Cross-Listing as a Signaling Device in Emerging Markets

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Abstract

Liberalizing financial markets gives firms from emerging market economies the possibility to cross-list on international stock exchanges. In fact, an increasing number of firms from emerging markets decide to cross-list, especially in the United States. As U.S. stock-exchanges, as opposed to emerging markets, typically have very high disclosure requirements, this can be seen as the introduction of a signaling device. While the existing literature has primarily investigated the reasons for this cross-listing decision and its impact on the cross-listing firm, I focus on the resulting equilibrium effects in the country of origin and investigate welfare effects. First, I show that the cross-listing decision will have negative cost of capital spillovers on non-cross-listing firms in the local market. Secondly, I show that despite these negative spillovers welfare can be enhanced by the introduction of the possibility to cross-list. Furthermore, local welfare will only be reduced if allowing firms to cross-list does not sufficiently mitigate overinvestment problems in the local market.

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1 Introduction

Over the last decades globalization has significantly changed the economic setting of the world. One of the predominant and most controversially discussed aspects of increased globalization is the integration of financial markets. Several emerging countries have quickly abolished capital controls and liberalized their financial markets. This financial market liberalization was followed by a strong increase in the number of cross-listings on international stock exchanges, especially in the United States. While in 1988 only one single company from an emerging market issued Level II/III American Depositary Receipts (ADR) on an US stock exchange, this number increased to 106 by 1995 and again almost doubled reaching 205 cross-listed companies by the end of 2005.[2] Potential explanatory approaches for this increase are manifold, reaching from the reduction of market segmentation to the increase of firm's liquidity and the diversification and broadening of the investor base. Empirical evidence with respect to these approaches are mixed. One explanation, which has also been confirmed empirically, highlights the informational value of cross-listing on a stock-exchange with significantly higher disclosure requirements. For for the case of the US these requirements are reflected by high accounting standards under US GAAP and compliance with the SEC. Financial markets in emerging countries are typically characterized by a very high degree of informational opacity combined with a weak regulatory environment. Especially firms from these countries can significantly reduce problems of asymmetric infor-

[2]Source: Moel (1999) and Bank of New York Depository Receipts, http://www.adrbny.com/. Firms form other countries have different possibilities to access US capital markets: They can either obtain a direct listing on an US stock exchange, or they can participate in a so called American Depository Receipt (ADR) Program. Depository Receipts are certificates issued by a US Depository Bank and represent a non-US company's traded equity or debt. The orginial shares of the company are hold in custody by the issuing bank in the companies home country. There are four types of ADR issues: unsponsored or sponsored Level I issues, Level II issues, and Level III issues. While Level I ADRs are unlisted and are only allowed to be traded over-the-counter, Level II and III issues are needed for listing on an US stock exchange. Only with a Level III issue firms are allowed to raise new capital. The different types of ADR programs differ substantially with respect to disclosure requirements. While Level I issues have the lowest disclosure requirements, and firms do not have to modify there current reporting system, level II and level III issues have very high informational requirements, firms have to register with the SEC and comply with US GAAP disclosure. For a detailed overview over ADR programs see Moel (1999).

mation by cross-listing on stock exchanges with 'tough' regulatory requirements.[3] Cross-listing can be seen as a signaling and bonding device. On the one hand, cross-listing allows firms to credibly convey more and better information about their performance On the other hand it allows managers to credibly commit to act more in the interest of external shareholders. There have been a few theoretical models explaining how cross-listing allows managers to signal their commitment to comply with high disclosure and corporate governance standards (e.g., Fuerst (1998), Moel (1999) and Cantale (1996)). Coffee (1999, 2002) was among the first to rationalize the so called 'bonding hypothesis'. At the same time, Stulz (1999) provided empirical evidence on the positive impact of increased globalization on the costs of capital due to the improvement of agency problems. Also a study by Miller (1999) seems to confirm the hypothesis about the informational value of cross-listing. He finds positive share price reactions for the announcement dates of initiation of ADR-programs. Interestingly, these reactions where significantly higher for firms from emerging countries in which informational problems are much more severe than for developed countries, and for exchange-listings, which typically have much higher disclosure requirements, and thus entail higher informational value. Also, more recent studies confirm the informational hypothesis. Cleassens, Klingebiel and Schmuckler (2003) find evidence that firms from less developed countries use the cross-listing to bond to higher legal and other standards. And Doidge et al. (2004) found a significant positive effect of cross-listing on the valuation of the company. This higher valuation was indeed more pronounced for exchange-listed firms, which confirms the informational hypothesis Furthermore, from the 205 companies with level II/III ADR issues in 2005 mentioned above, only about 80 used this issue to raise new capital. This finding is also in support of the informational value of cross-listing. More than half of the firms decide to cross-list, even though they apparently do not want to raise any additional funds.

