(1+i_A)]\} \equiv r_B^{GR}$$

$$\pi_A^{GR} = mt\gamma\left(\widetilde{\phi}_A^{GR}\right)^2 - F_{GR}$$

$$\pi_{B_1}^{GR} = \pi_{B_2}^{GR} = mt\gamma\left(\widetilde{\phi}_B^{GR}\right)^2 \equiv \pi_B^{GR}$$

with market shares $\widetilde{\phi}_A^{GR} \equiv \frac{2}{5t\gamma}[\frac{5}{6}t\gamma + \Delta + \mu(1-\gamma)(1+i_A)\delta_A]$ and $\widetilde{\phi}_{B_1}^{GR} = \widetilde{\phi}_{B_2}^{GR} = \frac{1}{5t\gamma}[\frac{5}{3}t\gamma - \Delta - \mu(1-\gamma)(1+i_A)\delta_A] \equiv \widetilde{\phi}_B^{GR}$.

Proof of Proposition 1.2:

Note that $\frac{d\pi_A^{GR}}{d\delta_A} = \frac{4m\mu(1-\gamma)(1+i_A)}{5}\widetilde{\phi}_A^{GR} > 0$ and $\frac{d^2\pi_A^{GR}}{d\delta_A^2} = \frac{2m}{t\gamma}[\frac{2}{5}\mu(1-\gamma)(1+i_A)]^2 > 0$. Further, due to $\widetilde{\phi}_B^{GR} > \widetilde{\phi}_B^{CBL}$ and $0 < \alpha < 1$ it holds that $\frac{d\pi_A^{GR}}{d\delta_A} > \frac{d\pi_A^{CBL}}{d\delta_A}$ and $\frac{d^2\pi_A^{GR}}{d\delta_A^2} > \frac{d^2\pi_A^{CBL}}{d\delta_A^2}$. Since it also holds that $\pi_A^{CBL}\ |_{\delta_A=0} = mt\gamma\{\frac{2}{5t\gamma}[\frac{5}{6}t\gamma + (i_B - i_A)]\}^2 - F_{CBL} > \pi_A^{GR}\ |_{\delta_A=0} = mt\gamma\{\frac{2}{5t\gamma}[\frac{5}{6}t\gamma + (i_B - i_A)]\}^2 - F_{GR}$ due to $F_{GR} > F_{CBL}$, it follows that only one intersection between π_A^{GR} and π_A^{CBL} is possible for $\delta_A > 0$. Greenfield entry is feasible for bank A in case of $\pi_A^{GR} \geq \pi_A^{CBL}$. Solving for bank A's screening ability yields

$$\delta_A \geq \frac{\sqrt{X_{GR}} - \Delta - \frac{5}{6}t\gamma}{\mu(1+\alpha)(1-\gamma)(1+i_A)} \equiv \delta_A^{GR}$$

with $X_{GR} \equiv (\Delta + \frac{5}{6}t\gamma)^2 + \frac{25t\gamma(1+\alpha)(F_{GR}-F_{CBL})}{4m(1-\alpha)}$.

Proof of Lemma 1.3:

The marginal borrower between bank A and B is given by $x_{A,B}^{AC} = \frac{1}{4} + \frac{r_B^{AC} - r_A^{AC}}{2t}$.

It follows that the market share of banks can be expressed by $m\phi_A^{AC}$ and $m\phi_B^{AC}$ with $\phi_A^{AC} \equiv \frac{1}{2} + \frac{r_B^{AC} - r_A^{AC}}{t}$ and $\phi_B^{AC} \equiv \frac{1}{2} + \frac{r_A^{AC} - r_B^{AC}}{t}$.

Hence, banks' profit functions are given by

$$\pi_A^{AC} = \left[\gamma\left(r_A^{AC} - i_A\right) - (1-\gamma)(1-\delta_A)(1+i_A)\right] m\phi_A^{AC} - F_{AC} - P_{AC}$$
$$\pi_B^{AC} = \left[\gamma\left(r_B^{AC} - i_B\right) - (1-\gamma)(1-\delta_B)(1+i_B)\right] m\phi_B^{AC}.$$

$\frac{d\pi_A^{AC}}{dr_A^{AC}} \overset{!}{=} 0$ and $\frac{d\pi_B^{AC}}{dr_B^{AC}} \overset{!}{=} 0$ implies

$$\widetilde{r}_A^{AC} = \frac{1}{3\gamma}\{\frac{3}{2}t\gamma + i_B + 2i_A + (1-\gamma)[3 - \delta_B(1+i_B) - 2\delta_A(1+i_A)]\}$$
$$\widetilde{r}_B^{AC} = \frac{1}{3\gamma}\{\frac{3}{2}t\gamma + 2i_B + i_A + (1-\gamma)[3 - 2\delta_B(1+i_B) - \delta_A(1+i_A)]\}$$

$\pi_A^{AC} = mt\gamma\{\left(\widetilde{\phi}_A^{AC}\right)^2\} - P_{AC} - F_{AC}$

$\pi_B^{AC} = mt\gamma\left(\widetilde{\phi}_B^{AC}\right)^2$

with $\widetilde{\phi}_A^{AC} = \frac{1}{3t\gamma}[\frac{3}{2}t\gamma+\Delta+(1-\gamma)(1+i_A)\delta_A]$ and $\widetilde{\phi}_B^{AC} = \frac{1}{3t\gamma}[\frac{3}{2}t\gamma-\Delta-(1-\gamma)(1+i_A)\delta_A]$.

Proof of Proposition 1.3:

Derivation of Domestic Banks' Profits with no Foreign Bank Entry

The marginal borrower between bank B_1 and B_2 is given by $x_{B_1,B_2}^{NE} = \frac{1}{4} + \frac{r_{B_2}^{NE}-r_{B_1}^{NE}}{2t}$.

It follows that the market share of banks can be expressed by $m\phi_{B_1}^{NE}$ and $m\phi_{B_2}^{NE}$ with $\phi_{B_1}^{NE} \equiv \frac{1}{2} + \frac{r_{B_2}^{NE}-r_{B_1}^{NE}}{t}$ and $\phi_{B_2}^{NE} \equiv \frac{1}{2} - \frac{r_{B_2}^{NE}-r_{B_1}^{NE}}{t}$.

Hence, banks' profit functions are given by

$\pi_{B_1}^{NE} = \left[\gamma\left(r_{B_1}^{NE} - i_B\right) - (1-\gamma)(1-\delta_B)(1+i_B)\right] m\phi_{B_1}^{NE}$

$\pi_{B_2}^{NE} = \left[\gamma\left(r_{B_2}^{NE} - i_B\right) - (1-\gamma)(1-\delta_B)(1+i_B)\right] m\phi_{B_2}^{NE}$.

$\frac{d\pi_{B_1}^{NE}}{dr_{B_1}^{NE}} \overset{!}{=} 0$ and $\frac{d\pi_{B_2}^{NE}}{dr_{B_2}^{NE}} \overset{!}{=} 0$ implies

$\widetilde{r}_{B_1}^{NE} = \widetilde{r}_{B_2}^{NE} = \frac{1}{2\gamma}[t\gamma + 2i_B + 2(1-\delta_B(1+i_B))(1-\gamma)] \equiv \widetilde{r}_B^{NE}$

$\pi_{B_1}^{NE} = \pi_{B_2}^{NE} = \frac{mt\gamma}{4} \equiv \pi_B^{NE}$.

Derivation of δ_A^{AC}

Note, first, that it is useful to show that (1) $\frac{d\pi_A^{AC}}{d\delta_A} > \frac{d\pi_A^{CBL}}{d\delta_A}$ in the range of $\delta_A^{CBL} \le \delta_A < \delta_A^{GR}$ and (2) $\frac{d\pi_A^{AC}}{d\delta_A} > \frac{d\pi_A^{GR}}{d\delta_A}$ in the range of $\delta_A^{GR} \le \delta_A < 1$:

(1) proof of $\frac{d\pi_A^{AC}}{d\delta_A} > \frac{d\pi_A^{CBL}}{d\delta_A}$ for $\delta_A^{CBL} \le \delta_A < \delta_A^{GR}$

Note that $\frac{d\pi_A^{AC}}{d\delta_A} = 2m(1-\gamma)(1+i_A)\left(\frac{1}{3}\widetilde{\phi}_A^{AC} + \frac{1}{5}\alpha\mu\widetilde{\phi}_B^{CBL}\right) > 0$ and $\frac{d^2\pi_A^{AC}}{d\delta_A^2} = 2\frac{m}{t\gamma}(1-\gamma)^2(1+i_A)^2\left(\frac{1}{9} - \frac{1}{25}\alpha^2\mu^2\right) > 0$.

Note also, beforehand, that by abstracting from exit of domestic banks, $\widetilde{\phi}_A^{GR} \leq \frac{2}{3}$ must hold due to the symmetric location of banks on the Salop circle. $\widetilde{\phi}_A^{GR} \leq \frac{2}{3}$ is equivalent to $\frac{5}{6}t\gamma - \Delta - \mu(1-\gamma)(1+i_A)\delta_A \geq 0$. We will use this condition further on and refer to it as

Condition (2): $\frac{5}{6}t\gamma - \Delta - \mu(1-\gamma)(1+i_A)\delta_A \geq 0.$

From *Condition (2)* follows a further useful condition which we will refer to as

Condition (3): $\frac{5}{6}t\gamma - \Delta > 0.$

Note that $\frac{d\pi_A^{AC}}{d\delta_A} > \frac{d\pi_A^{CBL}}{d\delta_A}$ is equivalent to $\frac{5}{6}t\gamma - \frac{5(9\alpha\mu-5)}{9(5-2\alpha\mu)}\Delta - \frac{5\left(9\alpha^2\mu^2-5\right)}{9(5-2\alpha\mu)}(1-\gamma)(1+i_A)\delta_A > 0$ which is fulfilled due to *Condition (2)* since numerical simulations show that $-1 < \frac{5(9\alpha\mu-5)}{9(5-2\alpha\mu)} < 1$ and $\frac{5\left(9\alpha^2\mu^2-5\right)}{9(5-2\alpha\mu)} < \mu$. Hence, π_A^{AC} and π_A^{CBL} may intersect only once.

(2) proof of $\frac{d\pi_A^{AC}}{d\delta_A} > \frac{d\pi_A^{GR}}{d\delta_A}$ *for* $\delta_A^{GR} \leq \delta_A < 1$

Note that $\frac{d\pi_A^{AC}}{d\delta_A} = 2m(1-\gamma)(1+i_A)[\frac{1}{3}\widetilde{\phi}_A^{AC} + \frac{\mu}{5}\widetilde{\phi}_B^{GR}] > 0$ and $\frac{d^2\pi_A^{AC}}{d\delta_A^2} = \frac{2m}{t\gamma}(1-\gamma)^2 (1+i_A)^2\left(\frac{1}{9} - \frac{\mu^2}{25}\right) > 0.$

$\frac{d\pi_A^{AC}}{d\delta_A} > \frac{d\pi_A^{GR}}{d\delta_A}$ is equivalent to $\frac{9}{8}t\gamma - \Delta - \frac{9\mu-5}{4}(1-\gamma)(1+i_A)\delta_A > 0$ which is fulfilled due to *Condition (2)* as $\frac{9\mu-5}{4} < \mu$. Hence, π_A^{AC} and π_A^{GR} may intersect only once.

As a consequence, π_A^{AC} is increasing in δ_A and jumps upwards twice due to the changing acquisition prices at δ_A^{CBL} and δ_A^{GR}. Since, according to the above calculations, π_A^{AC} is steeper than both π_A^{CBL} and π_A^{GR}, in principle, four possible locations exist for π_A^{AC}. First, π_A^{AC} could lie above π_A^{CBL} and π_A^{GR}, thus eliminating cross border lending and greenfield entry from the entry mode pattern. Second, π_A^{AC} could intersect with π_A^{CBL} which would exclude greenfield entry from the entry mode pattern. Third, and most interesting for us, π_A^{AC} could intersect with π_A^{GR}, allowing for the richest possible entry mode pattern. Fourth, π_A^{AC} may be located below π_A^{CBL} and π_A^{GR}, thus excluding acquisition entry from the entry mode pattern.

Since we concentrate throughout our analysis on the richest possible entry mode pattern, bank A chooses acquisition entry for $\pi_A^{AC} \geq \pi_A^{GR}$. Solving for bank A's screening ability yields

$\delta_A \geq \frac{3t\gamma(5-2\mu)-2\Delta(9\mu-5)}{2(9\mu^2-5)(1-\gamma)(1+i_A)}\left(1-\sqrt{X_{AC}}\right) \equiv \delta_A^{AC}$

with $X_{AC} \equiv 1 + \frac{\left(9\mu^2-5\right)\left[\left(5t^2\gamma^2+36t\gamma\Delta-16\Delta^2\right)+\frac{180t\gamma}{m}(F_{GR}-F_{AC})\right]}{(3t\gamma(5-2\mu)-2\Delta(9\mu-5))^2}$.

Proof of Proposition 1.5:

$\frac{d\delta_A^{CBL}}{d\mu} = -\frac{1}{\mu}\delta_A^{CBL} < 0$

$\frac{d\delta_A^{GR}}{d\mu} = -\frac{1}{\mu}\delta_A^{GR} < 0$

$\left|\frac{d\delta_A^{CBL}}{d\mu}\right| < \left|\frac{d\delta_A^{GR}}{d\mu}\right|$ is fulfilled since $\delta_A^{CBL} < \delta_A^{GR}$.

$$\frac{d\delta_A^{AC}}{d\mu} = -\frac{9\left[\left(9\mu^2-5\right)\left(\frac{1}{3}t\gamma+\Delta\right)+45\mu\lambda\right]\left(1-\sqrt{X_{AC}}\right)}{(1-\gamma)(1+i_A)(9\mu^2-5)^2} - \frac{9\left[45\mu\lambda+2\left(9\mu^2-5\right)\left(\frac{1}{3}t\gamma+\Delta\right)\right]}{2(1-\gamma)(1+i_A)\sqrt{X_{AC}}(9\mu^2-5)^2}\,\frac{\left(9\mu^2-5\right)\left[\left(5t^2\gamma^2+36t\gamma\Delta-16\Delta^2\right)+\frac{180t\gamma}{m}(F_{GR}-F_{AC})\right]}{(3t\gamma(5-2\mu)-2\Delta(9\mu-5))^2}$$

with $\lambda \equiv \frac{1}{45}[3t\gamma\,(5-2\mu) - 2\Delta\,(9\mu-5)]$.

Since $\frac{\left(9\mu^2-5\right)\left[\left(5t^2\gamma^2+36t\gamma\Delta-16\Delta^2\right)+\frac{180t\gamma}{m}(F_{GR}-F_{AC})\right]}{(3t\gamma(5-2\mu)-2\Delta(9\mu-5))^2} = X_{AC}-1 = \left(\sqrt{X_{AC}}-1\right)\left(\sqrt{X_{AC}}+1\right)$, it follows that

$$\frac{d\delta_A^{AC}}{d\mu} = -\frac{9\left[\left(9\mu^2-5\right)\left(\frac{1}{3}t\gamma+\Delta\right)+45\mu\lambda\right]\left(1-\sqrt{X_{AC}}\right)}{(1-\gamma)(1+i_A)(9\mu^2-5)^2} + \frac{9\left[45\mu\lambda+2\left(9\mu^2-5\right)\left(\frac{1}{3}t\gamma+\Delta\right)\right]}{2(1-\gamma)(1+i_A)\sqrt{X_{AC}}(9\mu^2-5)^2}\left(1-\sqrt{X_{AC}}\right)\left(1+\sqrt{X_{AC}}\right)$$

or, equivalently,

$$\frac{d\delta_A^{AC}}{d\mu} = \frac{3t\gamma(5-2\mu)-2\Delta(9\mu-5)}{2(9\mu^2-5)(1-\gamma)(1+i_A)}\left(1-\sqrt{X_{AC}}\right)\frac{2}{5\lambda\sqrt{X_{AC}}} \left[\frac{3t\gamma(5-2\mu)-2\Delta(9\mu-5)}{2(9\mu^2-5)(1-\gamma)(1+i_A)}\left(1-\sqrt{X_{AC}}\right)\mu\,(1-\gamma)\,(1+i_A)+\left(\frac{1}{3}t\gamma+\Delta\right)\right].$$

Due to $\frac{3t\gamma(5-2\mu)-2\Delta(9\mu-5)}{2(9\mu^2-5)(1-\gamma)(1+i_A)}\left(1-\sqrt{X_{AC}}\right) = \delta_A^{AC}$, this expression can be written as

$\frac{d\delta_A^{AC}}{d\mu} = \frac{2\delta_A^{AC}}{5\lambda\sqrt{X_{AC}}}\left[\mu\,(1-\gamma)\,(1+i_A)\,\delta_A^{AC} + \frac{1}{3}t\gamma + \Delta\right]$ or, equivalently,

$\frac{d\delta_A^{AC}}{d\mu} = \frac{4\delta_A^{AC}}{25\lambda\sqrt{X_{AC}}}\left\{\frac{5}{6}t\gamma + \Delta + \frac{3}{2}\left[\Delta + \frac{5}{3}\mu\,(1-\gamma)\,(1+i_A)\,\delta_A^{AC}\right]\right\}$.

Note, first, that $\frac{5}{6}t\gamma + \Delta > 0$ due to *Condition (1)*. Second, as we assume $\delta_A > \delta_B$ it must hold that $\widetilde{\phi}_B^{AC} = \frac{1}{3t\gamma}\left[\frac{3}{2}t\gamma - \Delta - (1-\gamma)\,(1+i_A)\,\delta_A\right] < \frac{1}{2}$. This is equivalent to

$\Delta+(1-\gamma)(1+i_A)\,\delta_A>0$. By assuming $\frac{5}{3}\mu\geq 1$, or, respectively, $\mu\geq 0.6$, we have that $\frac{3}{2}[\Delta+\frac{5}{3}\mu(1-\gamma)(1+i_A)\,\delta_A^{AC}]\geq 0$.[33] Third, $\lambda=\frac{1}{45}[3t\gamma(5-2\mu)-2\Delta(9\mu-5)]>0$ is equivalent to $\frac{5}{6}t\gamma-\frac{5(9\mu-5)}{9(5-2\mu)}\Delta>0$ which holds due to *Condition (3)* since $0<\frac{5(9\mu-5)}{9(5-2\mu)}<1$. Hence, it holds that $\frac{d\delta_A^{AC}}{d\mu}>0$.

Proof of Proposition 1.6:

$$\frac{d\delta_A^{CBL}}{d\delta_B}=\frac{1+i_B}{\alpha\mu(1+i_A)}>0$$

$$\frac{d\delta_A^{GR}}{d\delta_B}=\frac{(1-\gamma)(1+i_B)}{\sqrt{X_{GR}}}\delta_A^{GR}>0$$

$$\frac{d\delta_A^{AC}}{d\delta_B}=\frac{(1+i_B)(9\mu-5)\left(1-\sqrt{X_{AC}}\right)}{(1+i_A)(9\mu^2-5)}+\frac{(1+i_B)(9\mu-5)}{(1+i_A)(9\mu^2-5)\sqrt{X_{AC}}}\frac{\left(9\mu^2-5\right)\left[\left(5t^2\gamma^2+36t\gamma\Delta-16\Delta^2\right)+\frac{180t\gamma}{m}(F_{GR}-F_{AC})\right]}{\left(3t\gamma(5-2\mu)-2\Delta(9\mu-5)\right)^2}+$$
$$\frac{8(1+i_B)\left(\frac{9}{8}t\gamma-\Delta\right)}{45(1+i_A)\lambda\sqrt{X_{AC}}}.$$

Since $\frac{\left(9\mu^2-5\right)\left[\left(5t^2\gamma^2+36t\gamma\Delta-16\Delta^2\right)+\frac{180t\gamma}{m}(F_{GR}-F_{AC})\right]}{\left(3t\gamma(5-2\mu)-2\Delta(9\mu-5)\right)^2}=X_{AC}-1=\left(\sqrt{X_{AC}}-1\right)\left(\sqrt{X_{AC}}+1\right)$,

it follows that

$$\frac{d\delta_A^{AC}}{d\delta_B}=\frac{(1+i_B)(9\mu-5)\left(1-\sqrt{X_{AC}}\right)}{(1+i_A)(9\mu^2-5)}-\frac{(1+i_B)(9\mu-5)}{(1+i_A)(9\mu^2-5)\sqrt{X_{AC}}}\left(1-\sqrt{X_{AC}}\right)\left(1+\sqrt{X_{AC}}\right)+$$
$$\frac{8(1+i_B)\left(\frac{9}{8}t\gamma-\Delta\right)}{45(1+i_A)\lambda\sqrt{X_{AC}}}$$

or, equivalently,

$$\frac{d\delta_A^{AC}}{d\delta_B}=\frac{2(1+i_B)(1-\gamma)(9\mu-5)}{45\lambda}\frac{3t\gamma(5-2\mu)-2\Delta(9\mu-5)}{2(9\mu^2-5)(1-\gamma)(1+i_A)}\left(1-\sqrt{X_{AC}}\right)-$$
$$\frac{2(1+i_B)(1-\gamma)(9\mu-5)\left(1+\sqrt{X_{AC}}\right)}{45\lambda\sqrt{X_{AC}}}\frac{3t\gamma(5-2\mu)-2\Delta(9\mu-5)}{2(9\mu^2-5)(1-\gamma)(1+i_A)}\left(1-\sqrt{X_{AC}}\right)+\frac{8(1+i_B)\left(\frac{9}{8}t\gamma-\Delta\right)}{45(1+i_A)\lambda\sqrt{X_{AC}}}.$$

Since $\frac{3t\gamma(5-2\mu)-2\Delta(9\mu-5)}{2(9\mu^2-5)(1-\gamma)(1+i_A)}\left(1-\sqrt{X_{AC}}\right)=\delta_A^{AC}$ it follows that

$$\frac{d\delta_A^{AC}}{d\delta_B}=\frac{2(1+i_B)(1-\gamma)(9\mu-5)}{45\lambda}\delta_A^{AC}-\frac{2(1+i_B)(1-\gamma)(9\mu-5)\left(1+\sqrt{X_{AC}}\right)}{45\lambda\sqrt{X_{AC}}}\delta_A^{AC}+\frac{8(1+i_B)\left(\frac{9}{8}t\gamma-\Delta\right)}{45(1+i_A)\lambda\sqrt{X_{AC}}}$$

which, in turn, is equivalent to

[33] In order to keep our analysis tractable, we henceforth assume $\mu>0.6$. We think this is justified since in that case, the foreign bank would not lose more than 40 percent of its screening efficiency due to soft information problems which seems reasonable.

$$\frac{d\delta_A^{AC}}{d\delta_B} = \frac{2(1+i_B)[4\left(\frac{9}{8}t\gamma-\Delta\right)-(1-\gamma)(1+i_A)(9\mu-5)\delta_A^{AC}]}{45\lambda(1+i_A)\sqrt{X_{AC}}}.$$

Note that $4\left(\frac{9}{8}t\gamma-\Delta\right)-(1-\gamma)(1+i_A)(9\mu-5)\delta_A^{AC}>0$ is equivalent to $\frac{9}{8}t\gamma-\Delta-\frac{9\mu-5}{4}(1-\gamma)(1+i_A)\delta_A^{AC}>0$ which is fulfilled due to *Condition (2)* since $\frac{9\mu-5}{4}<\mu$. Hence, $\frac{d\delta_A^{AC}}{d\delta_B}>0$ holds.