[3]Note that the informational value of the cross-listing decision is not limited to emerging markets. As soon as two countries differ with respect to the 'toughness' of their stock exchanges and regulatory environment, these differentials can be exploited. In fact, several of the cited publications did not focus their analysis on emerging markets only. Nevertheless, for emerging economies the informational value of cross-listing is of course much more pronounced.

While much has been said about the reasons for cross-listing and the resulting effects for the cross-listing firm, the impact of cross-listing on other firms in the country of origin has started to be investigated only a few years ago. With this respect, Melvin and Valero-Tonone (2005) for example found empirical evidence for a negative stock price impact of the cross-listing decision of a firm on its home-market rivals. They interpret their result as evidence for the investors' valuation of firms' future profitability. If investors observe a cross-listing, this is perceived as a positive signal about the firms growth prospects. Not listing on another stock-exchange is therefore associated with relatively poor growth prospects. Lee (2003) shows as well, that the announcement of cross-listing in the U.S. is associated with negative abnormal returns for the local competitors and that these effects are higher for firms with higher agency costs. Karolyi (2004) also finds evidence for negative spillover effects to the home-market rivals of a cross-listing firm. He shows that on the contrary to the evidence for cross-listing firms', the capitalization and number of listed firms and turnover ratios of local non-cross-listing firms in twelve emerging markets decline with the increase in cross-listings. Negative spillovers on the domestic firms liquidity through internationalization, thus cross-listing, of other firms are found by Levine and Schmuckler (2003) Thus overall, there is significant evidence that cross-listing has adverse spillover effects for domestic firms on the local market.

While there is some evidence regarding valuation and liquidity spillover effects for domestic market firms, up to my knowledge, there is no paper explicitly investigating total welfare effects for the local market. Even though cross-listing might entail negative spillover effects on domestic firms, this does not necessarily imply a reduction in local welfare. On the contrary, from a welfare point of view it might well be that a reduction in valuation, trading volumes and an increase in the costs of capital for domestic firms is valuable. This is the case, when domestic firms are mainly unprofitable.

The goal of my paper is to explain equilibria and consider these welfare effects of cross-listing on the country of origin. For this purpose, I develop a model of asymmetric information, consistent with emirical findings, which incorporates negative spillover effects of cross-listing on local firms. Based on this set-up, I

can derive resulting equilibria and assess overall welfare effects for the emerging economy. As I show in my analysis, even though spillover effects on local firms are negative resulting welfare effects do not have to be such. Welfare can increase or decrease with financial market liberalization, and hence the decision of some firms to cross-list.The underlying reason is, that the quality of local firms determines welfare effects. While negative spillover effects on profitable domestic firms are certainly welfare reducing, negative spillover effects on unprofitable firms are valuable. Thus, whether financial market liberalization has a positive or negative welfare effect depends on the inefficiencies in the emerging economy before financial market liberalization. If the economy was characterized by an underinvestment problem, in the sense that profitable firms could not obtain financing due to problems of asymmetric information, liberalizing financial markets is welfare enhancing, as it alleviates the underinvestment problem. If on the other hand, the closed economy is characterized by an overinvestment problem, thus unprofitable firms obtain financing due to problems of asymmetric information, welfare effects are not clear up-front. They will only be positive if cross-listing helps to mitigate the overinvestment problem.

The outline of my model is as follows:

Due to the lack of information in the closed economy, outside investors have no means to distinguish between firms with good investment opportunities (net present value (NPV)-positive projects), and firms with bad investment opportunities (NPV-negative projects). Risk-neutral investors will therefore base their investment decision on the average project quality known to them. The average quality of the pool and thus the interest rate required depends on the respective market shares of good and bad firms and the specific quality of their investment opportunities.

In equilibrium, the required average interest rate will either be low enough – if the average quality of the local pool is sufficiently high – that all good and bad firms invest at this average interest rate or it is so high – if the quality of the pool is too low – that the market completely breaks down and non of the firms obtain financing.

In the first case, the economy is characterized by an overinvestment problem:

Bad firms, which from a welfare point of view should not invest at all, are 'cross-subsidized' by good firms via the much lower interest rate as compared to the full information situation. Due to their limited liability, bad firms have thus an incentive to invest into the NPV-negative project reducing the overall welfare of the economy.

In the second case, the economy is affected by an underinvestment problem: In this case the market completely breaks down, as the average interest rate would be too high for good firms to invest into their NPV-positive projects at this interest rate, an investment which from a welfare point of view should be undertaken.

The important aspect of this set-up is that it captures both potential cases of inefficient allocation in settings of asymmetric information focused on in the existing literature. On the one hand the underinvestment problem focused on by Stiglitz and Weiss (1981) in their analysis of credit rationing, on the other hand the overinvestment problem depicted by de Meza and Webb (1987). In my model, I only allow for the extreme cases of under- and overinvestment problems, thus either full financing or total market breakdown. This set-up is attractive, because it allows me to contemporarily analyze welfare effects for both possible inefficient levels of investments, while keeping the analysis relatively simple and clear. Within this set-up, I can derive equilibria and welfare effects resulting financial market liberalization, thus the introduction of cross-listing as a signaling device. As I will show – naturally in a very stylized way – these results will differ significantly for the different the situations and hence inefficiencies the closed economy.

As stated above, liberalizing the financial market provides firms with the opportunity to cross-list on international stock-exchanges. Given that informational requirements at these stock-exchanges are very high, cross-listing has an informational value. It conveys information about investment opportunities of the firm. Only good firms will therefore have an interest in using this signaling device, as being identified as a good firm allows them to obtain financing at a much lower interest rate than the prevailing average market interest rate.[4]

[4]One could also think about other signalling devices like engaging an auditor or certified accountant. In principle, also these instruments have a similar effect. The problem with employing these devices is, however, that they underlie the same weak legal environment like the company. Thus, if the informational problem arises especially because of the weaknesses of this system, most probably similar problems will arise as to the reliability of the certificate provided

The crucial point about the cross-listing decision is that it is costly. Apart from the direct costs of an issue, the costs of cross-listing also consist in the costs of complying with new accounting standards and typically providing much more detailed and accurate financial information than required under local legislation. These costs crucially depend on the firm-specific corporate governance level and disclosure practices already in place – even though these are typically not traceable and verifiable in the closed economy.[5] Thus, firms will differ with respect to their costs of cross-listing. As a consequence only some of the good firms decide to cross-list and obtain financing at more favourable terms. As these good firms leave the local pool the average quality of the pool worsens. Therefore, after financial market liberalization, investors will require a higher average interest rate from firms in the local pool as before. Note that a negative valuation effect of the cross-listing decision on rival firms at the home market is consistent with empirical data. Melvin and Valero-Tonone (2005) have found a negative stock price effect of a firms' US cross-listing decision on the home-market rival firms.

The resulting equilibrium in the open economy and welfare effects crucially depend on the previous situation in the closed economy.

If the closed economy was characterized by an underinvestment problem, thus there was market breakdown, liberalizing financial markets has the following effects: Now it pays for good firms with low costs to cross-list and thus invest into their NPV-positive projects. As the average pool quality decreases, there will still be market breakdown for the local pool. While in the closed economy no NPV-positive investment was undertaken at all, in the open economy at least some of the NPV-positive projects can be realized (at positive expected profits!). Thus, the underinvestment problem is mitigated and welfare enhanced.

If the situation in the closed economy was characterized by the overinvestment problem, welfare effects are not clear up front. As I show, there are cases in which welfare effects can be positive, but generally financial market liberalization will

by an auditor. In fact, for example Rahman (1998) shows how auditors failed to act as effective external monitors in the east asian crisis.