Proof of Proposition 1.7:

$$\frac{d\delta_A^{CBL}}{di_B} = -\frac{1-(1-\gamma)\delta_B}{\alpha\mu(1-\gamma)(1+i_A)} < 0$$

$$\frac{d\delta_A^{GR}}{di_B} = -\frac{1-(1-\gamma)\delta_B}{\sqrt{X_{GR}}}\delta_A^{GR} < 0$$

Note that $\left|\frac{d\delta_A^{CBL}}{di_B}\right| > \left|\frac{d\delta_A^{GR}}{di_B}\right|$ is equivalent to $\frac{1}{\alpha} > -\frac{\frac{5}{6}t\gamma+\Delta}{\sqrt{X_{GR}}}$ which is fulfilled as $\frac{5}{6}t\gamma+\Delta>0$ due to *Condition (1)*.

$$\frac{d\delta_A^{AC}}{di_B} = \frac{2\left(\frac{1}{9}-\frac{1}{5}\mu\right)[1-(1-\gamma)\delta_B]}{\lambda}\frac{3t\gamma(5-2\mu)-2\Delta(9\mu-5)}{2(9\mu^2-5)(1-\gamma)(1+i_A)}\left(1-\sqrt{X_{AC}}\right) - \frac{8[1-(1-\gamma)\delta_B]\left(\frac{9}{8}t\gamma-\Delta\right)}{45(1-\gamma)(1+i_A)\lambda\sqrt{X_{AC}}} + \frac{[1-(1-\gamma)\delta_B]\left(\frac{1}{9}-\frac{1}{5}\mu\right)}{(1-\gamma)(1+i_A)\sqrt{X_{AC}}\left(\frac{\mu^2}{5}-\frac{1}{9}\right)}\frac{(9\mu^2-5)[\left(5t^2\gamma^2+36t\gamma\Delta-16\Delta^2\right)+\frac{180t\gamma}{m}(F_{GR}-F_{AC})]}{(3t\gamma(5-2\mu)-2\Delta(9\mu-5))^2}.$$

Since $\frac{(9\mu^2-5)[\left(5t^2\gamma^2+36t\gamma\Delta-16\Delta^2\right)+\frac{180t\gamma}{m}(F_{GR}-F_{AC})]}{(3t\gamma(5-2\mu)-2\Delta(9\mu-5))^2} = X_{AC}-1 = \left(\sqrt{X_{AC}}-1\right)\left(\sqrt{X_{AC}}+1\right)$,

it follows that

$$\frac{d\delta_A^{AC}}{di_B} = \frac{2\left(\frac{1}{9}-\frac{1}{5}\mu\right)[1-(1-\gamma)\delta_B]}{\lambda}\frac{3t\gamma(5-2\mu)-2\Delta(9\mu-5)}{2(9\mu^2-5)(1-\gamma)(1+i_A)}\left(1-\sqrt{X_{AC}}\right) - \frac{8[1-(1-\gamma)\delta_B]\left(\frac{9}{8}t\gamma-\Delta\right)}{45(1-\gamma)(1+i_A)\lambda\sqrt{X_{AC}}} - \frac{[1-(1-\gamma)\delta_B]\left(\frac{1}{9}-\frac{1}{5}\mu\right)}{(1-\gamma)(1+i_A)\sqrt{X_{AC}}\left(\frac{\mu^2}{5}-\frac{1}{9}\right)}\left(1-\sqrt{X_{AC}}\right)\left(1+\sqrt{X_{AC}}\right)$$

or, equivalently,

$$\frac{d\delta_A^{AC}}{di_B} = \frac{2\left(\frac{1}{9}-\frac{1}{5}\mu\right)[1-(1-\gamma)\delta_B]}{\lambda}\frac{3t\gamma(5-2\mu)-2\Delta(9\mu-5)}{2(9\mu^2-5)(1-\gamma)(1+i_A)}\left(1-\sqrt{X_{AC}}\right) - \frac{8[1-(1-\gamma)\delta_B]\left(\frac{9}{8}t\gamma-\Delta\right)}{45(1-\gamma)(1+i_A)\lambda\sqrt{X_{AC}}} - \frac{2[1-(1-\gamma)\delta_B]\left(\frac{1}{9}-\frac{1}{5}\mu\right)\left(1+\sqrt{X_{AC}}\right)}{\lambda\sqrt{X_{AC}}}\frac{3t\gamma(5-2\mu)-2\Delta(9\mu-5)}{2(9\mu^2-5)(1-\gamma)(1+i_A)}\left(1-\sqrt{X_{AC}}\right).$$

Since $\frac{3t\gamma(5-2\mu)-2\Delta(9\mu-5)}{2(9\mu^2-5)(1-\gamma)(1+i_A)}\left(1-\sqrt{X_{AC}}\right)=\delta_A^{AC}$ it follows that

$$\frac{d\delta_A^{AC}}{di_B} = \frac{2\left(\frac{1}{9}-\frac{1}{5}\mu\right)[1-(1-\gamma)\delta_B]}{\lambda}\delta_A^{AC} - \frac{8[1-(1-\gamma)\delta_B]\left(\frac{9}{8}t\gamma-\Delta\right)}{45(1-\gamma)(1+i_A)\lambda\sqrt{X_{AC}}} - \frac{2[1-(1-\gamma)\delta_B]\left(\frac{1}{9}-\frac{1}{5}\mu\right)\left(1+\sqrt{X_{AC}}\right)}{\lambda\sqrt{X_{AC}}}\delta_A^{AC}$$

which is equivalent to

$$\frac{d\delta_A^{AC}}{di_B} = -\frac{2[1-(1-\gamma)\delta_B][4\left(\frac{9}{8}t\gamma-\Delta\right)-(1-\gamma)(1+i_A)(9\mu-5)\delta_A^{AC}]}{45\lambda\sqrt{X_{AC}}(1-\gamma)(1+i_A)}.$$

Note that $4\left(\frac{9}{8}t\gamma-\Delta\right)-(1-\gamma)(1+i_A)(9\mu-5)\delta_A^{AC}>0$ is equivalent to $\frac{9}{8}t\gamma-\Delta-\frac{9\mu-5}{4}(1-\gamma)(1+i_A)\delta_A^{AC}>0$ which is fulfilled due to *Condition (2)* since $\frac{9\mu-5}{4}<\mu$. Hence, it holds that $\frac{d\delta_A^{AC}}{di_B}<0$.

Proof of Proposition 1.8:

$$\frac{d\delta_A^{CBL}}{d\frac{1}{t}} = \frac{5\gamma t^2}{4\alpha\mu(1-\gamma)(1+i_A)}\left(\frac{2}{3}-\sqrt{\frac{F_{CBL}}{mt\gamma}}\right)$$

Note, first, that $\delta_A^{CBL}<1$ is equivalent to $\sqrt{\frac{F_{CBL}}{mt\gamma}}<\frac{1}{3}+\frac{2\alpha\mu(1-\gamma)(1+i_A)+2\Delta}{5t\gamma}$. Second, as we abstract from exit of domestic banks it must hold that $\widetilde{\phi}_B^{CBL}\geq\frac{1}{6}$ which is equivalent to $\frac{5}{6}t\gamma-\Delta-\alpha\mu(1-\gamma)(1+i_A)\delta_A\geq 0$. Accordingly, $\frac{2\alpha\mu(1-\gamma)(1+i_A)+2\Delta}{5t\gamma}\leq\frac{1}{3}$ which is equivalent to $\frac{5}{6}t\gamma-\Delta-\alpha\mu(1-\gamma)(1+i_A)\geq 0$ is fulfilled. Consequently, it must hold that $\sqrt{\frac{F_{CBL}}{mt\gamma}}<\frac{2}{3}$. Hence, it holds that $\frac{d\delta_A^{CBL}}{d\frac{1}{t}}>0$.

$$\frac{d\delta_A^{GR}}{d\frac{1}{t}} = \frac{5t^2\gamma}{6\sqrt{X_{GR}}}[\delta_A^{GR}-\frac{15(F_{GR}-F_{CBL})}{4m\mu(1-\alpha)(1-\gamma)(1+i_A)}]$$

Note that $\frac{d\delta_A^{GR}}{d\frac{1}{t}}>0$ is equivalent to $\delta_A^{GR}>\frac{15(F_{GR}-F_{CBL})}{4m\mu(1-\alpha)(1-\gamma)(1+i_A)}$. Thus, it holds that

$\frac{d\delta_A^{GR}}{d\frac{1}{t}}>0$ for $\delta_A^{GR}>\frac{15(F_{GR}-F_{CBL})}{4m\mu(1-\alpha)(1-\gamma)(1+i_A)}$ and
$\frac{d\delta_A^{GR}}{d\frac{1}{t}}<0$ for $\delta_A^{GR}<\frac{15(F_{GR}-F_{CBL})}{4m\mu(1-\alpha)(1-\gamma)(1+i_A)}$.

$$\frac{d\delta_A^{AC}}{d\frac{1}{t}} = -\frac{\gamma t^2\left(1-\frac{2}{5}\mu\right)}{3\lambda}\frac{3t\gamma(5-2\mu)-2\Delta(9\mu-5)}{2(9\mu^2-5)(1-\gamma)(1+i_A)}\left(1-\sqrt{X_{AC}}\right)-\frac{t^2\gamma[-\frac{101}{360}t\gamma+\frac{1}{5}\left(\frac{9}{8}t\gamma-\Delta\right)-\frac{(F_{GR}-F_{AC})}{m}]}{(1-\gamma)(1+i_A)\lambda\sqrt{X_{AC}}}-$$
$$\frac{\gamma t^2\left(1-\frac{2}{5}\mu\right)}{6(1-\gamma)(1+i_A)\sqrt{X_{AC}}\left(\frac{\mu^2}{5}-\frac{1}{9}\right)}\frac{\left(9\mu^2-5\right)[\left(5t^2\gamma^2+36t\gamma\Delta-16\Delta^2\right)+\frac{180t\gamma}{m}(F_{GR}-F_{AC})]}{(3t\gamma(5-2\mu)-2\Delta(9\mu-5))^2}.$$

Since $\frac{\left(9\mu^2-5\right)[\left(5t^2\gamma^2+36t\gamma\Delta-16\Delta^2\right)+\frac{180t\gamma}{m}(F_{GR}-F_{AC})]}{(3t\gamma(5-2\mu)-2\Delta(9\mu-5))^2}=X_{AC}-1=\left(\sqrt{X_{AC}}-1\right)\left(\sqrt{X_{AC}}+1\right)$,

it follows that

$$\frac{d\delta_A^{AC}}{d\frac{1}{t}} = -\frac{\gamma t^2\left(1-\frac{2}{5}\mu\right)}{3\lambda}\frac{3t\gamma(5-2\mu)-2\Delta(9\mu-5)}{2(9\mu^2-5)(1-\gamma)(1+i_A)}\left(1-\sqrt{X_{AC}}\right) - \frac{t^2\gamma[-\frac{101}{360}t\gamma+\frac{1}{5}\left(\frac{9}{8}t\gamma-\Delta\right)-\frac{(F_{GR}-F_{AC})}{m}]}{(1-\gamma)(1+i_A)\lambda\sqrt{X_{AC}}} + \frac{\gamma t^2\left(1-\frac{2}{5}\mu\right)}{6(1-\gamma)(1+i_A)\sqrt{X_{AC}}\left(\frac{\mu^2}{5}-\frac{1}{9}\right)}\left(1-\sqrt{X_{AC}}\right)\left(1+\sqrt{X_{AC}}\right)$$

or, equivalently,

$$\frac{d\delta_A^{AC}}{d\frac{1}{t}} = -\frac{\gamma t^2\left(1-\frac{2}{5}\mu\right)}{3\lambda}\frac{3t\gamma(5-2\mu)-2\Delta(9\mu-5)}{2(9\mu^2-5)(1-\gamma)(1+i_A)}\left(1-\sqrt{X_{AC}}\right) - \frac{t^2\gamma[-\frac{101}{360}t\gamma+\frac{1}{5}\left(\frac{9}{8}t\gamma-\Delta\right)-\frac{(F_{GR}-F_{AC})}{m}]}{(1-\gamma)(1+i_A)\lambda\sqrt{X_{AC}}} + \frac{\gamma t^2\left(1-\frac{2}{5}\mu\right)}{3\lambda}\frac{\left(1+\sqrt{X_{AC}}\right)}{\sqrt{X_{AC}}}\frac{3t\gamma(5-2\mu)-2\Delta(9\mu-5)}{2(9\mu^2-5)(1-\gamma)(1+i_A)}\left(1-\sqrt{X_{AC}}\right).$$

Using $\frac{3t\gamma(5-2\mu)-2\Delta(9\mu-5)}{2(9\mu^2-5)(1-\gamma)(1+i_A)}\left(1-\sqrt{X_{AC}}\right) = \delta_A^{AC}$ we arrive at

$$\frac{d\delta_A^{AC}}{d\frac{1}{t}} = -\frac{\gamma t^2\left(1-\frac{2}{5}\mu\right)}{3\lambda}\delta_A^{AC} - \frac{t^2\gamma[-\frac{101}{360}t\gamma+\frac{1}{5}\left(\frac{9}{8}t\gamma-\Delta\right)-\frac{(F_{GR}-F_{AC})}{m}]}{(1-\gamma)(1+i_A)\lambda\sqrt{X_{AC}}} + \frac{\gamma t^2\left(1-\frac{2}{5}\mu\right)}{3\lambda}\frac{\left(1+\sqrt{X_{AC}}\right)}{\sqrt{X_{AC}}}\delta_A^{AC}$$

which is equivalent to

$$\frac{d\delta_A^{AC}}{d\frac{1}{t}} = \frac{\gamma t^2[(1-\gamma)(1+i_A)(5-2\mu)\delta_A^{AC}+\frac{5}{6}t\gamma+3\Delta+\frac{15}{m}(F_{GR}-F_{AC})]}{15(1-\gamma)(1+i_A)\lambda\sqrt{X_{AC}}}.$$

We now prove that $\frac{d\delta_A^{AC}}{d\frac{1}{t}} > 0$. $\frac{d\delta_A^{AC}}{d\frac{1}{t}} > 0$ is equivalent to $F_{AC} - F_{GR} < \frac{m}{15}[\frac{5}{6}t\gamma + \Delta + 2\Delta + (5-2\mu)(1-\gamma)(1+i_A)\delta_A^{AC}]$. Note, beforehand, that in case of acquisition entry $\widetilde{\phi}_B^{AC} \leq \frac{1}{2}$ must hold due to $i_B - i_A > 0$, $\delta_A > \delta_B$ and $\mu = 0$. $\widetilde{\phi}_B^{AC} \leq \frac{1}{2}$ is equivalent to $2\Delta + 2(1-\gamma)(1+i_A)\delta_A \geq 0$. As the minimum of $(5-2\mu)$ is 3, $2\Delta + (5-2\mu)(1-\gamma)(1+i_A)\delta_A^{AC} > 0$ must then also hold. As $\frac{5}{6}t\gamma + \Delta > 0$ due to *Condition (3)*, it follows that the right hand side of the above inequality is positive. However, the left hand side of that expression is negative. As a consequence, the above inequality is fulfilled and it holds that $\frac{d\delta_A^{AC}}{d\frac{1}{t}} > 0$.

Proof of Proposition 1.9:

$$\frac{d\delta_A^{CBL}}{dm} = -\frac{5t\gamma}{4\alpha m\mu(1-\gamma)(1+i_A)}\sqrt{\frac{F_{CBL}}{mt\gamma}} < 0$$

$$\frac{d\delta_A^{GR}}{dm} = -\frac{25t\gamma(F_{GR}-F_{CBL})}{8\mu m^2(1-\alpha)(1-\gamma)(1+i_A)\sqrt{X_{GR}}} < 0$$

$$\frac{d\delta_A^{AC}}{dm} = \frac{t\gamma(F_{GR}-F_{AC})}{\lambda m^2(1-\gamma)(1+i_A)\sqrt{X_{AC}}} > 0$$

Proof of Proposition 1.10:

Welfare functions:

(1) No Entry:

Consumer surplus is given by $vm\gamma + 0 \cdot m\,(1-\gamma) - \widetilde{r}^{B}_{NE} m\gamma - 4m \int_{0}^{\frac{1}{4}} xtdx$.

Producer surplus is given by $2\pi_B^{NE} = mt\gamma \cdot \left(\frac{1}{2}\right)^2$.

Hence, by rearranging we yield the welfare function

$W_{NE} = m[\gamma\,(v - i_B) - (1-\gamma)\,(1-\delta_B)\,(1+i_B) - \frac{t}{8}]$.[34]

(2) Cross Border Lending:

Consumer surplus is given by

$$vm\gamma + 0 \cdot m\,(1-\gamma) - \left(\widetilde{r}^{CBL}_A \widetilde{\phi}^{CBL}_A + 2\widetilde{r}^{CBL}_B \widetilde{\phi}^{CBL}_B\right) m\gamma - 2m \left(\int_0^{\frac{1}{6}} xtdx + \int_0^{x^{CBL}_{A,B_1}} xtdx + \int_0^{x^{CBL}_{A,B_2}} xtdx \right).$$

Producer surplus is given by $2\pi_B^{CBL}$.

Hence, by rearranging we yield the welfare function

$$W_{CBL} = m\{\gamma v - \tfrac{t}{12} - \tfrac{1}{3}\gamma\left(\widetilde{r}^{CBL}_A + 2\widetilde{r}^{CBL}_B\right) + \tfrac{1}{t}\left(\gamma - \tfrac{1}{2}\right)\left(\widetilde{r}^{CBL}_B - \widetilde{r}^{CBL}_A\right)^2 + \\ 2[\tfrac{1}{3} - \tfrac{1}{2t}\left(\widetilde{r}^{CBL}_B - \widetilde{r}^{CBL}_A\right)][\gamma\left(\widetilde{r}^{CBL}_B - i_B\right) - (1-\gamma)\,(1-\delta_B)\,(1+i_B)]\}.$$

[34] For our analysis to be interesting, we assume $W_{NE} > 0$.

(3) Greenfield Entry

Consumer surplus is given by

$$vm\gamma+0\cdot m\left(1-\gamma\right)-\left(\widetilde{r}_A^{GR}\widetilde{\phi}_A^{GR}+2\widetilde{r}_B^{GR}\widetilde{\phi}_B^{GR}\right)m\gamma-2m\left(\int_0^{\frac{1}{6}}xtdx+\int_0^{x_{A,B_1}^{GR}}xtdx+\int_0^{\frac{1}{3}-x_{A,B_1}^{GR}}xtdx\right).$$

Producer surplus is given by $2\pi_B^{GR}$.

Hence, by rearranging we yield the welfare function

$$W_{GR}=m\{\gamma v-\tfrac{t}{12}-\tfrac{1}{3}\gamma\left(\widetilde{r}_A^{GR}+2\widetilde{r}_B^{GR}\right)+\tfrac{1}{t}\left(\gamma-\tfrac{1}{2}\right)\left(\widetilde{r}_B^{GR}-\widetilde{r}_A^{GR}\right)^2+2[\tfrac{1}{3}-\tfrac{1}{2t}\left(\widetilde{r}_B^{GR}-\widetilde{r}_A^{GR}\right)]$$
$$[\gamma\left(\widetilde{r}_B^{GR}-i_B\right)-\left(1-\gamma\right)\left(1-\delta_B\right)\left(1+i_B\right)]\}.$$

(4) Entry via Acquisition

Consumer surplus is given by

$$vm\gamma+0\cdot m\left(1-\gamma\right)-\left(\widetilde{r}_A^{AC}\widetilde{\phi}_A^{AC}+\widetilde{r}_B^{AC}\widetilde{\phi}_B^{AC}\right)m\gamma-2m\left(\int_0^{x_{A,B}^{AC}}xtdx+\int_0^{\frac{1}{2}-x_{A,B}^{AC}}xtdx\right).$$

Producer surplus is given by π_B^{AC} and the acquisition price amounts to π_B^{GR}.