[5]Doidge et al (2005) have analyzed, how the incentives to cross-list are determined to the possibility of consuming private benefits and thus the corporate governance level of a particular company. In line with my assumption about the negative relation between cross-listing costs and corporate governance level, they show that firms with bad corporate governance, thus high benefits of control, are less likely to cross-list.

have a welfare decreasing effect.

First of all, good firms with low costs of cross-listing will definitely prefer to leave the pool and raise their funds at a much lower interest rate by incurring the costs of cross-listing. If the number of good firms leaving the market is not too high (this is the case, if costs of cross-listing are very high for most of the firms), all remaining firms will continue to invest at the new average interest rate.

If in contrast the number of good firms leaving the local pool is very high (as costs of cross-listing are relatively small), than the interest rate investors require is be so high that it does not pay for the remaining good firms to invest at this rate. Thus, there will be market breakdown in the open economy.

In the first of the two cases financial market liberalization does not mitigate the problem of overinvestment, as at the prevailing average interest rate all bad firms still invest into their NPV-negative projects. From a welfare point of view the only effect financial market liberalization has in this case is that some good firms now incur cross-listing costs. Thus, welfare is unambiguously reduced.

If financial market liberalization leads to the breakdown of the local market, however, we face the following trade-off. On the one hand the overinvestment problem is mitigated, as now no investment into NPV-negative projects is undertaken. On the other hand also some NPV-positive projects can not be undertaken anymore (by good firms with very high costs of cross-listing) and cross-listing good firms incur the waste of cross-listing. Thus, in this case it crucially depends on the market structure, whether welfare will be increased or reduced.

Overall it can be said, that financial market liberalization can have negative welfare implications for the emerging economy, which will be higher, the lower the underinvestment problem in the closed economy.

The remainder of this paper is organized as follows: The next chapter describes the set-up of the model. In the following two chapters equilibria for the closed and open economy are analyzed. The welfare analysis is presented in chapter 5. Chapter 6 concludes.

2 The Model

Consider the situation in the closed economy first. There is a continuum of risk-neutral firms, each endowed with a new investment opportunity for which external finance is needed. The prevailing gross risk free market interest rate is R_0, which for simplification is assumed to be equal to the risk-free world interest rate. There are two possible types of projects in the economy. All projects require the same initial investment, which is normalized to 1. The projects generate the same cash-flow of CF, with $CF > R_0$, with the two types of projects differing only in their probability of success. Good projects are assumed to be risk-free and exhibit a positive net return of $CF - R_0 > 0$, thus they have a positive net present value (NPV). Bad projects, however, will only be successful with a probability of $p_B < 1$ Otherwise, they generate a return of 0. It is assumed that the bad projects' probability of success is so low that they have a negative NPV and generate an expected net return of $p_B CF - R_0 < 0$. A fraction α of the firms disposes of an NPV-positive project, whereas the remaining fraction $1 - \alpha$ has an NPV-negative project at hand. For being able to invest into the new project, firms have to raise external capital. They have to borrow the required investment amount from an external investor at the prevailing gross market interest rate of R.[6] Firms are protected by limited liability and therefore only have to pay R in case of success.

The market is characterized by asymmetric information. Thus, while firms perfectly know their project quality, external investors only know the ex-ante distribution of good and bad firms and can not distinguish whether a particular firm they are facing disposes of a good or a bad project. There is a continuum of potential investors, which are assumed to be risk-neutral and all provide one unit of financing. The investors will base their financing decision on expected returns given the ex-ante probability distribution of firms.

Note that investors are assumed to be perfectly competitive and the availability

[6] Of course, firms also have the opportunity to raise external equity, especially if they are already listed on a stock-exchange, but for several reasons they might prefer to avoid the issuance of new shares. Besides diluting the value of existing shares and other adverse effects, issuing new shares involves cumbersome and time-consuming transactions.

Furthermore, I deliberately want to focus attention to the case of external debt financing in order to clearly point out the informational value of the cross-listing decision as a signaling device.

of funds is not limited. Investors also have the possibility to invest into a risk-free asset at the prevailing risk-free gross interest rate of R_0. These assumptions hold for the closed as well as the open economy.[7] Being perfectly competitive, investors will therefore ask for an average gross interest rate R, which yields them an expected return of R_0. The required interest rate, R, depends on the probabilities of facing a good or a bad firm in the pool, and as I will show, will be different for the open and closed economy. As bad firms only pay the interest rate in case of success, the average market interest rate R for the pool will be higher than the risk-free interest rate R_0.

As firms are also risk-neutral, they will base their investment decision on expected profits which are given by

$$E\pi_G = CF - R \tag{1}$$

for good firms and

$$E\pi_B = p_B(CF - R) \tag{2}$$

for bad firms. A firm will only invest into his new investment opportunity, if the project yields a positive expected profit.

3 Equilibrium in the Closed Economy

First, consider the equilibrium in the closed economy.[8] In the closed economy, firms can not cross-list and thus convey information about their project quality. Hence, investors have no means to distinguish between firms with good or bad investment opportunities. Thus, the required interest rate will be determined

[7] As stated also in the introduction, these simplifying assumptions are made on purpose in order to focus on the effects of financial market liberalization on firms' incentives and investment decisions. This paper indeed wants to emphasize, that financial market liberalization does not only have a major impact on international capital flows and availability, but it significantly affects firms' behavior. This, as shown in this paper, has major implications for the welfare of the local economy as a whole.

[8] Note, that the situation in the closed economy can also be considered as a benchmark case solely. This is helpful, if the effects of cross-listing on national welfare are to be analyzed for an emerging market economy, which has already been liberalized. Important insights could be gained, for government actions to enhance national welfare.

based on the ex-ante probabilities, thus market shares, of good and bad firms. The only decision firms can take in the closed economy is either to invest at the average interest rate investors require or to completely stay out of the market.

Proposition 1 *In the closed economy, there will be a pooling equilibrium with all firms investing at the average interest rate*

$$R_a = \frac{R_0}{\alpha + (1-\alpha)p_B} \tag{3}$$

if good firms realize positive expected profits given this interest rate, thus $E\pi_G = CF - R_a \geq 0$.
If at the required average interest rate R_a *good firms made expected losses, thus* $E\pi_G = CF - R_a \leq 0$, *then a pooling equilibrium arises with total market breakdown, thus non of the firms invests.*

Proof: see Appendix.

The intuition is straightforward. First note that bad firms will also have an incentive to invest, whenever the investment is profitable for good firms. Given the average interest rate, the incentives for good and bad firms are identical. Thus, the average interest rate required by investors is either low enough, thus close enough to the risk-free interest rate, to sustain an equilibrium, with all firms investing at this rate, or it is too high for firms to profitably invest at the given interest rate – in this case, no firm invests.

The better the performance in the local economy, thus the higher the average project quality is, the closer the required interest rate to the risk-free rate and the higher expected profits of firms. Thus, the less probable market breakdown becomes. This can be driven by a high market share of good firms α, a relatively high cash-flow in case of success CF, or a high probability of success for bad firms p_B. All cases result in a high average project quality in the emerging economy and thus make the equilibrium with market breakdown less likely to arise. Thus in financial markets with 'strong economies' good firms will be likely to 'cross-subsidize' bad firms. On the other hand, if average pool quality in an economy is

relatively bad, it is quite plausible to assume, that it would be too costly for good firms to cross-subsidize bad firms and hence market breakdown will occur.

There is an interesting interpretation of this result. With this basic set-up, it is possible to capture both potential cases of inefficient investment levels stressed in the existing literature. On the one hand, the underinvestment problem focused on by Stiglitz and Weiss (1981) in their analysis of credit rationing. On the other hand the overinvestment problem addressed by de Meza and Webb (1987). The underinvestment problem appears when bad projects drive out good projects, thus valuable investments are not undertaken because of the adverse selection problem. The overinvestment appears when good projects drive in bad projects, thus NPV-negative projects are omitted because of the adverse selection problem. In my model the pooling equilibrium with complete market breakdown captures the underinvestment problem. In this case, the required average interest rate is too high for good firms to invest into their NPV-positive projects. Thus, due to the adverse selection problem, investments, which from a welfare point of view should be undertaken, are not realized. The overinvestment problem emerges in the pooling equilibrium with all firms investing at the average interest rate. In this case, bad firms are 'cross-subsidized' by good firms via the relatively low average interest rate. Due to their limited liability they find it attractive to invest into their NPV-negative projects at this interest rate, reducing the overall welfare of the economy.