Hence, by rearranging we yield the welfare function

$$W_{AC}=m\{\gamma[v-\widetilde{r}_A^{AC}\left(\tfrac{1}{2}+\tfrac{1}{t}\left(\widetilde{r}_B^{AC}-\widetilde{r}_A^{AC}\right)\right)-\left(\tfrac{1}{2}-\tfrac{1}{t}\left(\widetilde{r}_B^{AC}-\widetilde{r}_A^{AC}\right)\right)i_B]-$$
$$\left(\tfrac{1}{2}-\tfrac{1}{t}\left(\widetilde{r}_B^{AC}-\widetilde{r}_A^{AC}\right)\right)\left(1-\gamma\right)\left(1-\delta_B\right)\left(1+i_B\right)-\tfrac{t}{2}[\tfrac{1}{4}+\tfrac{1}{t^2}\left(\widetilde{r}_B^{AC}-\widetilde{r}_A^{AC}\right)^2]+$$
$$\tfrac{1}{25t\gamma}[\tfrac{5}{3}t\gamma-\Delta-\mu\left(1-\gamma\right)\left(1+i_A\right)\delta_A]^2\}.$$

Shape of Welfare Functions:

$\frac{dW_{NE}}{d\delta_A} = 0$

$\frac{dW_{CBL}}{d\delta_A} \mid_{\delta_A=0}= \frac{\alpha m\mu(1-\gamma)(1+i_A)}{75t\gamma^2}[5t\gamma^2 + 12\,(3\gamma - 1)\,(i_B - i_A)] > 0$

$\frac{d^2W_{CBL}}{d\delta_A^2} = \frac{m(1-\gamma)\left(4\gamma-1-3\gamma^2\right)}{t}\left(\frac{2\alpha\mu(1+i_A)}{5\gamma}\right)^2 > 0$

$\frac{dW_{GR}}{d\delta_A} \mid_{\delta_A=0}= \frac{m\mu(1-\gamma)(1+i_A)}{75t\gamma^2}[5t\gamma^2 + 12\,(3\gamma - 1)\,(i_B - i_A)] > 0$

$\frac{d^2W_{GR}}{d\delta_A^2} = \frac{m(1-\gamma)\left(4\gamma-1-3\gamma^2\right)}{t}\left(\frac{2\mu(1+i_A)}{5\gamma}\right)^2 > 0$

$\frac{dW_{AC}}{d\delta_A} \mid_{\delta_A=0}= \frac{m(1+i_A)(1-\gamma)}{450t\gamma^2}[15t\gamma^2\,(5 - 4\mu) + 2\,(100\gamma + 18\mu\gamma - 25)\,(i_B - i_A)] > 0$

$\frac{d^2W_{AC}}{d\delta_A^2} = \frac{m\left(18\gamma\mu^2+100\gamma-25\right)}{t}\left(\frac{(1-\gamma)(1+i_A)}{15\gamma}\right)^2 > 0$

Note that $4\gamma - 1 - 3\gamma^2 > 0$ as well as $18\gamma\mu^2 + 100\gamma - 25 > 0$ hold for $\gamma > 0.5$ which we will assume henceforth. We find, first, that W_{NE} is independent of δ_A. Second, W_{CBL}, W_{GR}, and W_{AC} are quadratic, increasing, and convex functions in δ_A with $\underset{\delta_A\in\mathbb{R}}{\arg\min}\,(W_{CBL}) < 0$, $\underset{\delta_A\in\mathbb{R}}{\arg\min}\,(W_{GR}) < 0$, and $\underset{\delta_A\in\mathbb{R}}{\arg\min}\,(W_{AC}) < 0$ since the second order conditions with respect to δ_A are positive and since the first order conditions with respect to δ_A at $\delta_A = 0$ are positive as well.

Next, we show that $W_{GR} > W_{CBL}$ always holds. $W_{GR} - W_{CBL} > 0$ is equivalent to $\frac{2}{25t\gamma}m\mu\delta_A(1-\gamma)(1+i_A)(1-\alpha)\{\frac{5}{6}t\gamma + 2\frac{(3\gamma-1)}{\gamma}[\Delta + \frac{1}{2}\mu\delta_A\,(1-\gamma)\,(1+i_A)\,(1+\alpha)]\} > 0$ which is fulfilled if we assume $\Delta > 0$.[35]

Hence, we only need to calculate the intersection points of W_{NE}, W_{GR}, and W_{AC}.

[35] Regarding the welfare analysis, we only look at host banking markets on a rather low financial development stage and assume henceforth $\Delta = i_B - i_A - (1-\gamma)\,(1+i_B)\,\delta_B > 0$. This expression is the more likely fulfilled the larger is the difference in refinancing conditions of foreign and host country banks and the lower is the screening ability of host country banks. This limitation seems justified as the entry of foreign banks into financially very well developed countries is, in general, not very much regulated.

(a) Intersection between W_{NE} and W_{GR}

Note that $W_{GR}-W_{NE}>0$ is equivalent to

$\frac{1}{1800}\frac{m}{t\gamma^2}\{144\mu^2(3\gamma-1)(1-\gamma)^2(1+i_A)^2(\delta_A)^2+24\mu(1-\gamma)(1+i_A)[5t\gamma^2+12(3\gamma-1)\Delta]\delta_A-5t\gamma^2[5t(8\gamma-3)-24\Delta]+144(3\gamma-1)\Delta^2\}>0.$

Solving for δ_A yields $\delta_A<\frac{\frac{5}{12}t\gamma\left(-\sqrt{25\gamma^2-17\gamma+3}-\gamma\right)-(3\gamma-1)\Delta}{\mu(1-\gamma)(3\gamma-1)(1+i_A)}$ and $\delta_A>\frac{\frac{5}{12}t\gamma\left(+\sqrt{25\gamma^2-17\gamma+3}-\gamma\right)-(3\gamma-1)\Delta}{\mu(1-\gamma)(3\gamma-1)(1+i_A)}$.

Since, as derived above, $\underset{\delta_A\in\mathbb{R}}{\arg\min}(W_{GR})<0$, $\frac{dW_{NE}}{d\delta_A}=0$ and $\frac{dW_{GR}}{d\delta_A}|_{\delta_A=0}>0$, only one intersection between W_{NE} and W_{GR} for $0<\delta_A<1$ is possible so that we only need to consider the intersection point $\delta_A=\frac{\frac{5}{12}t\gamma\left(\sqrt{25\gamma^2-17\gamma+3}-\gamma\right)-(3\gamma-1)\Delta}{\mu(1-\gamma)(3\gamma-1)(1+i_A)}$.

Hence, $W_{GR}>W_{NE}$ is equivalent to $\delta_A>\frac{\frac{5}{12}t\gamma\left(\sqrt{25\gamma^2-17\gamma+3}-\gamma\right)-(3\gamma-1)\Delta}{\mu(1-\gamma)(3\gamma-1)(1+i_A)}\equiv\delta_W^{GR}$.

(b) Intersection between W_{GR} and W_{AC}

Note that $W_{AC}-W_{GR}>0$ is equivalent to

$\frac{1}{1800}\frac{m}{t\gamma^2}\{4(1-\gamma)^2(1+i_A)^2(100\gamma-25+36\mu^2-90\mu^2\gamma)(\delta_A)^2-4(1-\gamma)(1+i_A)[(15t\gamma^2(6\mu-5)-2(100\gamma-25+36\mu-90\gamma\mu)\Delta)]\delta_A+4(10\gamma+11)\Delta^2-25t^2\gamma^2(2\gamma+3)-60t\gamma^2\Delta\}>0.$

Solving for δ_A yields $\delta_A<x_{AC}^W-\frac{5\sqrt{X_{AC}^W}}{2(1-\gamma)(1+i_A)[25(4\gamma-1)-18\mu^2(5\gamma-2)]}$ and
$\delta_A>x_{AC}^W+\frac{5\sqrt{X_{AC}^W}}{2(1-\gamma)(1+i_A)[25(4\gamma-1)-18\mu^2(5\gamma-2)]}$

with $x_{AC}^W\equiv\frac{[\frac{15}{2}t\gamma(6\mu-5)\gamma-[25(4\gamma-1)-18\mu(5\gamma-2)]\Delta]}{(1-\gamma)(1+i_A)[25(4\gamma-1)-18\mu^2(5\gamma-2)]}$ and

$$\begin{aligned}X_{AC}^W\equiv t\gamma^2\{t[25(10\gamma+17\gamma^2-3)+18\mu(6\mu-30\gamma^2-11\gamma\mu+8\gamma^2\mu)]+\\72(1-\mu)[5\gamma(4-3\mu)+6\mu-5]\Delta\}+72(1-\mu)^2(4\gamma-1)(5\gamma-2)\Delta^2.\end{aligned}$$

In principle, two intersections of W_{AC} and W_{GR} for $\delta_A>0$ are possible. However, remember that $\frac{dW_{GR}}{d\delta_A}|_{\delta_A=0}>0$ as well as $\frac{dW_{AC}}{d\delta_A}|_{\delta_A=0}>0$. Hence, by proofing that $W_{GR}|_{\delta_A=0}>W_{AC}|_{\delta_A=0}$ we show that we only need to consider the upper intersection point $x_{AC}^W+\frac{5\sqrt{X_{AC}^W}}{2(1-\gamma)(1+i_A)[25(4\gamma-1)-18\mu^2(5\gamma-2)]}$. Note that $W_{GR}|_{\delta_A=0}-W_{AC}|_{\delta_A=0}=$

$m\frac{25t^2\gamma^2(2\gamma+3)-4\Delta^2(10\gamma+11)+60t\gamma^2\Delta}{1800t\gamma^2}$. Further, $25t^2\gamma^2(2\gamma+3)-4\Delta^2(10\gamma+11)>0$ is equivalent to $\frac{5}{6}t\gamma-\frac{1}{3}\sqrt{\frac{(10\gamma+11)}{(2\gamma+3)}}\Delta>0$. Numerical solutions show that $0<\frac{1}{3}\sqrt{\frac{(10\gamma+11)}{(2\gamma+3)}}<1$ so that *Condition (2)* is fulfilled and, hence, it must hold that $W_{GR}\mid_{\delta_A=0}>W_{AC}\mid_{\delta_A=0}$.

It follows that $W_{AC}>W_{GR}$ holds for

$$\delta_A>x_{AC}^W+\frac{5\sqrt{X_{AC}^W}}{2(1-\gamma)(1+i_A)[25(4\gamma-1)-18\mu^2(5\gamma-2)]}\equiv\delta_W^{AC}.$$

As we can abstract from the lower threshold, it must further hold that $\frac{dW_{AC}}{d\delta_A}\mid_{\delta_A=\delta_W^{AC}}>\frac{dW_{GR}}{d\delta_A}\mid_{\delta_A=\delta_W^{AC}}$.

(c) Intersection of W_{NE} and W_{AC} and proof of $\delta_W^{GR}<\delta_W^{AC}$

Note, first, that it is useful to show that $\delta_W^{GR}<\delta_W^{AC}$. $\delta_W^{GR}<\delta_W^{AC}$ is equivalent to

$$\frac{5}{2[25(4\gamma-1)-18\mu^2(5\gamma-2)]}(t\gamma^2\{t[25(10\gamma+17\gamma^2-3)+18\mu(6\mu-30\gamma^2-11\gamma\mu+8\gamma^2\mu)]+72(1-\mu)[5\gamma(4-3\mu)+6\mu-5]\Delta\}+72(1-\mu)^2(4\gamma-1)(5\gamma-2)\Delta^2)^{\frac{1}{2}}>$$
$$\frac{1}{2\mu(3\gamma-1)[25(4\gamma-1)-18\mu^2(5\gamma-2)]}\{-\gamma(90\mu+100\gamma+234\mu^2\gamma-270\mu\gamma-72\mu^2-25)+[25(4\gamma-1)-18\mu^2(5\gamma-2)]\sqrt{-17\gamma+25\gamma^2+3}]\}$$
$$[\tfrac{5}{6}t\gamma+\frac{-50(4\gamma-1)(3\gamma-1)(1-\mu)}{[25(4\gamma-1)-18\mu^2(5\gamma-2)]\sqrt{-17\gamma+25\gamma^2+3}-\gamma(90\mu+100\gamma+234\mu^2\gamma-270\mu\gamma-72\mu^2-25)}\Delta].$$

Numerical simulations show that $25(4\gamma-1)-18\mu^2(5\gamma-2)>0$ so that the left hand side of this expression is clearly positive. The right hand side is also positive as numerical simulations show that $\{-\gamma(90\mu+100\gamma+234\mu^2\gamma-270\mu\gamma-72\mu^2-25)+[25(4\gamma-1)-18\mu^2(5\gamma-2)]\sqrt{-17\gamma+25\gamma^2+3}\}$ is positive and $-1<\frac{-50(4\gamma-1)(3\gamma-1)(1-\mu)}{\sqrt{-17\gamma+25\gamma^2+3}(100\gamma-90\mu^2\gamma+36\mu^2-25)-\gamma(90\mu+100\gamma+234\mu^2\gamma-270\mu\gamma-72\mu^2-25)}<1$ such that $[\frac{5}{6}t\gamma+\frac{-50(4\gamma-1)(3\gamma-1)(1-\mu)}{\sqrt{-17\gamma+25\gamma^2+3}(100\gamma-90\mu^2\gamma+36\mu^2-25)-\gamma(90\mu+100\gamma+234\mu^2\gamma-270\mu\gamma-72\mu^2-25)}\Delta]>0$ holds according to *Condition (1)*. Squaring and rearranging yields

$$[25(4\gamma-1)-18\mu^2(5\gamma-2)]\{\tfrac{144}{5}(3\gamma-1)(1-\mu)\Delta[\gamma(18\mu(3\gamma-1)-5(4\gamma-1))+5\sqrt{-17\gamma+25\gamma^2+3}(4\gamma-1)][\tfrac{5}{6}t\gamma-\frac{5(4\gamma-1)(3\gamma-1)(1-\mu)}{\gamma[18\mu(3\gamma-1)-5(4\gamma-1)]+5(4\gamma-1)\sqrt{-17\gamma+25\gamma^2+3}}\Delta]+t^2\gamma^2$$
$$[18\gamma\mu(-10\gamma+17\mu+30\gamma^2-95\gamma\mu+130\gamma^2\mu)-25(4\gamma-1)(-17\gamma+26\gamma^2+3)+2\gamma[25(4\gamma-1)+18\mu(13\gamma\mu+5-15\gamma-4\mu)]\sqrt{-17\gamma+25\gamma^2+3}]\}>0$$

Numerical simulations show that $[18\mu(3\gamma-1)-5(4\gamma-1)]>0$, $-1<\frac{5(4\gamma-1)(3\gamma-1)(1-\mu)}{\gamma[18\mu(3\gamma-1)-5(4\gamma-1)]+5(4\gamma-1)\sqrt{-17\gamma+25\gamma^2+3}}<1$ and

$[18\gamma\mu\,(-10\gamma+17\mu+30\gamma^2-95\gamma\mu+130\gamma^2\mu)-25\,(4\gamma-1)\,(-17\gamma+26\gamma^2+3)+$
$2\gamma[25\,(4\gamma-1)+18\mu\,(13\gamma\mu+5-15\gamma-4\mu)]\sqrt{-17\gamma+25\gamma^2+3}]\;>\;0$ for $\mu\;>\;0.75$.[36]
Hence, the whole expression is positive since due to *Condition (3)*
$[\frac{5}{6}t\gamma-\frac{5(4\gamma-1)(3\gamma-1)(1-\mu)}{\gamma[18\mu(3\gamma-1)-5(4\gamma-1)]+5(4\gamma-1)\sqrt{-17\gamma+25\gamma^2+3}}\Delta]>0.$

The above calculations show that $\delta_W^{GR}<\delta_W^{AC}$. Remember that we also found that $\arg\min\limits_{\delta_A\in\mathbb{R}}(W_{GR})<0$, $\frac{dW_{GR}}{d\delta_A}\;|_{\delta_A=0}>0$, $\arg\min\limits_{\delta_A\in\mathbb{R}}(W_{AC})<0$, $\frac{dW_{AC}}{d\delta_A}\;|_{\delta_A=0}>0$, and $\frac{dW_{AC}}{d\delta_A}\;|_{\delta_A=\delta_W^{AC}}>\frac{dW_{GR}}{d\delta_A}\;|_{\delta_A=\delta_W^{AC}}$. Hence, we can neglect the intersection point between W_{NE} and W_{AC}, since the policy maker would always prefer greenfield or acquisition entry to the right hand side of this point.

(d) Entry Mode Pattern Preferred by the Social Planner

It follows from the analysis above that the entry mode pattern the social planner prefers is - increasing in the screening ability of the foreign bank: no entry - greenfield entry - acquisition entry. Again, one or both entry modes could drop out of the pattern depending on the parameter constellations, but the sequence of the pattern can never be different.

Proof of Proposition 1.11:

(1) Proof of $\delta_A^{CBL}<\widehat{\delta}_A^{GR}<\delta_W^{GR}$

Note that the policy maker cannot require that the foreign bank enters via a de novo investment if the foreign bank makes losses in case of greenfield entry. Hence, greenfield entry is only possible for $\pi_A^{GR}\geq 0$ which is equivalent to $\delta_A\geq\frac{1}{\mu(1-\gamma)(1+i_A)}\left(\frac{5}{2}\sqrt{\frac{t\gamma F_{GR}}{m}}-\frac{5}{6}t\gamma-\Delta\right)\equiv\widehat{\delta}_A^{GR}$. Note that $\widehat{\delta}_A^{GR}>\delta_A^{CBL}$ holds.

(2) Proof of $\delta_W^{AC}>\delta_A^{AC}$

Note that $\delta_W^{AC}>\delta_A^{AC}$ is equivalent to

[36] In order to keep our analysis tractable, we henceforth assume $\mu>0.75$.

$\frac{6}{5}[25\left(15\gamma+2\mu-2\gamma\mu-5\right)+9\mu^2\left(-25\gamma-8\mu-10\gamma\mu+20\right)]$
$[\frac{5}{6}t\gamma-\frac{25\mu(1-\mu)(10\gamma-1)\Delta}{(25(15\gamma+2\mu-2\gamma\mu-5)+9\mu^2(-25\gamma-8\mu-10\gamma\mu+20))}]<$
$15\lambda[25\left(4\gamma-1\right)-18\mu^2\left(5\gamma-2\right)]\sqrt{X_{AC}}+\frac{5}{3}\left(9\mu^2-5\right)\sqrt{X_{AC}^W}.$

The right hand side of this expression is positive since $25\left(4\gamma-1\right)-18\mu^2\left(5\gamma-2\right)>0$ as shown before. The left hand side is positive if $25\left(15\gamma+2\mu-2\gamma\mu-5\right)+9\mu^2\left(20-25\gamma-8\mu-10\gamma\mu\right)>0$ and $\frac{5}{6}t\gamma-\frac{25\mu(1-\mu)(10\gamma-1)\Delta}{25(15\gamma+2\mu-2\gamma\mu-5)+9\mu^2(20-25\gamma-8\mu-10\gamma\mu)}>0$. Numerical simulations show that the first expression is fulfilled and that $-1<\frac{30\mu(1-\mu)(10\gamma-1)}{25(15\gamma+2\mu-2\gamma\mu-5)+9\mu^2(-25\gamma-8\mu-10\gamma\mu+20)}<1$ holds, which, in turn, guarantees that *Condition (3)* is fulfilled and, accordingly, $\frac{5}{6}t\gamma-\frac{25\mu(1-\mu)(10\gamma-1)\Delta}{25(15\gamma+2\mu-2\gamma\mu-5)+9\mu^2(20-25\gamma-8\mu-10\gamma\mu)}>0$ holds. Squaring both sides and rearranging results in

$$\frac{t^2\gamma^2\left(400\gamma+216\mu^2\gamma-720\mu\gamma-171\mu^2+100\right)-12\Delta(1-\mu)\left(27\Delta-27\mu\Delta-90\gamma\Delta-70t\gamma^2+10t\gamma+90\mu\gamma\Delta+135\mu t\gamma^2-36\mu t\gamma\right)}{25(4\gamma-1)-18\mu^2(5\gamma-2)}<$$
$$\frac{36t\gamma}{m}\left(F_{GR}-F_{AC}\right)+\frac{90\lambda\sqrt{X_{AC}^W\cdot X_{AC}}}{25(4\gamma-1)-18\mu^2(5\gamma-2)}.$$

The right hand side of this inequality is positive. The left hand side, however, is negative. To see this, note, first, that $(400\gamma+216\mu^2\gamma-720\mu\gamma-171\mu^2+100)<0$. Second, $27\Delta-27\mu\Delta-90\gamma\Delta-70t\gamma^2+10t\gamma+90\mu\gamma\Delta+135\mu t\gamma^2-36\mu t\gamma>0$ is equivalent to $\frac{6}{5}\left(135\mu\gamma+10-36\mu-70\gamma\right)\left(\frac{5}{6}t\gamma-\frac{15(10\gamma-3)(1-\mu)}{2(135\mu\gamma+10-36\mu-70\gamma)}\Delta\right)>0$. Note that $-1<\frac{15(10\gamma-3)(1-\mu)}{2(135\mu\gamma+10-36\mu-70\gamma)}<1$ holds for not too small (γ,μ) combinations[37]; then, $135\mu\gamma+10-36\mu-70\gamma>0$ also holds. Accordingly, *Condition (3)* is fulfilled and it follows that $\frac{6}{5}\left(135\mu\gamma+10-36\mu-70\gamma\right)\left(\frac{5}{6}t\gamma-\frac{15(10\gamma-3)(1-\mu)}{2(135\mu\gamma+10-36\mu-70\gamma)}\Delta\right)>0$. As a consequence, the left hand side of the above expression is negative. Hence, the above expression is true and, consequently, it holds that $\delta_W^{AC}>\delta_A^{AC}$.