This stylized set-up allows me in the following to contemporarily analyze and compare welfare effects for both types of inefficiencies, which yield, as I will show, very different welfare effects and thus policy implications.

4 Equilibrium in the Open Economy

Now consider the situation in the open economy. As stated above, the scope of this analysis is to investigate the effects of financial market liberalization from an informational point of view. Therefore, the model is designed in a way to exclude any effects of capital inflows and the changes of availability of funds on the market interest rate in the economy. As already in the closed economy enough funds were

available, investors were fully competitive and they had the opportunity to invest into a risk-free asset at the world risk-free interest rate, the only effect financial market liberalization has, is indeed to provide firms with the opportunity of cross-listing as a signaling device. Thus, all resulting interest rate effects are purely due to the introduction of this signaling device.[9] Consequently, this setting allows me to analyze welfare effects resulting from informational issues in isolation.

I assume that cross-listing implies full disclosure of relevant project information; it is a perfect signal. Bad firms will therefore never have an incentive to make use of this signal. Even if it was costless, they would prefer not to convey information about their project quality. As soon as investors know the project quality, they will ask for the adequate interest rate. As shown above, the interest rate for an NPV-negative project is so high that bad firms prefer to stay out of the market at this interest rate. Thus, only good firms will consider using this signaling device. Being identified as a good firm allows them to obtain financing at the lower risk-free interest rate R_0.

The crucial point about the cross-listing decision is that it is costly. Apart from the direct costs of cross-listing, the costs also consist in the adoption of new accounting standards and providing much more detailed and accurate financial information than required under local legislation. These costs critically depend on the firm-specific corporate governance level and the disclosure practices already in place – even though these are typically not traceable and verifiable in the closed economy. Thus, firms will differ with respect to their costs of cross-listing. For simplification reasons, in this basic model, the disclosure practices applied by the single firms are exogenously given and the individual costs of cross-listing F_i for good firms are uniformly distributed on the interval $\left[0; \overline{F}\right]$.[10] Note that the upper

[9] Note furthermore, that in the open economy, it does not matter whether firms obtain financing from national or international investors. First of all, the interest rate a firm from the emerging market will have to pay is the same independent of the source of financing. Either he does not make use of the signaling device. Then he will have to pay the average interest rate for the pool in any case. Or he makes use of the signaling device. Than he will obtain financing at the world risk-free interest rate independent from the investor providing him finance. National investors on the other hand will be able to invest and make expected profits of R_0 independent of whom they lend their funds.

[10] It would be a natural extension of the model to investigate and endogenously derive the disclosure levels chosen by firms in the closed economy in a second step depending on whether they anticipate financial market liberalization.

limit of the interval is determined by the legal environment of the emerging economy. The corporate governance practices and disclosure requirements applied and enforced in the emerging country determine the minimum accounting standards and therefore set an upper limit on the individual costs of cross-listing.

What are the options a good firm faces, when it considers cross-listing?

Whether a good firm will indeed have an incentive to cross-list crucially depends on its individual costs of cross-listing F_i. Each good firm can make use of the signaling device by incurring its individual costs of cross-listing and invest at the risk-free interest rate R_0. Or it can decide not to cross-list and stay in the home market pool. A firm will want to cross-list, as long as it can realize higher profits by doing so. As the costs of cross-listing are assumed to be uniformly distributed on the interval $\left[0; \overline{F}\right]$, each firm has to incur a different cost level. As a consequence, only some of the good firms will decide to cross-list and obtain financing at more favorable terms.

The resulting equilibrium in the open economy and welfare effects crucially depend on the previous situation in the closed economy. Consider the situation with underinvestment in the closed economy first.

Proposition 2 *For $E\pi_G = CF - R_a \leq 0$, thus if the closed economy is characterized by an underinvestment problem, in equilibrium all good firms with costs below the threshold value*

$$F_i^* = CF - R_0 \tag{4}$$

will cross-list and invest at R_0. All other firms will not invest at all.

Proof: see Appendix.

This result is very intuitive: If the closed economy is characterized by an underinvestment problem, thus market breakdown, there will definitely be market breakdown in the open economy as well. The reasoning is straightforward. In a liberalized market only good firms consider to leave the home market pool, as they face a much lower interest rate by incurring the costs of cross-listing. Thus, with good firms with low costs of cross-listing leaving the local market, the average

project quality in the pool deteriorates and thus investors require an even higher average interest rate. Thus again too high to realize positive expected profits at given this interest rate.
The only effect liberalizing the financial market has in this situation is to give good firms the opportunity to cross-list and obtain financing at the risk-free interest rate R_0. Good firms will use this option only if they can realize positive profits. Their profits crucially depend on their individual costs of cross-listing. Thus, in equilibrium all good firms with costs $F_i \leq F_i^*$, thus realizing positive profits by incurring these costs will indeed cross-list. All other firms will still not invest at all. Note that while in the closed economy no NPV-positive investment was undertaken, in the open economy at least some of the NPV-positive projects can be realized with positive expected profits. Thus, the underinvestment problem is mitigated.

Now turn to the situation with overinvestment in the closed economy.

Condition 1 *For $E\pi_G = CF - R_a \geq 0$, thus if the closed economy is characterized by an overinvestment problem, there will be an equilibrium without market breakdown, if*

$$F_i^{**} \leq \widehat{F} = \overline{F}(1 + \frac{(1-\alpha)(p_B CF - R_0)}{\alpha(CF - R_0)}) \tag{5}$$

Proposition 3 *If condition 1 is fulfilled in the open economy, in equilibrium all good firms with costs of $F_i \leq F_i^{**}$ will cross-list, whereas all other firms will invest at the average interest rate on the home pool of*

$$\widetilde{R} = \frac{(1 - \alpha\frac{F_i^{**}}{\overline{F}})R_0}{(1-\alpha)p_B + \alpha(1 - \frac{F_i^{**}}{\overline{F}})} \tag{6}$$

The threshold value for cross-listing is given by

$$F_i^{**} = \frac{\overline{F}}{2\alpha}\left[p_B(1-\alpha) + \alpha - \sqrt{[p_B(1-\alpha)+\alpha]^2 - \frac{4\alpha}{\overline{F}}R_0(1-\alpha)(1-p_B)}\right] \tag{7}$$

If condition 1 is not satisfied, then also for $E\pi_G = CF - R_a \geq 0$, in equilibrium

all good firms with costs below the threshold value $F_i^* = CF - R_0$ will cross-list and invest at R_0, whereas all other firms will not invest at all.

Proof: see Appendix.

The intuition for the above results is as follows: In a situation without market breakdown in the closed economy, financial market liberalization gives good firms the following choice: As above, they can incur the cross-listing costs and invest at the risk-free interest rate R_0. But now, they can also continue to invest at the average interest rate prevailing for the home market pool. Whenever a good firm realizes higher profits by cross-listing it will prefer to do so. The important issue is that the interest rate for the home pool and thus the expected profits on the home market in turn depend on the number of good firms actually deciding to cross-list. The interest rate is higher the more good firms leave the local pool, as then the average project quality in the local pool decreases with good firms leaving the pool. Thus, also expected profits on the home market decrease the more good firms decide to cross-list. Depending on the average project quality in the home pool, two different situations can arise in equilibrium. If the average quality is high enough to allow for positive profits at the home market, because there are still enough good firms in the home market pool, then in equilibrium all good firms with fixed costs of cross-listing below a certain threshold value F_i^{**} decide to cross-list and leave the local pool, whereas all other firms, good and bad, continue to invest at the average interest rate for the home pool. If on the other hand the average pool quality decreases too much, than there will be market breakdown at the local pool and in equilibrium, good firms with costs of cross-listing below the threshold level F_i^* determined in proposition 2 will cross-list and invest at the risk-free interest rate. All other firms will not be able to invest anymore.