(3) Proof of $\frac{d\delta_W^{GR}}{d\left(\frac{1}{t}\right)}<0$

$$\frac{d\delta_W^{GR}}{d\left(\frac{1}{t}\right)}=-\frac{5t^2\gamma}{12\mu(1-\gamma)(3\gamma-1)(1+i_A)}\left(\sqrt{25\gamma^2-17\gamma+3}-\gamma\right)<0.$$

[37] To keep our analysis tractable, we assume $\mu>\frac{5}{3}\frac{58\gamma-13}{140\gamma-39}$, which is slightly larger than 0.75.

Appendix to Chapter 2

Proof of Proposition 2.1:

From the point of view of an arbitrary bank that maximizes its profit by choosing the repayment r it demands from its borrowers, the condition determining the marginal borrower is given by

$$x_z = \frac{r_z - r}{2t} + \frac{1}{2n} \quad \text{with} \quad z = L, H.$$

Note that for bad borrowers, only transportation costs and not repayments asked by banks matter for their decision where to apply for credit. However, since banks can observe the location of borrowers, bad borrowers must imitate the behavior of good borrowers. Hence, for the fraction of bad borrowers, the marginal borrower is also located at $x_z = \frac{r_z - r}{2t} + \frac{1}{2n}$.[38]

It follows that the expected market share of a bank can be expressed by

$$2m[(1-q)\,x_H + qx_L] = m[\frac{(1-q)r_H - r + qr_L}{t} + \frac{1}{n}].$$

Hence, the profit of a domestic bank investing in screening $\pi_{DB,L}$, the profit of a domestic bank not investing in screening $\pi_{DB,H}$, and the profit of a foreign bank π_{FB} are given by:

$$\pi_{DB,L} = (r-i)\,\gamma m[\frac{(1-q)r_H - r + qr_L}{t} + \frac{1}{n}] - F$$

$$\pi_{DB,H} = (r-i)\,\gamma m[\frac{(1-q)r_H - r + qr_L}{t} + \frac{1}{n}] - i\alpha\,(1-\gamma)\,m[\frac{(1-q)r_H - r + qr_L}{t} + \frac{1}{n}]$$

$$\pi_{FB} = (r-i)\,\gamma m[\frac{(1-q)r_H - r + qr_L}{t} + \frac{1}{n}].$$

[38] In order for bad borrowers to apply for credit, we assume that $i > \frac{t}{n}$ holds.

Banks maximize their profits with respect to the repayment they ask from borrowers which gives $r_L = i + \frac{t}{n} + \frac{\alpha i(1-\gamma)}{\gamma}\frac{1-q}{2}$ and $r_H = i + \frac{t}{n} + \frac{\alpha i(1-\gamma)}{\gamma}\left(1 - \frac{q}{2}\right)$. Clearly, it holds that $r_L < r_H$.

Proof of Proposition 2.2:

(1) Equilibrium in which All Domestic Banks Invest in Perfect Screening

It must hold that $k^* = n - l$. Since there must not be any incentives to deviate from the equilibrium it must be satisfied that:

$\pi_{DB,L}\left(k = n - l\right) \geq \pi_{DB,H}\left(k = n - l - 1\right)$ which is equivalent to

$$\frac{\gamma m}{t}\left[\frac{1}{2}\frac{n-l-(n-l)}{n-1}\frac{\alpha i(1-\gamma)}{\gamma} + \frac{t}{n}\right]^2 - F \geq \frac{\gamma m}{t}\left[-\frac{1}{2}\frac{l+(n-l-1)-1}{n-1}\frac{\alpha i(1-\gamma)}{\gamma} + \frac{t}{n}\right]^2 \quad \text{or}$$

$$F \leq \frac{n-2}{n-1}\left[\frac{m\alpha i(1-\gamma)}{n} - \frac{m(\alpha i(1-\gamma))^2}{4t\gamma}\frac{n-2}{n-1}\right] \equiv \underline{F}.$$

(2) Equilibrium in which No Domestic Bank Invests in Perfect Screening

It must hold that $k^* = 1$.[39] Since there must not be any incentives to deviate from the equilibrium, it must be satisfied that:

$\pi_{DB,H}\left(k = 1\right) \geq \pi_{DB,L}\left(k = 2\right)$ which is equivalent to

$$\frac{\gamma m}{t}\left[-\frac{1}{2}\frac{l+1-1}{n-1}\frac{\alpha i(1-\gamma)}{\gamma} + \frac{t}{n}\right]^2 \geq \frac{\gamma m}{t}\left\{\frac{1}{2}\left[1 - \frac{l+2-1}{n-1}\right]\frac{\alpha i(1-\gamma)}{\gamma} + \frac{t}{n}\right\}^2 - F \quad \text{or}$$

$$F \geq \frac{n-2}{n-1}\left[\frac{m\alpha i(1-\gamma)}{n} + \frac{m(\alpha i(1-\gamma))^2}{4t\gamma}\frac{n-2l-2}{n-1}\right] \equiv \overline{F}.$$

(3) Equilibrium in which the Domestic Banks Coordinate about a Certain Number of Banks Investing in Perfect Screening

In an equilibrium in which the domestic banks coordinate about a certain number k^* of banks investing in the perfect screening technology it must hold that

[39] since q is defined as $q = \frac{l+k-1}{n-1}$, k^* is defined to be equal to 1 in case no domestic bank invests in screening. The probability that the neighboring bank is a perfectly screening bank is then equal to $\frac{l}{n-1}$.

given that k^* domestic banks invest in screening all domestic banks are indifferent between investing or not investing in the screening technology. However, for $\pi_{DB,H}\left(k=\widetilde{k}^*\right)=\pi_{DB,L}\left(k=\widetilde{k}^*\right)$ there are incentives to deviate from $\widetilde{k}^*$ as it holds that $\frac{d\pi_H}{dk}=-\frac{m\alpha i(1-\gamma)}{t(n-1)}[\frac{t}{n}-\frac{1}{2}\frac{l+k-1}{n-1}\frac{\alpha i(1-\gamma)}{\gamma}]$ which is negative since the term in brackets corresponds to the market share of a domestic bank not investing in screening which must be positive. Hence, $\pi_{DB,H}\left(k=\widetilde{k}^*-1\right)>\pi_{DB,L}\left(k=\widetilde{k}^*\right)$ holds and the condition guaranteeing that there are no incentives to deviate from the equilibrium in which the domestic banks coordinate about a certain number k^* of banks investing in perfect screening is given by:

$$\pi_{DB,L}\left(k=k^*\right)\geq\pi_{DB,H}\left(k=k^*-1\right)\ \wedge\ \pi_{DB,H}\left(k=k^*\right)\geq\pi_{DB,L}\left(k=k^*+1\right).$$

This is equivalent to

$$\frac{\gamma m}{t}\{\frac{1}{2}[1-\frac{l+k^*-1}{n-1}]\frac{\alpha i(1-\gamma)}{\gamma}+\frac{t}{n}\}^2-F\geq\frac{\gamma m}{t}[-\frac{1}{2}\frac{l+(k^*-1)-1}{n-1}\frac{\alpha i(1-\gamma)}{\gamma}+\frac{t}{n}]^2\ \wedge$$
$$\frac{\gamma m}{t}[-\frac{1}{2}\frac{l+k^*-1}{n-1}\frac{\alpha i(1-\gamma)}{\gamma}+\frac{t}{n}]^2\geq\frac{\gamma m}{t}\{\frac{1}{2}[1-\frac{l+(k^*+1)-1}{n-1}]\frac{\alpha i(1-\gamma)}{\gamma}+\frac{t}{n}\}^2-F$$

It follows that k^* must lie in the range

$$\frac{n}{2}-l-\frac{2t\gamma(n-1)}{\alpha i(1-\gamma)}[\frac{F}{m\alpha i(1-\gamma)}\frac{(n-1)}{(n-2)}-\frac{1}{n}]\leq k^*\leq\frac{n}{2}-l+1-\frac{2t\gamma(n-1)}{\alpha i(1-\gamma)}[\frac{F}{m\alpha i(1-\gamma)}\frac{(n-1)}{(n-2)}-\frac{1}{n}].$$

We define $k^*=:\frac{n}{2}-l-\frac{2t\gamma(n-1)}{\alpha i(1-\gamma)}[\frac{F}{m\alpha i(1-\gamma)}\frac{(n-1)}{(n-2)}-\frac{1}{n}]+\Delta$ with $\Delta\in[0;1]$.

Further, it must hold that

$$1<\frac{n}{2}-l-\frac{2t\gamma(n-1)}{\alpha i(1-\gamma)}[\frac{F}{m\alpha i(1-\gamma)}\frac{(n-1)}{(n-2)}-\frac{1}{n}]\text{ and }\frac{n}{2}-l+1-\frac{2t\gamma(n-1)}{\alpha i(1-\gamma)}[\frac{F}{m\alpha i(1-\gamma)}\frac{(n-1)}{(n-2)}-\frac{1}{n}]<n-l$$

which simplifies to

$$F<\frac{n-2}{n-1}[\frac{m\alpha i(1-\gamma)}{n}+\frac{m(\alpha i(1-\gamma))^2}{4t\gamma}\frac{n-2l-2}{n-1}]\text{ and }F>\frac{n-2}{n-1}[\frac{m\alpha i(1-\gamma)}{n}-\frac{m(\alpha i(1-\gamma))^2}{4t\gamma}\frac{n-2}{n-1}].$$

Hence, an equilibrium in which the domestic banks coordinate about a certain number k^* of banks investing in perfect screening exists for $\underline{F}<F<\overline{F}$.

Proof of Proposition 2.3:

$\frac{dk^*}{d(-\alpha)} = \frac{2t\gamma(n-1)}{\alpha^2 i(1-\gamma)}[\frac{1}{n} - \frac{2F}{m\alpha i(1-\gamma)}\frac{n-1}{n-2}]$ and

$\frac{dk^*}{d(-\alpha)} < 0$ if $F > \frac{1}{2}\frac{m\alpha i(1-\gamma)}{n}\frac{n-2}{n-1}$.

Note that from the condition that the marginal borrower must be located in between two neighboring banks it follows that $\frac{(1-\gamma)\alpha i}{2t\gamma} \leq \frac{1}{n}$. Note also that with $\frac{(1-\gamma)\alpha i}{2t\gamma} = \frac{1}{n}$ the lowest possible value of $\underline{F}$ is reached and equals $\frac{1}{2}\frac{m\alpha i(1-\gamma)}{(n-1)}\frac{n-2}{n-1} \equiv \underline{\underline{F}}$. Since $\frac{1}{2}\frac{m\alpha i(1-\gamma)}{n}\frac{n-2}{n-1} < \underline{\underline{F}}$ it holds that $\frac{dk^*}{d(-\alpha)} < 0$.

$\frac{d^2k^*}{d(-\alpha)^2} = \frac{4t\gamma(n-1)}{(1-\gamma)i\alpha^3}[\frac{1}{n} - \frac{3F}{m\alpha i(1-\gamma)}\frac{n-1}{n-2}]$ and

$\frac{d^2k^*}{d(-\alpha)^2} < 0$ if $F > \frac{1}{3}\frac{m\alpha i(1-\gamma)}{n}\frac{n-2}{n-1}$.

Since $\frac{1}{3}\frac{m\alpha i(1-\gamma)}{n}\frac{n-2}{n-1} < \underline{\underline{F}}$ it holds that $\frac{d^2k^*}{d(-\alpha)^2} < 0$.

Proof of Proposition 2.4:

$\frac{dk^*}{dn} = \frac{1}{2} - \frac{2t\gamma}{\alpha i(1-\gamma)}[\frac{F(n-1)(n-3)}{m\alpha i(1-\gamma)(n-2)^2} - \frac{1}{n^2}]$.

Consider first $\widehat{F} = \frac{m\alpha i(1-\gamma)}{n}\frac{n-2}{n-1} - \frac{m[\alpha i(1-\gamma)]^2}{4t\gamma}\frac{(n-6)(n-2)}{(n-1)^2}$ for which $k^* = n-l-2$ holds. In that case, we arrive at

$\frac{dk^*}{dn} = \frac{1}{2} - \frac{2t\gamma}{\alpha i(1-\gamma)}\{\frac{(n-1)(n-3)}{m\alpha i(1-\gamma)(n-2)^2}[\frac{m\alpha i(1-\gamma)}{n}\frac{n-2}{n-1} - \frac{m(\alpha i(1-\gamma))^2}{4t\gamma}\frac{(n-6)(n-2)}{(n-1)^2}] - \frac{1}{n^2}\}$.

If follows that $\frac{dk^*}{dn} < 0$ if $\frac{\alpha i(1-\gamma)}{2t\gamma} < \frac{1}{n}\frac{(n-1)\left(n^2-4n+2\right)}{n(n^2-6n+10)}$.

Since $\frac{\alpha i(1-\gamma)}{2t\gamma} \leq \frac{1}{n}$ and $\frac{(n-1)\left(n^2-4n+2\right)}{n(n^2-6n+10)} > 1$, it follows that $\frac{dk^*}{dn} < 0$. Since $\frac{\partial^2 k^*}{\partial n \partial F} = -\frac{2t\gamma(n-1)(n-3)}{m[\alpha i(1-\gamma)]^2(n-2)^2} < 0$, $\frac{dk^*}{dn} < 0$ also holds for $F > \widehat{F}$.

Consider second $\widetilde{F} = \frac{m\alpha i(1-\gamma)}{n}\frac{n-2}{n-1} - \frac{m[\alpha i(1-\gamma)]^2}{4t\gamma}\frac{(n-4)(n-2)}{(n-1)^2}$ for which $k^* = n-l-1$ holds. In that case, we arrive at

$\frac{dk^*}{dn} = \frac{1}{2} - \frac{2t\gamma}{\alpha i(1-\gamma)}\{\frac{(n-1)(n-3)}{m\alpha i(1-\gamma)(n-2)^2}[\frac{m\alpha i(1-\gamma)}{n}\frac{n-2}{n-1} - \frac{m(\alpha i(1-\gamma))^2}{4t\gamma}\frac{(n-4)(n-2)}{(n-1)^2}] - \frac{1}{n^2}\}$.

If follows that $\frac{dk^*}{dn} < 0$ if $\frac{\alpha i(1-\gamma)}{2t\gamma} < \frac{1}{n}\frac{(n-1)\left(n^2-4n+2\right)}{n(n^2-5n+7)}$.

Since $\frac{\alpha i(1-\gamma)}{2t\gamma} \leq \frac{1}{n}$ but $\frac{(n-1)\left(n^2-4n+2\right)}{n(n^2-5n+7)} < 1$ is possible, $\frac{dk^*}{dn} > 0$ is feasible for $F = \widetilde{F}$. However, $k^*\left(n+1,\widetilde{F}\right) < k^*\left(n,\widetilde{F}\right)$ if $\frac{\alpha i(1-\gamma)}{2t\gamma} < \frac{1}{n+1}\frac{2n(n-1)(n-3)}{2n^3-10n^2+16n-5}$. Since $\frac{\alpha i(1-\gamma)}{2t\gamma} \leq \frac{1}{n+1}$ must hold and $\frac{2n(n-1)(n-3)}{16n-10n^2+2n^3-5} > 1$, $k^*\left(n+1,\widetilde{F}\right) < k^*\left(n,\widetilde{F}\right)$ holds. Thus, with a rising number of banks, the number of domestic banks investing in perfect screening falls.

$\frac{d^2k^*}{dn^2} = -\frac{2t\gamma}{\alpha i(1-\gamma)}[\frac{2}{n^3} + \frac{2F}{m\alpha i(1-\gamma)(n-2)^3}]$ is clearly negative.

Proof of Proposition 2.5:

$\frac{\partial^2 k^*}{\partial(-\alpha)\partial n} = \frac{2t\gamma}{n^2\alpha^2 i(1-\gamma)} - \frac{4t\gamma F}{m\alpha^3 i^2(1-\gamma)^2}\frac{(n-1)(n-3)}{(n-2)^2}$ and

$\frac{\partial^2 k^*}{\partial(-\alpha)\partial n} < 0$ if $F > \frac{1}{2}\frac{m\alpha i(1-\gamma)}{(n-1)}\frac{(n-2)^2}{n^2(n-3)}$.

Since $\frac{1}{2}\frac{m\alpha i(1-\gamma)}{(n-1)}\frac{(n-2)^2}{n^2(n-3)} < \underline{\underline{F}}$ it holds that $\frac{\partial^2 k^*}{\partial(-\alpha)\partial n} < 0$.

Proof of Proposition 2.6:

$\frac{dk^*}{d\left(\frac{1}{t}\right)} = \frac{2t^2\gamma(n-1)}{\alpha i(1-\gamma)}[\frac{F}{m\alpha i(1-\gamma)}\frac{n-1}{n-2} - \frac{1}{n}]$ and

$\frac{dk^*}{d\left(\frac{1}{t}\right)} > 0$ if $F > \frac{m\alpha i(1-\gamma)}{n}\frac{n-2}{n-1}$ and $\frac{dk^*}{d\left(\frac{1}{t}\right)} < 0$ if $F < \frac{m\alpha i(1-\gamma)}{n}\frac{n-2}{n-1}$.

We define $F_1 \equiv \frac{m\alpha i(1-\gamma)}{n}\frac{n-2}{n-1}$.

$\frac{d^2k^*}{d\left(\frac{1}{t}\right)^2} = \frac{4\gamma t^3(n-1)}{\alpha i(1-\gamma)}[\frac{1}{n} - \frac{F}{m\alpha i(1-\gamma)}\frac{n-1}{n-2}]$ and

$\frac{d^2k^*}{d\left(\frac{1}{t}\right)^2} > 0$ if $F < F_1$ and $\frac{d^2k^*}{d\left(\frac{1}{t}\right)^2} < 0$ if $F > F_1$.

Note that $F > F_1$ is only possible if $F_1 < \overline{F}$ which holds for $l < \frac{n-2}{2}$.

Proof of Proposition 2.7:

$$\frac{\partial^2 k^*}{\partial(-\alpha)\partial\left(\frac{1}{t}\right)} = \frac{2\gamma t^2(n-1)}{\alpha^2 i(1-\gamma)}\left[\frac{2F(n-1)}{m\alpha i(1-\gamma)(n-2)} - \frac{1}{n}\right] \text{ and}$$

$$\frac{\partial^2 k^*}{\partial(-\alpha)\partial\left(\frac{1}{t}\right)} > 0 \text{ if } F > \frac{1}{2}\frac{m\alpha i(1-\gamma)}{n}\frac{n-2}{n-1}.$$

Since $\frac{1}{2}\frac{m\alpha i(1-\gamma)}{n}\frac{n-2}{n-1} < \underline{\underline{F}}$ it holds that $\frac{\partial^2 k^*}{\partial(-\alpha)\partial\left(\frac{1}{t}\right)} > 0$.

$$\frac{\partial^2 k^*}{\partial n\partial\left(\frac{1}{t}\right)} = \frac{2\gamma t^2}{\alpha i(1-\gamma)}\left[\frac{F(n-1)(n-3)}{m\alpha i(1-\gamma)(n-2)^2} - \frac{1}{n^2}\right] \text{ and}$$

$$\frac{\partial^2 k^*}{\partial n\partial\left(\frac{1}{t}\right)} > 0 \text{ if } F > \frac{m\alpha i(1-\gamma)}{n^2}\frac{(n-2)^2}{(n-1)(n-3)}.$$

Since $\frac{m\alpha i(1-\gamma)}{n^2}\frac{(n-2)^2}{(n-1)(n-3)} < \underline{\underline{F}}$ it holds that $\frac{\partial^2 k^*}{\partial n\partial\left(\frac{1}{t}\right)} > 0$.

Proof of Proposition 2.8:

Set-up of the Social Welfare Function:

Welfare consists of the sum of borrower rents and bank rents. Borrower rents are captured by the willingness to pay of borrowers minus the repayments of borrowers to banks and their transport costs. Bank rents include the revenues of banks minus their costs.[40]

Transport costs are given by

$$2m\left(k^*+l\right)\left[\frac{n-l-k^*}{n-1}\int_0^{\frac{1}{2n}+\frac{\alpha i(1-\gamma)}{4t\gamma}} tx\,dx + \frac{l+k^*-1}{n-1}\int_0^{\frac{1}{2n}} tx\,dx\right]+$$

$$2m\left(n-l-k^*\right)\left[\frac{n-l-k^*}{n-1}\int_0^{\frac{1}{2n}} tx\,dx + \frac{l+k^*-1}{n-1}\int_0^{\frac{1}{2n}-\frac{\alpha i(1-\gamma)}{4t\gamma}} tx\,dx\right] =$$

$$tm\left\{\frac{n-k^*-l}{n-1}\frac{\alpha i(1-\gamma)}{4t\gamma}\left[\frac{\alpha i(1-\gamma)}{4t\gamma}\left(2k^*+2l-1\right)+\frac{1}{n}\right]+\frac{1}{4n}\right\}.$$

[40] In order to analytically solve for the welfare implications, we focus on the following parameter ranges throughout section 2.6. We assume that the share of borrowers with good projects is larger than one half and not arbitrarily close to its boundary values, and that spillovers are not too large i.e. $1-\alpha < 0.75$.

Since the repayments of borrowers to banks equal the revenues of banks, welfare can be expressed as

$$W = vm\gamma + 0 \cdot m\,(1-\gamma) - tm\{\tfrac{n-k^*-l}{n-1}\tfrac{\alpha i(1-\gamma)}{4t\gamma}[\tfrac{\alpha i(1-\gamma)}{4t\gamma}\,(2k^*+2l-1)+\tfrac{1}{n}]+\tfrac{1}{4n}\}-$$
$$k^* mi\gamma[\tfrac{n-l-k^*}{n-1}\tfrac{\alpha i(1-\gamma)}{2t\gamma}+\tfrac{1}{n}] - k^*F - lmi\gamma[\tfrac{n-l-k^*}{n-1}\tfrac{\alpha i(1-\gamma)}{2t\gamma}+\tfrac{1}{n}]-$$
$$(n-l-k^*)\,im[-\tfrac{l+k^*-1}{n-1}\tfrac{\alpha i(1-\gamma)}{2t\gamma}+\tfrac{1}{n}][\gamma+(1-\gamma)\,\alpha].$$

Effect of Competitive Pressure $\frac{1}{t}$ on Welfare:

$$\frac{\partial W}{\partial(\frac{1}{t})} = \frac{1}{32mn\gamma^2[\alpha i(1-\gamma)]^2(n-1)(n-2)^2}\{[m\alpha i\,(1-\gamma)\,(n-2)]^2[\alpha\,(1-\gamma)\,i^2 n\,(n-2\Delta)$$
$$(\alpha\,(1-\gamma)\,(4\gamma-1)\,(n-1+2\Delta)-4\gamma\,(\alpha\,(1-\gamma)+2\gamma))-8t^2\gamma^2\,(n-1)]-F$$
$$[4t\gamma\,(n-1)]^2[Fn\,(n-1)\,(n-4\gamma-1)-m\alpha i\,(1-\gamma)\,(n-2)\,(2n-4\gamma-1)]\}.$$

$\frac{\partial W}{\partial(\frac{1}{t})} > 0$ holds if

$$\left(\tfrac{1}{t}\right)^2 > \frac{8(n-1)[m\gamma\alpha i(1-\gamma)(n-2)]^2+F[4\gamma(n-1)]^2[Fn(n-1)(n-4\gamma-1)-m\alpha i(1-\gamma)(n-2)(2n-4\gamma-1)]}{inm^2[\alpha i(1-\gamma)]^3(n-2)^2(n-2\Delta)[\alpha(1-\gamma)(4\gamma-1)(n-1+2\Delta)-4\gamma(\alpha(1-\gamma)+2\gamma)]}.$$ [41]

$\frac{\partial W}{\partial(\frac{1}{t})} > 0$ is satisfied for

$$\frac{8(n-1)[m\gamma\alpha i(1-\gamma)(n-2)]^2+F[4\gamma(n-1)]^2[Fn(n-1)(n-4\gamma-1)-m\alpha i(1-\gamma)(n-2)(2n-4\gamma-1)]}{inm^2[\alpha i(1-\gamma)]^3(n-2)^2(n-2\Delta)[\alpha(1-\gamma)(4\gamma-1)(n-1+2\Delta)-4\gamma(\alpha(1-\gamma)+2\gamma)]} < 0.$$

This inequality holds for

$$F_2[1-\sqrt{1-\tfrac{2n(n-4\gamma-1)}{(2n-4\gamma-1)^2}}] < F < F_2[1+\sqrt{1-\tfrac{2n(n-4\gamma-1)}{(2n-4\gamma-1)^2}}]$$

with $F_2 \equiv \frac{1}{2}\frac{m\alpha i(1-\gamma)}{n}\frac{n-2}{n-1}\frac{2n-4\gamma-1}{n-4\gamma-1}$.

(i) Proof of $F > F_2[1-\sqrt{1-\frac{2n(n-4\gamma-1)}{(2n-4\gamma-1)^2}}]$:

Since $F_2[1-\sqrt{1-\frac{2n(n-4\gamma-1)}{(2n-4\gamma-1)^2}}] < \underline{\underline{F}}$ for $n > 5$ it holds that $F > F_2[1-\sqrt{1-\frac{2n(n-4\gamma-1)}{(2n-4\gamma-1)^2}}]$.

[41] We assume that n is not too small and that γ is not too close to its boundary values such that $\alpha\,(1-\gamma)\,(4\gamma-1)\,(n-1+2\Delta)-4\gamma[\alpha\,(1-\gamma)+2\gamma] > 0$.

(ii) Proof of $F < F_2[1+\sqrt{1-\frac{2n(n-4\gamma-1)}{(2n-4\gamma-1)^2}}]$:

Note that with $\frac{(1-\gamma)\alpha i}{2t\gamma} = \frac{1}{n}$ the highest possible value of $\overline{F}$ is reached and equals $\frac{m\alpha i(1-\gamma)}{n}\frac{n-2}{n-1}[\frac{3}{2} - \frac{2l+1}{2(n-1)}]$. Further, $F_2[1+\sqrt{1-\frac{2n(n-4\gamma-1)}{(2n-4\gamma-1)^2}}] > \frac{3}{2}\frac{m\alpha i(1-\gamma)}{n}\frac{n-2}{n-1}$ holds for $n > 5$ such that $F < F_2[1+\sqrt{1-\frac{2n(n-4\gamma-1)}{(2n-4\gamma-1)^2}}]$ holds.

Proof of Proposition 2.9:

$$\begin{aligned}\frac{\partial W}{\partial(-\alpha)} = & -\frac{1}{\alpha mn(n-1)[4\alpha i\gamma(1-\gamma)(n-2)]^2}\{-m^2(n-2)^2[\alpha i(1-\gamma)]^3[\tfrac{in}{t}(n-2\Delta) \\ & [4\gamma(\gamma+\alpha(1-\gamma)) - \alpha(1-\gamma)(4\gamma-1)(n-1+2\Delta)]+ \\ & 2\gamma[4\gamma(n-1)^2 + (2\Delta-1)((n-1)(4\gamma-1)-n)]]-8Ft\gamma^2(n-1)^2 \\ & [2Fn(n-1)(n-4\gamma-1) - m\alpha i(1-\gamma)(n-2)\left(2n-4\gamma-1+\tfrac{2in\gamma}{t}\right)]\}.\end{aligned}$$

$\frac{\partial W}{\partial(-\alpha)} > 0$ holds if

$T_1 < \frac{1}{t} < T_2$

with $T_1 \equiv A\left(1-\sqrt{1-B}\right)$ and $T_2 \equiv A\left(1+\sqrt{1-B}\right)$ and

$$A \equiv \frac{8Fin\gamma^3(n-1)^2 - m\gamma[\alpha i(1-\gamma)]^2(n-2)C_1}{m[\alpha i(1-\gamma)]^2 n(n-2)(n-2\Delta)C_2}$$

$$B \equiv \frac{8F\alpha i(1-\gamma)\gamma^2 n(n-1)^2(n-2\Delta)[2Fn(n-1)(n-4\gamma-1) - m\alpha i(1-\gamma)(n-2)(2n-4\gamma-1)]C_2}{[8Fi\gamma^3 n(n-1)^2 - m\gamma(\alpha i(1-\gamma))^2(n-2)C_1]^2}$$

$$C_1 \equiv 4\gamma(n-1)^2 + (2\Delta-1)[(n-1)(4\gamma-1)-n] > 0$$

$$C_2 \equiv i[4\gamma[\gamma+\alpha(1-\gamma)] - \alpha(1-\gamma)(4\gamma-1)(n-1+2\Delta)] < 0.$$

Note that $A > 0$ holds if $F < \frac{m\alpha i(1-\gamma)}{n}\frac{n-2}{n-1}\frac{\alpha(1-\gamma)C_1}{8\gamma^2(n-1)}$.

Remember that $\overline{F} \leq \frac{3}{2}\frac{m\alpha i(1-\gamma)}{n}\frac{n-2}{n-1}$. Further, $\frac{\alpha(1-\gamma)C_1}{8\gamma^2(n-1)} > \frac{3}{2}$ is satisfied for $n > 13$. Hence, $F < \frac{m\alpha i(1-\gamma)}{n}\frac{n-2}{n-1}\frac{\alpha(1-\gamma)C_1}{8\gamma^2(n-1)}$ is fulfilled and $A > 0$ holds.

It follows from $A > 0$ that

(i) $T_2 > 0$ and

(ii) $T_1 > 0$ if $0 < B < 1$ and $T_1 < 0$ if $B < 0$.

Note that $B > 0$ is equivalent to $F < F_2$.

Further, it is easily verified that $T_2 \mid_{F>F_2} > T_2 \mid_{F<F_2}$. We define $T_3 \equiv T_2 \mid_{F>F_2}$.

It follows that

(i) for $F < F_2$, $\frac{\partial W}{\partial(-\alpha)} < 0$ if $\frac{1}{t} < T_1$ or $\frac{1}{t} > T_2$ and $\frac{\partial W}{\partial(-\alpha)} > 0$ if $T_1 < \frac{1}{t} < T_2$;

(ii) for $F > F_2$, $\frac{\partial W}{\partial(-\alpha)} > 0$ if $\frac{1}{t} < T_3$ and $\frac{\partial W}{\partial(-\alpha)} < 0$ if $\frac{1}{t} > T_3$.

Proof of Proposition 2.10:

$$\begin{aligned}\frac{\partial W}{\partial n} = &-\frac{1}{32(\alpha i(1-\gamma))^2 mn^2 t\gamma^2 (n-1)^2 (n-2)^3}\{(m\alpha i\,(1-\gamma))^2\,(n-2)^3[2\alpha i\,(1-\gamma)\,\Delta[\alpha i\,(1-\gamma)\,n^2\\ &[(4\gamma-1)\,(1-2\Delta)+4\gamma(1+\tfrac{2\gamma}{\alpha(1-\gamma)})]+4t\gamma(n^2-(n-1)^2\,(4\gamma-1))]+4t\gamma[(n-1)^2\\ &(8i\gamma^2\,(1-\alpha)+\alpha i\,(8\gamma-1)+2t\gamma)+\alpha i\,(n^2\,(2\gamma-1)-\gamma\,(2n-1))]-(n\alpha i\,(1-\gamma))^2\\ &[((4\gamma-1)\,(n-1)^2+4\gamma)+\tfrac{8\gamma^2}{\alpha(1-\gamma)}]]-4t\gamma\,(n-1)^2\,F[4t\gamma Fn^2\,(n-1)\,[(n-1)\,(n-4)\\ &+8\gamma]-m\alpha i\,(1-\gamma)\,(n-2)[in^2[\alpha\,(1-\gamma)(4\gamma\,(n-1)\,(n-2)-4\gamma\,(n-4\Delta)+1\\ &-4\Delta)-8\gamma^2]+4t\gamma[n^2\,(4\gamma-1)-2\,(4\gamma+1)\,(n-1)]]]]\}.\end{aligned}$$

$\frac{\partial W}{\partial n} < 0$ holds if

$T_4 < \frac{1}{t} < T_5$

with $T_4 \equiv D\left(1-\sqrt{1-E}\right)$ and $T_5 \equiv D\left(1+\sqrt{1-E}\right)$ and

$$D \equiv -\frac{2i\gamma[m\alpha i(1-\gamma)(n-2)^2 G_1+n^2(n-1)^2 FG_4]}{m[i\alpha(1-\gamma)]^3 n^2 (n-2)^2 G_2}$$

$$E \equiv \frac{2(n-2)[\alpha(1-\gamma)n(n-1)]^2[(m\alpha i(1-\gamma))^2(n-2)^3-2FG_3]G_2}{[m\alpha i(1-\gamma)(n-2)^2 G_1+n^2(n-1)^2 FG_4]^2}$$

$$G_1 \equiv 4\gamma\,(n-1)^2\,[\alpha\,(1-\gamma)+2\gamma]-\alpha\,(1-\gamma)\,(1-2\Delta)\,[2n\,(n-1)+1-4\gamma\,(n-1)^2]$$

$$G_2 \equiv [8\gamma-1+\frac{8\gamma^2}{\alpha(1-\gamma)}]\,(2\Delta-1)-(4\gamma-1)\,[n\,(n-2)+4\Delta^2]$$

$$G_3 \equiv Fn^2 (n-1) [(n-1)(n-4) + 8\gamma] -$$
$$m\alpha i (1-\gamma)(n-2) [n^2 (4\gamma - 1) - 2(4\gamma+1)(n-1)]$$

$$G_4 \equiv \alpha (1-\gamma) [4\gamma (n^2 - 4n + 2) + 1 + 4\Delta (4\gamma - 1)] - 8\gamma^2$$

It is useful to show for further proofs that (i) $G_1 > 0$, (ii) $G_2 < 0$ and (iii) $G_4 > 0$.

(i) Proof of $G_1 > 0$:

Note that for $\Delta = 1$, G_1 simplifies to $8\gamma^2 (n-1)^2 + \alpha (1-\gamma) [2n(n-1) + 1]$ which clearly is positive. Note that $\frac{dG_1}{d\Delta} = 2\alpha (1-\gamma) [2n(n-1) + 1 - 4\gamma (n-1)^2]$. Since $2n(n-1) + 1 - 4\gamma (n-1)^2 < 0$[42] it follows that $G_1 > 0$ holds also for $\Delta < 1$.

(ii) Proof of $G_2 < 0$:

For $\Delta = 1$, G_2 equals $8\gamma - 1 + \frac{8\gamma^2}{\alpha(1-\gamma)} - (4\gamma - 1)[n(n-2) + 4] < 0$.[43] Further, $\frac{dG_2}{d\Delta} > 0$ for $\Delta < \frac{8\gamma-1}{4(4\gamma-1)} + \frac{2\gamma^2}{\alpha(1-\gamma)(4\gamma-1)}$. Since $\frac{8\gamma-1}{4(4\gamma-1)} + \frac{2\gamma^2}{\alpha(1-\gamma)(4\gamma-1)} > 1$ it holds that $G_2 < 0$.

(iii) Proof of $G_4 > 0$:

$G_4 > 0$ holds if $\alpha > \frac{8\gamma^2}{(1-\gamma)[4\gamma(n^2-4n+2)+1+4\Delta(4\gamma-1)]}$. Further, for $\Delta = 0$ the condition simplifies to $\alpha > \frac{8\gamma^2}{(1-\gamma)[4\gamma(n^2-4n+2)+1]}$ which holds.[42] Hence, $\alpha > \frac{8\gamma^2}{(1-\gamma)[4\gamma(n^2-4n+2)+1+4\Delta(4\gamma-1)]}$ is also satisfied for $\Delta > 0$ and thus, $G_4 > 0$ holds.

We now show that $D > 0$. $D > 0$ holds if $G_2 < 0$ and $m\alpha i (1-\gamma)(n-2)^2 G_1 + n^2 (n-1)^2 FG_4 > 0$, with the first condition already proved. The second condition is equivalent to $F > -\frac{m\alpha i(1-\gamma)}{n^2} \frac{(n-2)^2}{(n-1)^2} \frac{G_1}{G_4}$. Since $G_1 > 0$ and $G_4 > 0$, this condition clearly is satisfied and $D > 0$ holds.

It follows from $D > 0$ that

(i) $T_5 > 0$ and

(ii) $T_4 > 0$ if $0 < E < 1$ and $T_4 < 0$ if $E < 0$.

[42] for γ not too close to 0.5 and n not too small
[43] for γ not too close to 1 and n not too small

Note that $E < 0$ is equivalent to

$F_4 < F < F_3$

with $F_4 \equiv H\left(1 - \sqrt{1+J}\right)$ and $F_3 \equiv H\left(1 + \sqrt{1+J}\right)$ and

$H \equiv \frac{m\alpha i(1-\gamma)(n-2)[n^2(4\gamma-1)-2(4\gamma+1)(n-1)]}{2n^2(n-1)[(n-1)(n-4)+8\gamma]}$

$J \equiv \frac{2(n-1)(n-2)n^2[(n-1)(n-4)+8\gamma]}{[n^2(4\gamma-1)-2(4\gamma+1)(n-1)]^2}$.

Note that since $n^2(4\gamma-1) - 2(4\gamma+1)(n-1) > 0$ it holds that $H > 0$ and $J > 0$ clearly holds.

It follows from $J > 0$ that $F_4 < 0$. Hence, it holds that $E < 0$ and thus $T_4 < 0$ for $F < F_3$ and $E > 0$ and thus $T_4 > 0$ for $F > F_3$.

Further, it is easily verified that $T_5 \mid_{F<F_3} > T_5 \mid_{F>F_3}$. We define $T_6 \equiv T_5 \mid_{F<F_3}$.

It follows that

(i) for $F < F_3$, $\frac{\partial W}{\partial n} < 0$ if $\frac{1}{t} < T_6$ and $\frac{\partial W}{\partial n} > 0$ if $\frac{1}{t} > T_6$;

(ii) for $F > F_3$, $\frac{\partial W}{\partial n} > 0$ if $\frac{1}{t} < T_4$ or $\frac{1}{t} > T_5$ and $\frac{\partial W}{\partial n} < 0$ if $T_4 < \frac{1}{t} < T_5$.

Appendix to Chapter 3

Proof of Lemma 3.1:

The utility of a safe borrower if she receives a loan from microfinance institution A is given by

$$U_S^A = i + p_S^2[v - \left(1 + r_S^A\right) i] + p_S\left(1 - p_S\right)\left[v - \left(1 + r_S^A\right) i - \lambda_S^A\left(1 + r_S^A\right) i\right] - tx - d.$$

The utility of a safe borrower if she receives a loan from microfinance institution B is given by

$$U_S^B = i + p_S^2[v - \left(1 + r_S^B\right) i] + p_S\left(1 - p_S\right)\left[v - \left(1 + r_S^B\right) i - \lambda_S^B\left(1 + r_S^B\right) i\right] - t\left(1 - x\right) - d.$$

Hence, the marginal borrower in the segment of safe borrowers is given by

$$x_S\left(G, G\right) = \frac{t - ip_S[\lambda_S^A(1-p_S)\left(1+r_S^A\right)+r_S^A-\lambda_S^B(1-p_S)\left(1+r_S^B\right)-r_S^B]}{2t}.$$

The utility of a risky borrower if she receives a loan from microfinance institution A is given by

$$U_R^A = i + p_R^2[v - \left(1 + r_R^A\right) i] + p_R\left(1 - p_R\right)\left[v - \left(1 + r_R^A\right) i - \lambda_R^A\left(1 + r_R^A\right) i\right] - tx - d.$$

The utility of a risky borrower if she receives a loan from microfinance institution B is given by

$$U_R^B = i + p_R^2[v - \left(1 + r_R^B\right) i] + p_R\left(1 - p_R\right)\left[v - \left(1 + r_R^B\right) i - \lambda_R^B\left(1 + r_R^B\right) i\right] - t\left(1 - x\right) - d.$$

Hence, the marginal borrower in the segment of risky borrowers is given by

$$x_R\left(G, G\right) = \frac{t - ip_R[\lambda_R^A(1-p_R)\left(1+r_R^A\right)+r_R^A-\lambda_R^B(1-p_R)\left(1+r_R^B\right)-r_R^B]}{2t}.$$

Profits of microfinance institutions are given as follows:

$$\pi^A(G,G) = \gamma x_S(G,G)[2p_S^2(1+r_S^A) + 2p_S(1-p_S)(1+\lambda_S^A)(1+r_S^A) - 2(1+c)]i +$$
$$(1-\gamma)x_R(G,G)[2p_R^2(1+r_R^A) + 2p_R(1-p_R)(1+\lambda_R^A)(1+r_R^A) - 2(1+c)]i$$

$$\pi^B(G,G) = \gamma[1-x_S(G,G)][2p_S^2(1+r_S^B) + 2p_S(1-p_S)(1+\lambda_S^B)(1+r_S^B) - 2(1+c)]i +$$
$$(1-\gamma)[1-x_R(G,G)][2p_R^2(1+r_R^B) + 2p_R(1-p_R)(1+\lambda_R^B)(1+r_R^B) - 2(1+c)]i.$$

Microfinance institutions maximize their profit with respect to interest rates and the joint liability factors. Note that the following relationships hold:

$\frac{d\left(\pi^j(G,G)\right)}{dr_S^j} \stackrel{!}{=} 0$ is equivalent to $\frac{d\left(\pi^j(G,G)\right)}{d\lambda_S^j} \stackrel{!}{=} 0$

$\frac{d\left(\pi^j(G,G)\right)}{dr_R^j} \stackrel{!}{=} 0$ is equivalent to $\frac{d\left(\pi^j(G,G)\right)}{d\lambda_R^j} \stackrel{!}{=} 0.$

The first order conditions imply the following equilibrium interest rates dependent on the joint liability parameters:

$$r_S^j(G,G) = \frac{t+(1+c)i-p_S[1+\lambda_S^j(1-p_S)]i}{p_S[1+\lambda_S^j(1-p_S)]i}$$
$$r_R^j(G,G) = \frac{t+(1+c)i-p_R[1+\lambda_R^j(1-p_R)]i}{p_R[1+\lambda_R^j(1-p_R)]i}.$$

In order to induce self-selection of borrowers into different contracts offered, the incentive constraints for both safe and risky borrowers must be fulfilled:

If a group of risky borrowers truly reveals its type, the utility of a group member is given by

$$U_R(R) = i + p_R^2[v - \left(1 + r_R^j(G,G)\right)i] +$$
$$p_R(1-p_R)[v - \left(1 + r_R^j(G,G)\right)i - \lambda_R^j\left(1 + r_R^j(G,G)\right)i] - tx - d.$$

If a group of risky borrowers pretends to be of the safe type, the utility of a group member is given by

$$U_R(S) = i + p_R^2[v - \left(1 + r_S^j(G,G)\right)i] +$$
$$p_R(1-p_R)[v - \left(1 + r_S^j(G,G)\right)i - \lambda_S^j\left(1 + r_S^j(G,G)\right)i] - tx - d.$$

Note that $U_R(R) - U_R(S) > 0$ is equivalent to $\lambda_S^j > \frac{1}{p_R+p_S-1}$.[44]

[44] We will assume throughout our analysis that $p_R + p_S - 1 > 0$ holds.

If a group of safe borrowers truly reveals its type, the utility of a group member is given by

$$U_S\left(S\right) = i + p_S^2[v - \left(1 + r_S^j\left(G,G\right)\right)i] + \\ p_S\left(1-p_S\right)[v - \left(1 + r_S^j\left(G,G\right)\right)i - \lambda_S^j\left(1 + r_S^j\left(G,G\right)\right)i] - tx - d.$$

If a group of safe borrowers pretends to be of the risky type, the utility of a group member is given by

$$U_S\left(R\right) = i + p_S^2[v - \left(1 + r_R^j\left(G,G\right)\right)i] + \\ p_S\left(1-p_S\right)[v - \left(1 + r_R^j\left(G,G\right)\right)i - \lambda_R^j\left(1 + r_R^j\left(G,G\right)\right)i] - tx - d.$$

Note that $U_S\left(S\right) - U_S\left(R\right) > 0$ is equivalent to $\lambda_R^j < \frac{1}{p_S+p_R-1}$.

As a consequence, if $\lambda_R^j < \frac{1}{p_S+p_R-1} < \lambda_S^j$ is ensured, self-selection of borrowers into the different contracts can be achieved when interest rates are set accordingly.

We now show that $r_S^j\left(G,G\right) < r_R^j\left(G,G\right)$ holds for contracts that achieve self-selection of borrowers. This expression is equivalent to $p_S[1+\lambda_S^j\left(1-p_S\right)] - p_R[1+\lambda_R^j\left(1-p_R\right)] > 0$. We now define $\lambda_R^j \equiv \alpha\frac{1}{p_S+p_R-1}$ with $0 < \alpha < 1$. We can then rewrite the expression as $p_S\left(1-p_S\right)[\lambda_S^j\left(p_S+p_R-1\right) - 1] + p_R\left(1-p_R\right)\left(1-\alpha\right) > 0$. Note that $\lambda_S^j\left(p_S+p_R-1\right) - 1 > 0$ is equivalent to $\lambda_S^j > \frac{1}{p_S+p_R-1}$ which holds when the incentive constraint of the safe borrowers holds.

Hence, we have shown that if $\lambda_R^j < \frac{1}{p_S+p_R-1} < \lambda_S^j$ and $r_S^j\left(G,G\right) < r_R^j\left(G,G\right)$ holds, self-selection of borrowers can be achieved.

Note that $\lambda_R^j = \frac{1}{p_S+p_R-1} = \lambda_S^j$ implies $r_S^j\left(G,G\right) = r_R^j\left(G,G\right)$. In this case, self-selection of borrowers cannot be achieved.

We now show that equilibria exist both in which self-selection of borrowers is and is not achieved.

Case 1: Equilibrium with Contracts that Achieve Self-selection of Borrowers

We will now examine whether microfinance institution A has an incentive to deviate from offering contracts that achieve self-selection of borrowers given that microfinance institution B offers contracts that achieve self-selection and, thus, satisfy $\lambda_R^B < \frac{1}{p_S+p_R-1} < \lambda_S^B$. We define $\lambda_R^B \equiv \alpha^B \frac{1}{p_R+p_S-1}$ with $0 < \alpha^B < 1$ and $\lambda_S^B \equiv \beta^B \frac{1}{p_R+p_S-1}$ with $\beta^B > 1$. Then, interest rates of microfinance institution B can be expressed as

$$r_S^B \left(\lambda_R^B = \alpha^B \frac{1}{p_R+p_S-1}, \lambda_S^B = \beta^B \frac{1}{p_R+p_S-1} \right) = \frac{t+(1+c)i-p_S[1+\alpha^B \frac{1}{p_R+p_S-1}(1-p_S)]i}{p_S[1+\alpha^B \frac{1}{p_R+p_S-1}(1-p_S)]i} \text{ and}$$
$$r_R^B \left(\lambda_R^B = \alpha^B \frac{1}{p_R+p_S-1}, \lambda_S^B = \beta^B \frac{1}{p_R+p_S-1} \right) = \frac{t+(1+c)i-p_R[1+\beta^B \frac{1}{p_R+p_S-1}(1-p_R)]i}{p_R[1+\beta^B \frac{1}{p_R+p_S-1}(1-p_R)]i}.$$

Microfinance institution A maximizes profit with respect to interest rates and joint liability parameters. Note that the following relationships hold:

$$\frac{d\left(\pi^A\left(\lambda_R^B=\alpha^B \frac{1}{p_R+p_S-1}, \lambda_S^B=\beta^B \frac{1}{p_R+p_S-1}\right)\right)}{dr_S^A} \stackrel{!}{=} 0 \text{ is equivalent to}$$
$$\frac{d\left(\pi^A\left(\lambda_R^B=\alpha^B \frac{1}{p_R+p_S-1}, \lambda_S^B=\beta^B \frac{1}{p_R+p_S-1}\right)\right)}{d\lambda_S^A} \stackrel{!}{=} 0 \text{ and}$$
$$\frac{d\left(\pi^A\left(\lambda_R^B=\alpha^B \frac{1}{p_R+p_S-1}, \lambda_S^B=\beta^B \frac{1}{p_R+p_S-1}\right)\right)}{dr_R^A} \stackrel{!}{=} 0 \text{ is equivalent to}$$
$$\frac{d\left(\pi^A\left(\lambda_R^B=\alpha^B \frac{1}{p_R+p_S-1}, \lambda_S^B=\beta^B \frac{1}{p_R+p_S-1}\right)\right)}{d\lambda_R^A} \stackrel{!}{=} 0.$$

This gives the equilibrium interest rates of microfinance institution A dependent on the joint liability parameters:

$$r_S^A \left(\lambda_R^B = \alpha^B \frac{1}{p_R+p_S-1}, \lambda_S^B = \beta^B \frac{1}{p_R+p_S-1} \right) = \frac{t+(1+c)i-p_S[1+\lambda_S^A(1-p_S)]i}{p_S[1+\lambda_S^A(1-p_S)]i}$$
$$r_R^A \left(\lambda_R^B = \alpha^B \frac{1}{p_R+p_S-1}, \lambda_S^B = \beta^B \frac{1}{p_R+p_S-1} \right) = \frac{t+(1+c)i-p_R[1+\lambda_R^A(1-p_R)]i}{p_R[1+\lambda_R^A(1-p_R)]i}.$$

If microfinance institution A also offers a contract that separates borrowers, it must hold that $\lambda_R^A < \frac{1}{p_S+p_R-1} < \lambda_S^A$. We set $\lambda_R^A = \alpha^A \frac{1}{p_R+p_S-1}$ with $0 < \alpha^A < 1$ and $\lambda_S^A = \beta^A \frac{1}{p_R+p_S-1}$ with $\beta^A > 1$. Then, equilibrium interest rates of microfinance institution A are given by

$$r_S^A \left(\lambda_R^A = \alpha^A \frac{1}{p_R+p_S-1}, \lambda_S^A = \beta^A \frac{1}{p_R+p_S-1}, \lambda_R^B = \alpha^B \frac{1}{p_R+p_S-1}, \lambda_S^B = \beta^B \frac{1}{p_R+p_S-1} \right) =$$
$$\frac{t+(1+c)i-p_S[1+\alpha^A \frac{1}{p_R+p_S-1}(1-p_S)]i}{p_S[1+\alpha^A \frac{1}{p_R+p_S-1}(1-p_S)]i}$$

$$r_R^A\left(\lambda_R^A=\alpha^A\tfrac{1}{p_R+p_S-1},\lambda_S^A=\beta^A\tfrac{1}{p_R+p_S-1},\lambda_R^B=\alpha^B\tfrac{1}{p_R+p_S-1},\lambda_S^B=\beta^B\tfrac{1}{p_R+p_S-1}\right)=\frac{t+(1+c)i-p_R[1+\beta^A\frac{1}{p_R+p_S-1}(1-p_R)]i}{p_R[1+\beta^A\frac{1}{p_R+p_S-1}(1-p_R)]i}.$$

This results in equilibrium profits of microfinance institution A as follows:

$$\pi^A\left(\lambda_R^A=\alpha^A\tfrac{1}{p_R+p_S-1},\lambda_S^A=\beta^A\tfrac{1}{p_R+p_S-1},\lambda_R^B=\alpha^B\tfrac{1}{p_R+p_S-1},\lambda_S^B=\beta^B\tfrac{1}{p_R+p_S-1}\right)=t.$$

Let us now look at the case in which microfinance institution A offers a contract that does not achieve self-selection of borrowers, that is, $\lambda_R^A=\frac{1}{p_R+p_S-1}=\lambda_S^A$. Then, equilibrium interest rates of microfinance institution A are given by

$$r_S^A\left(\lambda_R^A=\lambda_S^A=\tfrac{1}{p_R+p_S-1};\lambda_R^B=\alpha^B\tfrac{1}{p_R+p_S-1};\lambda_S^B=\beta^B\tfrac{1}{p_R+p_S-1}\right)=\frac{t+(1+c)i-p_S[1+\frac{1}{p_R+p_S-1}(1-p_S)]i}{p_S[1+\frac{1}{p_R+p_S-1}(1-p_S)]i}$$
$$r_R^A\left(\lambda_R^A=\lambda_S^A=\tfrac{1}{p_R+p_S-1};\lambda_R^B=\alpha^B\tfrac{1}{p_R+p_S-1};\lambda_S^B=\beta^B\tfrac{1}{p_R+p_S-1}\right)=\frac{t+(1+c)i-p_R[1+\frac{1}{p_R+p_S-1}(1-p_R)]i}{p_R[1+\frac{1}{p_R+p_S-1}(1-p_R)]i}.$$

This results in equilibrium profits of microfinance institution A as follows:

$$\pi^A\left(\lambda_R^A=\lambda_S^A=\tfrac{1}{p_R+p_S-1};\lambda_R^B=\alpha^B\tfrac{1}{p_R+p_S-1};\lambda_S^B=\beta^B\tfrac{1}{p_R+p_S-1}\right)=t.$$

Hence, if both microfinance institutions offer contracts that achieve self-selection, no incentive exists to deviate by offering a contract that does not achieve self-selection of borrowers.

Case 2: Equilibrium with Contracts that do Not Achieve Self-selection of Borrowers

We will now examine whether microfinance institution A has an incentive to deviate from offering a contract that does not achieve self-selection of borrowers given that microfinance institution B offers a contract that does not achieve self-selection and, thus, satisfies $\lambda_R^B=\frac{1}{p_S+p_R-1}=\lambda_S^B$. Then, interest rates of microfinance institution B can be expressed as

$$r_S^B\left(\lambda_R^B=\lambda_S^B=\tfrac{1}{p_S+p_R-1}\right)=\frac{t+(1+c)i-p_S[1+\frac{1}{p_R+p_S-1}(1-p_S)]i}{p_S[1+\frac{1}{p_R+p_S-1}(1-p_S)]i}\text{ and}$$
$$r_R^B\left(\lambda_R^B=\lambda_S^B=\tfrac{1}{p_S+p_R-1}\right)=\frac{t+(1+c)i-p_R[1+\frac{1}{p_R+p_S-1}(1-p_R)]i}{p_R[1+\frac{1}{p_R+p_S-1}(1-p_R)]i}.$$

Microfinance institution A maximizes profit with respect to interest rates and joint liability parameters. Note that the following relationships hold:

$$\frac{d\left(\pi^A\left(\lambda_R^B=\lambda_S^B=\frac{1}{p_S+p_R-1}\right)\right)}{dr_S^A}\overset{!}{=}0 \text{ is equivalent to } \frac{d\left(\pi^A\left(\lambda_R^B=\lambda_S^B=\frac{1}{p_S+p_R-1}\right)\right)}{d\lambda_S^A}\overset{!}{=}0$$
$$\frac{d\left(\pi^A\left(\lambda_R^B=\lambda_S^B=\frac{1}{p_S+p_R-1}\right)\right)}{dr_R^A}\overset{!}{=}0 \text{ is equivalent to } \frac{d\left(\pi^A\left(\lambda_R^B=\lambda_S^B=\frac{1}{p_S+p_R-1}\right)\right)}{d\lambda_R^A}\overset{!}{=}0.$$

This gives the equilibrium interest rates of microfinance institution A dependent on the joint liability parameters:

$$r_S^A\left(\lambda_R^B=\lambda_S^B=\frac{1}{p_S+p_R-1}\right)=\frac{t+(1+c)i-p_S[1+\lambda_S^A(1-p_S)]i}{p_S[1+\lambda_S^A(1-p_S)]i}$$
$$r_R^A\left(\lambda_R^B=\lambda_S^B=\frac{1}{p_S+p_R-1}\right)=\frac{t+(1+c)i-p_R[1+\lambda_R^A(1-p_R)]i}{p_R[1+\lambda_R^A(1-p_R)]i}.$$

If microfinance institution A also offers a contract that does not achieve self-selection of borrowers, it must hold that $\lambda_R^A=\frac{1}{p_S+p_R-1}=\lambda_S^A$. Then, equilibrium interest rates of microfinance institution A are given by

$$r_S^A\left(\lambda_R^A=\lambda_S^A=\lambda_R^B=\lambda_S^B=\frac{1}{p_R+p_S-1}\right)=\frac{t+(1+c)i-p_S[1+\frac{1}{p_R+p_S-1}(1-p_S)]i}{p_S[1+\frac{1}{p_R+p_S-1}(1-p_S)]i}$$
$$r_R^A\left(\lambda_R^A=\lambda_S^A=\lambda_R^B=\lambda_S^B=\frac{1}{p_R+p_S-1}\right)=\frac{t+(1+c)i-p_R[1+\frac{1}{p_R+p_S-1}(1-p_R)]i}{p_R[1+\frac{1}{p_R+p_S-1}(1-p_R)]i}.$$

This results in equilibrium profits of microfinance institution A as follows:

$$\pi^A\left(\lambda_R^A=\lambda_S^A=\lambda_R^B=\lambda_S^B=\frac{1}{p_R+p_S-1}\right)=t.$$

Let us now look at the case in which microfinance institution A offers a contract that achieves self-selection of borrowers, that is $\lambda_R^A=\alpha^A\frac{1}{p_R+p_S-1}$ and $\lambda_S^A=\beta^A\frac{1}{p_R+p_S-1}$. Then, equilibrium interest rates of microfinance institution A are given by

$$r_S^A\left(\lambda_R^A=\alpha^A\frac{1}{p_R+p_S-1};\lambda_S^A=\beta^A\frac{1}{p_R+p_S-1};\lambda_R^B=\lambda_S^B=\frac{1}{p_R+p_S-1}\right)=\frac{t+(1+c)i-p_S[1+\alpha^A\frac{1}{p_R+p_S-1}(1-p_S)]i}{p_S[1+\alpha^A\frac{1}{p_R+p_S-1}(1-p_S)]i}$$
$$r_R^A\left(\lambda_R^A=\alpha^A\frac{1}{p_R+p_S-1};\lambda_S^A=\beta^A\frac{1}{p_R+p_S-1};\lambda_R^B=\lambda_S^B=\frac{1}{p_R+p_S-1}\right)=\frac{t+(1+c)i-p_R[1+\beta^A\frac{1}{p_R+p_S-1}(1-p_R)]i}{p_R[1+\beta^A\frac{1}{p_R+p_S-1}(1-p_R)]i}.$$

This results in equilibrium profits of microfinance institution A as follows:

$$\pi^A\left(\lambda_R^A=\alpha^A\frac{1}{p_R+p_S-1};\lambda_S^A=\beta^A\frac{1}{p_R+p_S-1};\lambda_R^B=\lambda_S^B=\frac{1}{p_R+p_S-1}\right)=t.$$

Hence, if both microfinance institutions offer contracts that do not achieve self-selection, no incentive exists for a microfinance bank to deviate by offering a contract that does achieve self-selection of borrowers.

Note that there also exist equilibria in which one microfinance institution offers contracts that achieve self-selection of borrowers and the other microfinance institution offers contracts that do not achieve self-selection of borrowers.

Proof of Lemma 3.2:

The utility of a safe borrower if she receives a loan from microfinance institution A is given by

$$U_S^A = i + p_S[v - \left(1 + r_{SR}^A\right) i] - tx.$$

The utility of a safe borrower if she receives a loan from microfinance institution B is given by

$$U_S^B = i + p_S[v - \left(1 + r_{SR}^B\right) i] - t\left(1 - x\right).$$

Hence, the marginal borrower in the segment of safe borrowers is given by

$$x_S\left(I, I\right) = \frac{t - p_S\left(r_{RS}^A - r_{RS}^B\right) i}{2t}.$$

The utility of a risky borrower if she receives a loan from microfinance institution A is given by

$$U_R^A = i + p_R[v - \left(1 + r_{SR}^A\right) i] - tx.$$

The utility of a risky borrower if she receives a loan from microfinance institution B is given by

$$U_R^B = i + p_R[v - \left(1 + r_{SR}^B\right) i] - t\left(1 - x\right).$$

Hence, the marginal borrower in the segment of risky borrowers is given by

$$x_R(I,I) = \frac{t - p_R\left(r_{SR}^A - r_{SR}^B\right)i}{2t}.$$

Profits of microfinance institutions are given as follows:

$$\begin{aligned}\pi^A(I,I) = {} & 2\gamma x_S(I,I)\left[p_S\left(1+r_{SR}^A\right)i - (1+c)\,i - k\right] + \\ & 2(1-\gamma)\,x_R(I,I)\left[p_R\left(1+r_{SR}^A\right)i - (1+c)\,i - k\right]\end{aligned}$$

$$\begin{aligned}\pi^B(I,I) = {} & 2\gamma[1 - x_S(I,I)][p_S\left(1+r_{SR}^B\right)i - (1+c)\,i - k] + \\ & 2(1-\gamma)\,[1 - x_R(I,I)][p_R\left(1+r_{SR}^B\right)i - (1+c)\,i - k].\end{aligned}$$

Microfinance institutions maximize their profit with respect to interest rates which results in the following equilibrium interest rates, market shares and profits:

$$r_{SR}^A(I,I) = r_{SR}^B(I,I) \equiv r_{SR}(I,I) = \frac{[\gamma p_S + p_R(1-\gamma)][k+t+(1+c)i] - [\gamma p_S^2 + (1-\gamma)p_R^2]i}{[\gamma p_S^2 + (1-\gamma)p_R^2]i}$$

$$x_S(I,I) = x_R(I,I) = \frac{1}{2}$$

$$\pi^A(I,I) = \pi^B(I,I) = \frac{t[\gamma p_S + p_R(1-\gamma)]^2 - \gamma(p_S - p_R)^2(1-\gamma)[k+(1+c)i]}{\gamma p_S^2 + (1-\gamma)p_R^2}.$$

Proof of Lemma 3.3:

The utility of a safe borrower if she receives a loan from microfinance institution A is given by

$$U_S^A = i + p_S[v - \left(1+r_{SR}^A\right)i] - tx.$$

The utility of a safe borrower if she receives a loan from microfinance institution B is given by

$$U_S^B = i + p_S^2[v - \left(1+r_S^B\right)i] + p_S(1-p_S)\,[v - \left(1+r_S^B\right)i - \lambda_S^B\left(1+r_S^B\right)i] - t(1-x) - d.$$

Hence, the marginal borrower in the segment of safe borrowers is given by

$$x_S(I,G) = \frac{t + d + p_S[r_S^B - r_{RS}^A + \lambda_S^B(1-p_S)\left(1+r_S^B\right)]i}{2t}.$$

The utility of a risky borrower if she receives a loan from microfinance institution A is given by

$$U_R^A = i + p_R[v - \left(1 + r_{SR}^A\right) i] - tx.$$

The utility of a risky borrower if she receives a loan from microfinance institution B is given by

$$U_R^B = i + p_R^2[v - \left(1 + r_R^B\right) i] + p_R \left(1 - p_R\right) [v - \left(1 + r_R^B\right) i - \lambda_R^B \left(1 + r_R^B\right) i] - t\left(1 - x\right) - d.$$

Hence, the marginal borrower in the segment of risky borrowers is given by

$$x_R\left(I, G\right) = \frac{t + d + p_R[r_R^B - r_{SR}^A + \lambda_R^B(1 - p_R)\left(1 + r_R^B\right)]i}{2t}.$$

Profits of microfinance institutions are given as follows:

$$\begin{aligned}\pi^A\left(I, G\right) = {} & 2\gamma x_S\left(I, G\right)[p_S\left(1 + r_{SR}^A\right) i - \left(1 + c\right) i - k] + \\ & 2\left(1 - \gamma\right) x_R\left(I, G\right)[p_R\left(1 + r_{SR}^A\right) i - \left(1 + c\right) i - k]\end{aligned}$$

$$\begin{aligned}\pi^B(I, G) = {} & \gamma[1 - x_S(I, G)][2p_S^2(1 + r_S^B) + 2p_S(1 - p_S)(1 + \lambda_S^B)(1 + r_S^B) - 2(1 + c)]i + \\ & (1 - \gamma)[1 - x_R(I, G)][2p_R^2(1 + r_R^B) + 2p_R(1 - p_R)(1 + \lambda_R^B)(1 + r_R^B) - 2(1 + c)]i.\end{aligned}$$

Microfinance bank A chooses repayment rates and microfinance B both interest rates and joint liability factors to maximize profit. This results in the following equilibrium interest rates, market shares and profits:

$$r_{SR}^A\left(I, G\right) = \frac{[\gamma p_S + p_R(1 - \gamma)](d + 2k + 3t + 3(1 + c)i) - 3[\gamma p_S^2 + (1 - \gamma)p_R^2]i}{3[\gamma p_S^2 + (1 - \gamma)p_R^2]i}$$

$$r_S^B\left(I, G\right) = \frac{p_S[\gamma p_S + p_R(1 - \gamma)](d + 2k + 3t + 3(1 + c)i) + [\gamma p_S^2 + (1 - \gamma)p_R^2]\{3t - 3d + 3(1 + c)i - 6p_S[1 + \lambda_S^B(1 - p_S)]i\}}{6p_S[\gamma p_S^2 + (1 - \gamma)p_R^2][1 + \lambda_S^B(1 - p_S)]i}$$

$$r_R^B\left(I, G\right) = \frac{p_R[\gamma p_S + p_R(1 - \gamma)][d + 2k + 3t + 3(1 + c)i] + [\gamma p_S^2 + (1 - \gamma)p_R^2]\{3t - 3d + 3(1 + c)i - 6p_R[1 + \lambda_R^B(1 - p_R)]i\}}{6p_R[\gamma p_S^2 + (1 - \gamma)p_R^2][1 + \lambda_R^B(1 - p_R)]i}$$

$$x_S\left(I, G\right) = \frac{2[p_R^2 + \gamma\left(p_S^2 - p_R^2\right)](d - k + 3t) - (1 - \gamma)p_R(p_S - p_R)[3(1 + c)i + d + 2k + 3t]}{12t[p_R^2 + \gamma\left(p_S^2 - p_R^2\right)]}$$

$$x_R\left(I, G\right) = \frac{2[p_R^2 + \gamma\left(p_S^2 - p_R^2\right)](d - k + 3t) + \gamma p_S(p_S - p_R)[3(1 + c)i + d + 2k + 3t]}{12t[p_R^2 + \gamma\left(p_S^2 - p_R^2\right)]}$$

$$\pi^{A}\left(I,G\right)=\frac{2[\gamma p_S+p_R(1-\gamma)]^2(d-k+3t)^2-9\gamma(p_S-p_R)^2(1-\gamma)[k+(1+c)i][d+3t+(1+c)i]}{18t[\gamma p_S^2+(1-\gamma)p_R^2]}$$

$$\pi^{B}\left(I,G\right)=\frac{4[\gamma p_S+p_R(1-\gamma)]^2(d-k-3t)^2+9\gamma(p_S-p_R)^2(1-\gamma)[d-t+(1+c)i]^2}{36t[\gamma p_S^2+(1-\gamma)p_R^2]}.$$

Note that microfinance institution B attains the same profit both if it offers a profit maximizing contract that achieves self-selection of borrowers and if it offers a profit maximizing contract that does not achieve self-selection of borrowers given that microfinance bank A asks the pooled interest rate $r_{SR}^{A}\left(I,G\right)$. Hence, again, equilibria exist in which microfinance institution B offers a contract that achieves self-selection or offers a contract that does not achieve self-selection given that microfinance institution A offers individual loans.

Proof of Proposition 3.3:

Note that

$$\begin{aligned}\pi^{A}(I,G)-\pi^{A}(G,G)=&\frac{1}{18t[p_R^2+\gamma\left(p_S^2-p_R^2\right)]}\{2[p_R+\gamma\left(p_S-p_R\right)]^2\left(d-k\right)\left(d-k+6t\right)-\\&9\gamma\left(1-\gamma\right)\left(p_S-p_R\right)^2\left[\left(1+c\right)^2i^2+\left(d+k+3t\right)\left(1+c\right)i+\right.\\&\left.dk+3kt+2t^2\right]\}.\end{aligned}$$

Solving $\pi^{A}(I,G)-\pi^{A}(G,G)=0$ for i, we arrive at

$$i=-\frac{d+k+3t}{2(1+c)}\pm\frac{1}{2(c+1)}\sqrt{d^2+k^2+t^2-2\left(dk-3dt+3kt\right)+\frac{8[p_R+\gamma(p_S-p_R)]^2(d-k)(d-k+6t)}{9\gamma(p_S-p_R)^2(1-\gamma)}}.$$

As we only look at positive values of i, only the larger one of both thresholds is relevant for our analysis. We define

$$i_1\equiv-\frac{d+k+3t}{2(1+c)}+\frac{1}{2(c+1)}\sqrt{d^2+k^2+t^2-2\left(dk-3dt+3kt\right)+\frac{8[p_R+\gamma(p_S-p_R)]^2(d-k)(d-k+6t)}{9\gamma(p_S-p_R)^2(1-\gamma)}}.$$

Furthermore,

$$\frac{d\left(\pi^{A}(I,G)-\pi^{A}(G,G)\right)}{di}=-\frac{\gamma(1-\gamma)(p_S-p_R)^2(1+c)(d+k+3t+2i+2ci)}{2t[p_R^2+\gamma\left(p_S^2-p_R^2\right)]}<0\text{ and}$$

$$\frac{d^2\left(\pi^{A}(I,G)-\pi^{A}(G,G)\right)}{di^2}=-\frac{\gamma(1-\gamma)(p_S-p_R)^2(1+c)^2}{t[p_R^2+\gamma\left(p_S^2-p_R^2\right)]}<0.$$

Hence, $\pi^{A}(I,G)-\pi^{A}(G,G)$ describes a parabola with its maximum at $i=-\frac{d+k+3t}{2(1+c)}$.

It follows from the analysis above that

$$\pi^A(I,G) - \pi^A(G,G) > 0 \text{ if } i < i_1 \text{ and } \pi^A(I,G) - \pi^A(G,G) < 0 \text{ if } i > i_1.$$

Note that

$$\begin{aligned}\pi^A(I,I) - \pi^A(G,I) = {} & \tfrac{1}{36t[p_R^2+\gamma\left(p_S^2-p_R^2\right)]}\{4[p_R + \gamma\,(p_S - p_R)]^2\,(k-d)\,(d-k-6t) - \\ & 9\gamma\,(1-\gamma)\,(p_S - p_R)^2\,[(c+1)^2\,i^2 + 2\,(d+t)\,(1+c)\,i + d^2 + \\ & t^2 + 4kt - 2dt]\}.\end{aligned}$$

Solving $\pi^A(I,I) - \pi^A(G,I) = 0$ for i, we arrive at

$$i = -\tfrac{d+t}{1+c} \pm \tfrac{1}{(1+c)}\sqrt{4t\,(d-k) - \tfrac{4[p_R+\gamma(p_S-p_R)]^2(d-k-6t)(d-k)}{9\gamma(p_S-p_R)^2(1-\gamma)}}.$$

As we only look at positive values of i, only the larger one of both thresholds is relevant for our analysis. We define

$$i_2 \equiv -\tfrac{d+t}{1+c} + \tfrac{1}{(1+c)}\sqrt{4t\,(d-k) - \tfrac{4[p_R+\gamma(p_S-p_R)]^2(d-k-6t)(d-k)}{9\gamma(p_S-p_R)^2(1-\gamma)}}.$$

Furthermore,

$$\tfrac{d\left(\pi^A(I,G)-\pi^A(G,G)\right)}{di} = -\tfrac{\gamma(1-\gamma)(p_S-p_R)^2(1+c)[d+t+i(1+c)]}{2t[p_R^2+\gamma\left(p_S^2-p_R^2\right)]} < 0 \text{ and}$$

$$\tfrac{d^2\left(\pi^A(I,G)-\pi^A(G,G)\right)}{di^2} = -\tfrac{\gamma(1-\gamma)(p_S-p_R)^2(1+c)^2}{2t[p_R^2+\gamma\left(p_S^2-p_R^2\right)]} < 0.$$

Hence, $\pi^A(I,I) - \pi^A(G,I)$ describes a parabola with its maximum at $i = -\frac{d+t}{1+c}$.

It follows from the analysis above that

$$\pi^A(I,I) - \pi^A(G,I) > 0 \text{ if } i < i_2 \text{ and } \pi^A(I,I) - \pi^A(G,I) < 0 \text{ if } i > i_2.$$

Proof of Proposition 3.4:

Solving $\pi^A(I,G) - \pi^A(G,G) = 0$ for c, we arrive at

$$c = -\frac{d+k+3t+2i}{2i} \pm \frac{1}{2i}\sqrt{d^2+k^2+t^2-2\left(dk-3dt+3kt\right)+\frac{8[p_R+\gamma(p_S-p_R)]^2(d-k)(d-k+6t)}{9\gamma(1-\gamma)(p_S-p_R)^2}}.$$

As we only look at positive values of i, only the larger one of both thresholds is relevant for our analysis. We define

$$c_1 \equiv -\frac{d+k+3t+2i}{2i} + \frac{1}{2i}\sqrt{d^2+k^2+t^2-2\left(dk-3dt+3kt\right)+\frac{8[p_R+\gamma(p_S-p_R)]^2(d-k)(d-k+6t)}{9\gamma(1-\gamma)(p_S-p_R)^2}}.$$

Furthermore,

$$\frac{d\left(\pi^A(I,G)-\pi^A(G,G)\right)}{dc} = -\frac{\gamma(1-\gamma)(p_S-p_R)^2[d+k+3t+2i(1+c)]i}{2t[p_R^2+\gamma\left(p_S^2-p_R^2\right)]} < 0 \text{ and}$$

$$\frac{d^2\left(\pi^A(I,G)-\pi^A(G,G)\right)}{dc^2} = -\frac{\gamma(1-\gamma)(p_S-p_R)^2 i^2}{t[p_R^2+\gamma\left(p_S^2-p_R^2\right)]} < 0.$$

Hence, $\pi^A(I,G) - \pi^A(G,G)$ describes a parabola with its maximum at $c = -\frac{d+k+3t+2i}{2i}$.

It follows from the analysis above that

$\pi^A(I,G) - \pi^A(G,G) > 0$ if $c < c_1$ and $\pi^A(I,G) - \pi^A(G,G) < 0$ if $c > c_1$.

Solving $\pi^A(I,I) - \pi^A(G,I) = 0$ for c, we arrive at

$$c = -\frac{d+t+i}{i} \pm \frac{2}{i}\sqrt{(d-k)\,t - \frac{[p_R+\gamma(p_S-p_R)]^2(d-k-6t)(d-k)}{9\gamma(1-\gamma)(p_S-p_R)^2}}.$$

As we only look at positive values of i, only the larger one of both thresholds is relevant for our analysis. We define

$$c_2 \equiv -\frac{d+t+i}{i} + \frac{2}{i}\sqrt{(d-k)\,t - \frac{[p_R+\gamma(p_S-p_R)]^2(d-k-6t)(d-k)}{9\gamma(1-\gamma)(p_S-p_R)^2}}.$$

Furthermore,

$$\frac{d\left(\pi^A(I,G)-\pi^A(G,G)\right)}{dc} = -\frac{\gamma(1-\gamma)(p_S-p_R)^2[d+t+(1+c)i]i}{2t[p_R^2+\gamma\left(p_S^2-p_R^2\right)]} < 0 \text{ and}$$

$$\frac{d^2\left(\pi^A(I,G)-\pi^A(G,G)\right)}{dc^2} = -\frac{\gamma(1-\gamma)(p_S-p_R)^2 i^2}{2t[p_R^2+\gamma\left(p_S^2-p_R^2\right)]} < 0.$$

Hence, $\pi^A(I,I) - \pi^A(G,I)$ describes a parabola with its maximum at $c = -\frac{d+t+i}{i}$.

It follows from the analysis above that

$\pi^A(I,I) - \pi^A(G,I) > 0$ if $c < c_2$ and $\pi^A(I,I) - \pi^A(G,I) < 0$ if $c > c_2$.

Proof of Proposition 3.5:

(1) Shape of $\pi^A(G,G)$

$$\pi^A(G,G) = t$$

$$\frac{d\left(\pi^A(G,G)\right)}{dt} = 1$$

$$\frac{d^2\left(\pi^A(G,G)\right)}{dt^2} = 0.$$

(2) Shape of $\pi^A(I,G)$

$$\pi^A(I,G) = \frac{2[\gamma p_S+p_R(1-\gamma)]^2(d-k+3t)^2-9\gamma(p_S-p_R)^2(1-\gamma)[k+(1+c)i][d+3t+(1+c)i]}{18t[\gamma p_S^2+(1-\gamma)p_R^2]}$$

Note, first, that $\pi^A(I,G)$ is not defined at $t = 0$.

Note, second, that

$$\frac{d\left(\pi^A(I,G)\right)}{dt} = \frac{[p_R+\gamma(p_S-p_R)]^2}{p_R^2+\gamma\left(p_S^2-p_R^2\right)} - \frac{[p_R+\gamma(p_S-p_R)]^2(d-k)^2}{9[p_R^2+\gamma\left(p_S^2-p_R^2\right)]t^2} + \frac{\gamma(1-\gamma)(p_S-p_R)^2[d+(1+c)i][k+(1+c)i]}{2[p_R^2+\gamma\left(p_S^2-p_R^2\right)]t^2}.$$

If we solve $\frac{d\left(\pi^A(I,G)\right)}{dt} = 0$ for t, we arrive at

$$t = \pm\frac{\sqrt{[p_R+\gamma(p_S-p_R)]^2(d-k)^2-\frac{9}{2}\gamma(1-\gamma)(p_S-p_R)^2[d+(1+c)i][k+(1+c)i]}}{3[p_R+\gamma(p_S-p_R)]}.$$

In order for the above expression to be defined, we assume $[p_R+\gamma\left(p_S-p_R\right)]^2\left(d-k\right)^2 - \frac{9}{2}\gamma\left(1-\gamma\right)\left(p_S-p_R\right)^2[d+\left(1+c\right)i][k+\left(1+c\right)i] > 0$. In what follows, we will refer to this assumption as *Condition (1)*.

Note, third, that

$$\frac{d^2\left(\pi^A(I,G)\right)}{dt^2} = \frac{2}{9t^3[p_R^2+\gamma\left(p_S^2-p_R^2\right)]}\{[p_R+\gamma\left(p_S-p_R\right)]^2\left(d-k\right)^2 - \tfrac{9}{2}\gamma\left(1-\gamma\right)\left(p_S-p_R\right)^2$$
$$[d+(1+c)\,i][k+(1+c)\,i]\} > 0 \text{ due to } \textit{Condition (1)}.$$

Since we only consider $t>0$, $\pi^A(I,G)$ must be a parabola with a minimum at $t = \frac{\sqrt{[p_R+\gamma(p_S-p_R)]^2(d-k)^2-\frac{9}{2}\gamma(1-\gamma)(p_S-p_R)^2[d+(1+c)i][k+(1+c)i]}}{3[p_R+\gamma(p_S-p_R)]}$.

Furthermore, it holds that $\lim\limits_{t\to\infty}\frac{d\left(\pi^A(I,G)\right)}{dt} = \frac{[p_R+\gamma(p_S-p_R)]^2}{p_R^2+\gamma\left(p_S^2-p_R^2\right)}$.

Finally, note that $\frac{[p_R+\gamma(p_S-p_R)]^2}{p_R^2+\gamma\left(p_S^2-p_R^2\right)} < 1$ since this expression is equivalent to $-\gamma\left(p_S-p_R\right)^2\left(1-\gamma\right) < 0$. Hence, in the limit, the first order condition of $\pi^A(I,G)$ approaches $\frac{[p_R+\gamma(p_S-p_R)]^2}{p_R^2+\gamma\left(p_S^2-p_R^2\right)}$, a value that is smaller than the constant first order condition of $\pi^A(G,G)$ which is equal to 1. As a consequence, it must be true that there is exactly one intersection of $\pi^A(I,G)$ and $\pi^A(G,G)$. We now calculate the exact intersection point.

Calculation of the Intersection Point

Note that $\pi^A(I,G)-\pi^A(G,G)=0$ is equivalent to

$$t^2 + \frac{9\gamma(1-\gamma)(p_S-p_R)^2[k+(1+c)i]-4[p_R+\gamma(p_S-p_R)]^2(d-k)}{6\gamma(1-\gamma)(p_S-p_R)^2}t +$$
$$\frac{9\gamma(1-\gamma)(p_S-p_R)^2[(1+c)^2i^2+dk+(d+k)(1+c)i]-2[p_R+\gamma(p_S-p_R)]^2(d-k)^2}{18\gamma(1-\gamma)(p_S-p_R)^2} = 0$$

We define

$$B_1 \equiv \frac{9\gamma(1-\gamma)(p_S-p_R)^2[k+(1+c)i]-4[p_R+\gamma(p_S-p_R)]^2(d-k)}{6\gamma(1-\gamma)(p_S-p_R)^2}$$

$$C_1 \equiv \frac{9\gamma(1-\gamma)(p_S-p_R)^2[(1+c)^2i^2+dk+(d+k)(1+c)i]-2[p_R+\gamma(p_S-p_R)]^2(d-k)^2}{18\gamma(1-\gamma)(p_S-p_R)^2}$$

Solving the above expression for t, we arrive at

$$t = -\tfrac{1}{2}B_1 \pm \tfrac{1}{2}\sqrt{B_1^2-4C_1}.$$

Due to the above analysis, the larger one of both thresholds is the one that is relevant for our analysis. We define

$t_1 \equiv -\frac{1}{2}B_1 + \frac{1}{2}\sqrt{B_1^2 - 4C_1}$.

It follows from the analysis above that $\pi^A(I,G) > \pi^A(G,G)$ for $t < t_1$ and that $\pi^A(I,G) < \pi^A(G,G)$ for $t > t_1$.

(3) Shape of $\pi^A(I,I)$

$$\pi^A(I,I) = \frac{t[\gamma p_S + p_R(1-\gamma)]^2 - \gamma(p_S - p_R)^2(1-\gamma)[k+(1+c)i]}{\gamma p_S^2 + (1-\gamma)p_R^2}$$

$$\frac{d\left(\pi^A(I,I)\right)}{dt} = \frac{[\gamma p_S + p_R(1-\gamma)]^2}{\gamma p_S^2 + (1-\gamma)p_R^2}$$

$$\frac{d^2\left(\pi^A(I,I)\right)}{dt^2} = 0.$$

(4) Shape of $\pi^A(G,I)$

$$\pi^A(G,I) = \frac{4[\gamma p_S + p_R(1-\gamma)]^2(d-k-3t)^2 + 9\gamma(p_S-p_R)^2(1-\gamma)[d-t+(1+c)i]^2}{36t[\gamma p_S^2 + (1-\gamma)p_R^2]}$$

Note, that this is equivalent to

$$\pi^A(G,I) = \frac{\gamma}{36}\frac{\{2[p_R^2+\gamma\left(p_S^2-p_R^2\right)](d-k-3t) - p_R(p_S-p_R)(1-\gamma)(d+2k+3i+3ci+3t)\}^2}{t[p_R^2+\gamma\left(p_S^2-p_R^2\right)]^2} +$$
$$\frac{1-\gamma}{36}\frac{\{2[p_R^2+\gamma\left(p_S^2-p_R^2\right)](d-k-3t) + \gamma p_S(p_S-p_R)(d+2k+3t+3i+3ci)\}^2}{t[p_R^2+\gamma\left(p_S^2-p_R^2\right)]^2}$$

Note, first, that $\pi^A(G,I)$ is not defined for $t = 0$.

Second, note that

$$\frac{d\left(\pi^A(G,I)\right)}{dt} = -\frac{\gamma}{36t^2[p_R^2+\gamma\left(p_S^2-p_R^2\right)]^2}\{2[p_R^2+\gamma\left(p_S^2-p_R^2\right)]\left(d-k+3t\right) - p_R\left(p_S-p_R\right)\left(1-\gamma\right)$$
$$\left(d+2k+3i+3ci-3t\right)\}\{2[p_R^2+\gamma\left(p_S^2-p_R^2\right)]\left(d-k-3t\right) - p_R\left(p_S-p_R\right)$$
$$\left(1-\gamma\right)\left(d+2k+3i+3ci+3t\right)\}$$
$$-\frac{(1-\gamma)}{36t^2[p_R^2+\gamma\left(p_S^2-p_R^2\right)]^2}\{2[p_R^2+\gamma\left(p_S^2-p_R^2\right)]\left(d-k-3t\right) + \gamma p_S\left(p_S-p_R\right)$$
$$\left(d+2k+3i+3ci+3t\right)\}\{3\gamma p_S[\left(1+c\right)i+d+t]\left(p_S-p_R\right) + 2p_R$$
$$[p_R+\gamma\left(p_S-p_R\right)]\left(d-k+3t\right)\}.$$

We now show that $\frac{d\left(\pi^A(G,I)\right)}{dt} > 0$ holds. Therefore, we use the following four conditions:

Condition (2) follows from $x_S\left(I,G\right) > 0$ and is given by

$$2[p_R^2 + \gamma\left(p_S^2 - p_R^2\right)]\left(d - k + 3t\right) - p_R\left(p_S - p_R\right)\left(1-\gamma\right)\left(d + 2k + 3t + 3i + 3ci\right) > 0.$$

From *Condition (2)* we get *Condition (3)* which is given by

$$d - k + 3t > 0.$$

Condition (4) follows from $x_S\left(I,G\right) < 1$ and is given by

$$2[p_R^2 + \gamma\left(p_S^2 - p_R^2\right)]\left(d - k - 3t\right) - p_R\left(p_S - p_R\right)\left(1-\gamma\right)\left(d + 2k + 3i + 3ci + 3t\right) < 0.$$

Condition (5) follows from $x_R\left(I,G\right) < 1$ and is given by

$$2[p_R^2 + \gamma\left(p_S^2 - p_R^2\right)]\left(d - k - 3t\right) + \gamma p_S\left(p_S - p_R\right)\left(d + 2k + 3i + 3ci + 3t\right) < 0.$$

It can be easily seen that these four conditions ensure that $\frac{d\left(\pi^A(G,I)\right)}{dt} > 0$.

Third, note that

$$\frac{d^2\left(\pi^A(G,I)\right)}{dt^2} = \frac{4[p_R+\gamma(p_S-p_R)]^2(d-k)^2+9\gamma(1-\gamma)(p_S-p_R)^2(d+i+ci)^2}{18t^3[p_R^2+\gamma\left(p_S^2-p_R^2\right)]} > 0.$$

Hence, it follows from the above analysis, that $\pi^A(G,I)$ is a parabola with a minimum where only the increasing part of the parabola is of interest for us.

Note, further, that $\frac{d\left(\pi^A(G,I)\right)}{dt}$ can be written as

$$\frac{d\left(\pi^A(G,I)\right)}{dt} = \frac{3[p_R+\gamma(p_S-p_R)]^2+[p_R^2+\gamma\left(p_S^2-p_R^2\right)]}{4[p_R^2+\gamma\left(p_S^2-p_R^2\right)]} - \frac{[p_R+\gamma(p_S-p_R)]^2(d-k)^2}{9[p_R^2+\gamma\left(p_S^2-p_R^2\right)]t^2} - \frac{\gamma(p_S-p_R)^2(d+i+ci)^2(1-\gamma)}{4[p_R^2+\gamma\left(p_S^2-p_R^2\right)]t^2}.$$

Hence, it holds that $\lim_{t\to\infty}\frac{d\left(\pi^A(G,I)\right)}{dt} = \frac{3[p_R+\gamma(p_S-p_R)]^2+[p_R^2+\gamma\left(p_S^2-p_R^2\right)]}{4[p_R^2+\gamma\left(p_S^2-p_R^2\right)]}$.

Note, further, that $\frac{3[p_R+\gamma(p_S-p_R)]^2+[p_R^2+\gamma\left(p_S^2-p_R^2\right)]}{4[p_R^2+\gamma\left(p_S^2-p_R^2\right)]} > \frac{[\gamma p_S+p_R(1-\gamma)]^2}{\gamma p_S^2+(1-\gamma)p_R^2}$ is equivalent to $2\gamma\left(p_S - p_R\right)^2\left(1-\gamma\right)[p_R^2 + \gamma\left(p_S^2 - p_R^2\right)] > 0$. Hence, in the limit, the first order condition of $\pi^A(G,I)$ approaches $\frac{3[p_R+\gamma(p_S-p_R)]^2+[p_R^2+\gamma(p_S^2-p_R^2)]}{4[p_R^2+\gamma(p_S^2-p_R^2)]}$, a value that is larger than the constant first order condition of $\pi^A(I,I)$ which is equal to $\frac{[\gamma p_S+p_R(1-\gamma)]^2}{\gamma p_S^2+(1-\gamma)p_R^2}$. As a consequence, there must be exactly one intersection point of $\pi^A(G,I)$ and $\pi^A(I,I)$ that is interesting for our analysis. To the left of this intersection, it must hold that $\pi^A(I,I) > \pi^A(G,I)$ and to the right of this threshold, it must hold that $\pi^A(I,I) < \pi^A(G,I)$. We now calculate the exact intersection point.

Calculation of the Intersection Point

$\pi^A(I,I) - \pi^A(G,I) = 0$ is equivalent to

$$t^2 + 2\frac{4[p_R+\gamma(p_S-p_R)]^2(k-d)+3\gamma(1-\gamma)(p_S-p_R)^2[(1+c)i+2k-d]}{3\gamma(1-\gamma)(p_S-p_R)^2}t+ \frac{4[p_R+\gamma(p_S-p_R)]^2(d-k)^2+9\gamma(1-\gamma)(p_S-p_R)^2[d^2+(1+c)^2i^2+2d(1+c)i]}{9\gamma(1-\gamma)(p_S-p_R)^2} = 0.$$

We define

$$B_2 \equiv 2\frac{4[p_R+\gamma(p_S-p_R)]^2(k-d)+3\gamma(1-\gamma)(p_S-p_R)^2[(1+c)i+2k-d]}{3\gamma(1-\gamma)(p_S-p_R)^2}$$

$$C_2 \equiv \frac{4[p_R+\gamma(p_S-p_R)]^2(d-k)^2+9\gamma(1-\gamma)(p_S-p_R)^2[d^2+(1+c)^2i^2+2d(1+c)i]}{9\gamma(1-\gamma)(p_S-p_R)^2}$$

Solving the above expression for t, we arrive at

$$t = -\tfrac{1}{2}B_2 \pm \tfrac{1}{2}\sqrt{B_2^2 - 4C_2}.$$

Due to the above analysis, the larger one of both thresholds is the one that is relevant for our analysis. We define

$$t_2 \equiv -\tfrac{1}{2}B_2 + \tfrac{1}{2}\sqrt{B_2^2 - 4C_2}.$$

It follows from the analysis above that $\pi^A(I,I) > \pi^A(G,I)$ for $t < t_2$ and that $\pi^A(I,I) < \pi^A(G,I)$ for $t > t_2$.

Bibliography

Aghion, P. and M. Schankerman (2004) "On the Welfare Effects and Political Economy of Competition-Enhancing Policies" The Economic Journal 114, 800-824.

Ahlin, C. and R. Townsend (2007) "Selection into and across Credit Contracts: Theory and Field Research" Journal of Econometrics 136(2), 665-698.

Armendáriz de Aghion, B. (1999) "On the Design of a Credit Agreement with Peer Monitoring" Journal of Development Economics 60(1), 79-104.

Armendáriz de Aghion, B. and C. Gollier (2000) "Peer Group Formation in an Adverse Selection Model" The Economic Journal 110, 632-643.

Armendáriz de Aghion, B. and J. Morduch (2000) "Microfinance beyond Group Lending" Economics of Transition 8(2), 401-420.

Armendáriz de Aghion, B. and J. Morduch (2005) "The Economics of Microfinance" MIT Press, Cambridge.

Beck, T., Levine, R. and N. Loayza (2000) "Finance and the Sources of Growth" Journal of Financial Economics 58, 261-300.

Beermann, P. (2007) "M&A versus Greenfield - Optimal Entry Modes into Markets with Sequential Entry", in: Beermann, P. "Topics in Multinational Banking and International Industrial Organization" Dissertation, Ludwig-Maximilians-University Munich.

Berger, A. (2007) "Obstacles to a Global Banking System: 'Old Europe' versus 'New Europe'" Journal of Banking and Finance 31(7), 1955-1973.

Berger, A., Klapper, L., Martínez Pería, M.S. and R. Zaidi (2008) "Bank Ownership Type and Banking Relationships" Journal of Financial Intermediation 17(1), 37-62.

Besanko, D. and A. Thakor (1992) "Banking Deregulation: Allocational Consequences of Relaxing Entry Barriers" Journal of Banking and Finance 16, 909-932.

Besley, T. and S. Coate (1995) "Group Lending, Repayment Incentives and Social Collateral" Journal of Development Economics 46, 1-18.

Bhaumik, S.K. and R. Dimova (2004) "How Important is Ownership in a Market with Level Playing Field? The Indian Banking Sector Revisited" Journal of Comparative Economics 32, 165-180.

Blomström, M. and A. Kokko (1998) "Multinational Corporations and Spillovers" Journal of Economic Surveys 12(3), 247-277.

Boot, A.W.A. and M. Marinč (2006) "Competition and Entry in Banking: Implications for Stability and Capital Regulation" CEPR Discussion Paper 5518, London.

Brainard, L. (1993) "A Simple Theory of Multinational Corporations and Trade with a Trade-Off between Proximity and Concentration" NBER Working Paper 4269, Cambridge.

Broecker, T. (1990) "Credit-Worthiness Tests and Interbank Competition" Econometrica 58(2), 429-452.

Buch, C.M. (2003) "Information or Regulation: What Drives the International Activities of Commercial Banks?" Journal of Money, Credit, and Banking 35(6), 851-869.

Buch, C. and A. Lipponer (2007) "FDI versus Exports: Evidence from German Banks" Journal of Banking and Finance 31(3), 805-826

Ceccagnoli, M. (2005) "Firm Heterogeneity, Imitation, and the Incentives for Cost Reducing R&D Effort" The Journal of Industrial Economics 53(1), 83-100.

Champagne, P., Tjossem, P., Ohman, T., Pikholz, L. and D. Cracknell (2007) "Toolkit for Individual Lending for Credit Managers" ShoreCap Exchange Corporation, Chicago.

Chiappori, P.-A., Perez-Castrillo, D. and T. Verdier (1995) "Spatial Competition in the Banking System: Localization, Cross Subsidies and the Regulation of Deposit Rates" European Economic Review 39, 889-918.

Christen, R. and T. Cook (2001) "Commercialization and Mission Drift. The Transformation of Microfinance in Latin America" CGAP Occasional Paper 5, Washington.

Christen, R. and E. Rhyne (1999) "Microfinance Enters the Marketplace" USAID Microenterprise Publications, Washington.

Claessens, S. (2006) "Competitive Implications of Cross-Border Banking" World Bank Policy Research Working Paper 3854, Washington.

Claessens, S., Demirgüç-Kunt, A. and H. Huizinga (2001) "How Does Foreign Entry Affect the Domestic Banking Market?" Journal of Banking and Finance 25(5), 891-911.

Claessens, S., Van Horen, N., Gurcanlar, T. and J. Mercado (2008) "Foreign Bank Presence in Developing Countries 1995-2006: Data and Trends" Working Paper, University of Amsterdam.

Claeys, S. and C. Hainz (2006) "Acquisition versus Greenfield: The Impact of the Mode of Foreign Bank Entry on Information and Bank Lending Rates" ECB Working paper 653, Frankfurt.

Clarke, G.R.G., Cull, R. and M.S. Martínez Pería (2006) "Foreign Bank Participation and Access to Credit across Firms in Developing Countries" Journal of Comparative Economics 34, 774-795.

Clarke, G.R.G., Cull, R., Martínez Pería, M.S. and S.M. Sanchez (2003) "Foreign Bank Entry: Experience, Implications for Developing Countries and Agenda for Further Research" World Bank Research Observer 18(1), 25-59.

Coe, D.T. and E. Helpman (1995) "International R&D Spillovers" European Economic Review 39, 859-887.

Coe, D.T., Helpman, E. and A.W. Hoffmaister (1997) "North-South R&D Spillovers" The Economic Journal 107, 134-149.

Cohen, W.M. and D.A. Levinthal (1989) "Innovation and Learning: The Two Faces of R&D" The Economic Journal 99(397), 569-596.

Correa, R. (2008) "Cross-Border Bank Acquisitions: Is there a Performance Effect?" International Finance Discussion Papers 922, Washington.

Daley-Harris, S. (2007) "State of the Microcredit Summit Campaign Report" Microcredit Summit Campaign, Washington, available at *http://www.microcreditsummit.org/pubs/reports/socr/EngSOCR2007.pdf* [16.08.2008].

Degryse, H. and S. Ongena (2005) "Distance, Lending Relationships, and Competition" The Journal of Finance 60(1), 231-266.

De Haas, R. and I. Naaborg (2006) "Foreign Banks in Transition Countries: To Whom Do They Lend and How Are They Financed?" Financial Markets, Institutions & Instruments 15(4), 159-199.

De Haas, R. and I. van Lelyveld (2006) "Foreign Banks and Credit Stability in Central and Eastern Europe. A Panel Data Analysis" Journal of Banking and Finance 30(7), 1927-1952.

Dell'Ariccia, G. (2001) "Asymmetric Information and the Structure of the Banking Industry" European Economic Review 45(10), 1957-1980.

Dell'Ariccia, G., Friedman, E. and R. Marquez (1999) "Adverse Selection as a Barrier to Entry in the Banking Industry" The RAND Journal of Economics 30(3), 515-534.

Dell'Ariccia, G. and R. Marquez (2004) "Information and Bank Credit Allocation" Journal of Financial Economics 72(1), 185-214.

Dellien, H., Burnett, J., Gincherman, A. and E. Lynch (2005) "Product Diversification in Microfinance: Introducing Individual Lending" Women's World Banking Report, New York.

Economides, N., Hubbard, R. and D. Palia (1996) "The Political Economy of Branching Restrictions and Deposit Insurance: A Model of Monopolistic Competition among Small and Large Banks" Journal of Law and Economics 39(2), 667-704.

Eicher, T. and J. Kang (2005) "Trade, Foreign Direct Investment or Acquisition: Optimal Entry Modes for Multinationals" Journal of Development Economics 77(1), 207-228.

Fernando, N. (2007) "The Asian Microfinance Industry. Some Changes and Continuities" ADB Finance for the Poor 8(4), 1-11.

Focarelli, D. and A. Pozzolo (2001) "The Patterns of Cross-Border Bank Mergers and Shareholdings in OECD Countries" Journal of Banking and Finance 25(12), 2305-2337.

Fries, S. and A. Taci (2005) "Cost Efficiency of Banks in Transition: Evidence from 289 Banks in 15 Post-Communist Countries" Journal of Banking and Finance 29(1), 55-81.

Gangopadhyay, S. and R. Lensink (2007) "Delegated Monitoring and Moral Hazard in Underdeveloped Credit Markets" Working Paper, University of Groningen.

García Herrero, A. and M.S. Martínez Pería (2007) "The Mix of International Banks' Foreign Claims: Determinants and Implications" Journal of Banking and Finance 31(6), 1613-1631.

Ghatak, M. (2000) "Screening by the Company You Keep: Joint Liability Lending and the Peer Selection Effect" The Economic Journal 110, 601-631.

Ghatak, M. and T. Guinnane (1999) "The Economics of Lending with Joint Liability: Theory and Practice" Journal of Development Economics 60(1), 195-228.

Gilroy, B. and E. Lukas (2006) "The Choice between Greenfield Investment and Cross-Border Acquisition: A Real Option Approach" The Quarterly Review of Economics and Finance 46, 447-465.

Giné, X, Jakiela, P., Karlan, D. and J. Morduch (2006) "Microfinance Games" World Bank Policy Research Working Paper 3959, Washington.

Giné, X. and D. Karlan (2006) "Group versus Individual Liability – A Field Experiment in the Philippines" World Bank Policy Research Working Paper 4008, Washington.

Görg, H. (2000) "Analyzing Foreign Market Entry - The Choice between Greenfield Investment and Acquisitions" Journal of Economic Studies 27(3), 165-181.

Görg, H. and E. Strobl (2001) "Multinational Companies and Productivity Spillovers: A Meta-Analysis" The Economic Journal 111, F723-F739.

Görg, H. and E. Strobl (2005) "Spillovers from Foreign Firms through Worker Mobility: An Empirical Investigation" Scandinavian Journal of Economics 107(4), 693-709.

Goldberg, L. (2007) "Financial-Sector FDI and Host Countries: New and Old Lessons" Economic Policy Review 13(1), 1-17.

Gormley, T. (2008) "Costly Information, Foreign Entry, and Credit Access" AFA 2008 New Orleans Meetings Paper, Cambridge.

Harper, M. (2007) "What's Wrong with Groups?", in: Dichter, T. and M. Harper (Eds.) "What's Wrong with Microfinance?" Practical Action Publishing, Eastbourne, 35-48.

Hauswald, R. and R. Marquez (2003) "Information Technology and Financial Services Competition" The Review of Financial Studies 16(3), 921-948.

Hauswald, R. and R. Marquez (2006) "Competition and Strategic Information Acquisition in Credit Markets" The Review of Financial Studies 19(3), 967-1000.

Helpman, E., Melitz, M. and S. Yeaple (2004) "Export versus FDI with Heterogeneous Firms" American Economic Review 94(1), 300-316.

Iranzo, S. (2003) "FDI Mode of Entry and Acquisition of Firm Specific Assets" Working Paper, University of Sydney.

Isern, J. and D. Porteous (2005) "Commercial Banks and Microfinance: Evolving Models of Success" CGAP Focus Note 28, Washington.

Kaas, L. (2004) "Financial Market Integration and Loan Competition - When is Entry Deregulation Socially Beneficial?" ECB Working Paper 403, Frankfurt.

Karlan, D. (2007) "Social Connections and Group Banking" The Economic Journal 117, F52-F84.

Köhler, M. (2008) "Transparency of Regulation and Cross-Border Bank Mergers" ZEW Discussion Paper 08-009, Mannheim.

Kota, I. (2007) "Microfinance: Banking for the Poor" Finance & Development 06/07, 44-45.

Laffont, J. and T. N'Guessan (2000) "Regulation and Development – Group Lending with Adverse Selection" European Economic Review 44, 773-784.

Levin, R.C. and P.C. Reiss (1988) "Cost-Reducing and Demand-Creating R&D with Spillovers" The RAND Journal of Economics 19(4), 538-556.

Levine, R. (1996) "Foreign Banks, Financial Development, and Economic Growth", in: Barfield, C. (Ed.) "International Financial Markets: Harmonization versus Competition" The AEI Press, Washington D.C., 224-254.

Littlefield, E., Morduch, J. and S. Hashemi (2003) "Is Microfinance an Effective Strategy to Reach the Millennium Development Goals?" CGAP FocusNote 24, Washington.

Madajewicz, M. (2008) "Joint Liability versus Individual Liability in Credit Contracts" forthcoming in Journal of Economic Behavior & Organization.

Maioli, S., Ferrett, B., Girma, S. and H. Görg (2006) "The Market Disciplining Effects of FDI: Does the Mode of Entry Matter?" University of Nottingham Research Paper 2006/16.

Majnoni, G., Shankar, R. and E. Varhegyi (2003) "The Dynamics of Foreign Bank Ownership - Evidence from Hungary" World Bank Policy Research Working Paper 3114, Washington.

Martínez Pería, M.S. and A. Mody (2004) "How Foreign Participation and Market Concentration Impact Bank Spreads: Evidence from Latin America" Journal of Money, Credit and Banking 36(3), 511-537.

McIntosh, C., De Janvry, A. and E. Sadoulet (2005) "How Rising Competition among Microfinance Institutions Affects Incumbent Lenders" The Economic Journal 115, 987-1004.

Montgomery, R. (1996) "Disciplining or Protecting the Poor? Avoiding the Social Costs of Peer Pressure in Micro-Credit Schemes" Journal of International Development 8(2), 289-305.

Müller, T. (2007) "Analyzing Modes of Foreign Entry: Greenfield Investment versus Acquisition" Review of International Economics 15(1), 93-111.

Navajas, S., Conning, J. and C. Gonzalez-Vega (2003) "Lending Technologies, Competition and Consolidation in the Markets for Microfinance in Bolivia" Journal of International Development 15, 747-770.

Nocke, V. and S. Yeaple (2004) "An Assignment Theory of Foreign Direct Investment" NBER Working Paper 11003, Cambridge.

Nocke, V. and S. Yeaple (2007) "Cross-Border Mergers and Acquisitions vs. Greenfield Foreign Direct Investment: The Role of Firm Heterogeneity" Journal of International Economics 72(2), 336-365.

Peek, J. and E. Rosengren (2000) "Implications of the Globalization of the Banking Sector: The Latin American Experience" New England Economic Review 2000/09, 45-62.

Petersen, M. and R. Rajan (1994) "The Benefits of Lending Relationships: Evidence from Small Business Data" The Journal of Finance 49(1), 3-37.

Petersen, M. and R. Rajan (2002) "Does Distance Still Matter? The Information Revolution in Small Business Lending" The Journal of Finance 57(6), 2533-2570.

Raff, H., Ryan, M. and F. Staehler (2006) "Asset Ownership and Foreign Market Entry" CES-Ifo Working Paper 1676, Munich.

Raith, M. (2003) "Competition, Risk, and Managerial Incentives" The American Economic Review 93(4), 1425-1436.

Reddy, R. and E. Rhyne (2006) "Who Will Buy Our Paper: Microfinance Cracking the Capital Markets?" Accion Insight 18, Boston.

Sabi, M. (1996) "Comparative Analysis of Foreign and Domestic Bank Operations in Hungary" Journal of Comparative Economics 22, 179-188.

Saggi, K. (2002) "Trade, Foreign Direct Investment, and International Technology Transfer: A Survey" The World Bank Research Observer 17(2), 191-235.

Schnitzer, M. (1999) "Enterprise Restructuring and Bank Competition in Transition Economies" The Economics of Transition 7(1), 133-155.

Sengupta, R. (2007) "Foreign Entry and Bank Competition" Journal of Financial Economics 84(2), 502-528.

Sharpe, S.A. (1990) "Asymmetric Information, Bank Lending and Implicit Contracts: A Stylized Model of Customer Relationships" The Journal of Finance 45(4), 1069-1087.

Spence, M. (1984) "Cost Reduction, Competition, and Industry Performance" Econometrica 52(1), 101-122.

Stein, J. (2002) "Information Production and Capital Allocation: Decentralized versus Hierarchical Firms" The Journal of Finance 57(5), 1891-1921.

Stiglitz, J. (1990) "Peer Monitoring and Credit Markets" The World Bank Economic Review 4(3), 351-366.

Tekin-Koru, A. (2006) "Is FDI Indeed Tariff-Jumping? Firm-Level Evidence" Working Paper, Oregon State University.

Van Tassel, E. (1999) "Group Lending under Asymmetric Information" Journal of Development Economics 60, 3-25.

Van Tassel, E. and S. Vishwasrao (2007) "Asymmetric Information and the Mode of Entry in Foreign Credit Markets" Journal of Banking and Finance 31, 3742-3760.

Vives, X. (2004) "Innovation and Competitive Pressure" CEPR Working Paper 4369, London.

Vo Thi, N. and D. Vencappa (2007) "Does the Entry Mode of Foreign Banks Matter for Bank Efficiency? Evidence from Czech Republic, Hungary, and Poland" Working Paper, University of Paris X at Nanterre.

World Bank (2008) "Finance for All - Policies and Pitfalls in Expanding Access" World Bank Policy Research Report, Washington, available at *http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTPRRS/EXTFINFORALL/0,,contentMDK:21534425~menuPK:4099726~pagePK:64168098~piPK:64168032~theSitePK:4099598,00.html* [01.08.2008].

Yunus, M. (2007) "Banker to the Poor: Micro-Lending and the Battle Against World Poverty" Public Affairs, New York.

Zeitinger, C.-P. (1996) "Micro-Lending in the Russian Federation", in: Levitsky, J. (Ed.) "Small Business in Transition Economies: Promoting Enterprise in Central and Eastern Europe and the Former Soviet Union" ITDG Publishing, London, 85-94.

Curriculum Vitae

10/2004 - 09/2008	Research and teaching assistant Chair of Prof. Dr. Monika Schnitzer Ph.D. program in Economics Munich Graduate School of Economics Ludwig-Maximilians-University, Munich, Germany
08/2004	Diploma in Economics Regensburg University, Germany
10/1999 - 08/2004	Studies in Economics Regensburg University, Germany