Given these potential equilibria, the next question to be answered is about the relevance of these equilibria. Thus, which equilibrium will be more likely to arise in which emerging country? As will be shown in the following, the answer crucially depends on the quality of the local pool and on the overall level of cross-listing costs.

Proposition 4 *The better the average pool quality, thus the higher the market share of good firms, α, and the higher the probability of success for bad firms p_B, the lower will be the threshold value for cross-listing, F_i^{**} and the higher will be the critical value for market breakdown in the open economy, $\widehat{F}$. That is*

$$\frac{\partial F_i^{**}}{\partial \alpha} < 0$$

$$\frac{\partial F_i^{**}}{\partial p_B} < 0$$

and

$$\frac{\partial \widehat{F}}{\partial \alpha} > 0$$

$$\frac{\partial \widehat{F}}{\partial p_B} > 0$$

Proof: see Appendix.

Intuitively, proposition 4 can be explained as follows: The better the average quality on the local pool, thus, the higher the market share of good firms, α, or the probability of success of bad firms, p_B, the lower ceteris paribus the average interest rate on the local pool and therefore the higher expected profits on the local market. On the one hand, it will therefore only pay for good firms with relatively low levels of cross-listing costs to cross-list. Thus, ceteris paribus, in equilibrium only fewer firms will cross-list and the threshold level for cross-listing decreases F_i^{**}. On the other hand, with a lower average interest rate in the local pool, a larger fraction of good firms can leave the local market without inducing market breakdown. Thus, the critical value for market breakdown in the open economy, $\widehat{F}$, increases.

Overall it can be said that in the closed economy a situation characterized by an overinvestment problem becomes most likely for emerging economies disposing of a rather high average quality. Furthermore, as from the above proposition it follows that the threshold level for good firms to cross-list, F_i^{**}, increases in α and p_B, and the critical value for market breakdown,$\widehat{F}$, decreases in these parameters,

financial market liberalization will most probably lead to an equilibrium without market breakdown in these emerging economies.

Consider the effects of the overall corporate governance level, thus the level of cross-listing costs, $\overline{F}$, next.

Proposition 5 *The lower the corporate governance level in the emerging market, thus the higher the overall level of cross-listing costs determined by* $\overline{F}$*, the lower the threshold value of cross-listing and the higher the critical value for market breakdown in the open economy,* $\widehat{F}$*. That is*

$$\frac{\partial F_i^{**}}{\partial \overline{F}} < 0$$

$$\frac{\partial \widehat{F}}{\partial \overline{F}} > 0$$

Proof: see Appendix.

An increase in $\overline{F}$ implies a shift of the distribution of cross-listing costs and thus the average costs of cross-listing towards higher levels. It becomes more expensive for good firms to obtain a cross-listing. Thus, with higher costs of cross-listing only a smaller number of good firms will find it attractive to obtain a cross-listing and F_i^{**} decreases. Therefore, maintaining a low level of corporate governance allows local governments to keep good firms from leaving the local market. A shift of the distribution of cross-listing costs towards higher levels implies also that at a given threshold value of cross-listing costs only a smaller number of good firms will leave the local market. Thus, the average quality at the local pool will be better and the local market can be sustained for higher values of $\widehat{F}$.

Thus, with respect to the corporate governance level in the economy there is an interesting result. The local government can influence the effects of financial market liberalization by determining the overall level of corporate governance. The better the corporate governance level, hence the lower $\overline{F}$, the higher F_i^{**} and the lower will be $\widehat{F}$. Thus, it becomes more likely that financial market liberalization

leads to a breakdown of the local market even though a pooling equilibrium with investment could be sustained in the closed economy.

5 Welfare Effects of Cross-Listing

In the above analysis, I have shown how financial market liberalization affects the resulting equilibrium for different emerging market economies. In this section, I want to investigate the welfare implications of financial market liberalization for these economies and determine under which circumstances financial market liberalization will be beneficial for the emerging market economy. In a first step I derive welfare for the first best full information situation as a benchmark case, which makes the inefficiencies in the different situations more evident. Secondly, I determine welfare for the different equilibrium situations possibly arising in the closed and open economy. And finally, I focus on the welfare effects of financial market liberalization. (For a detailed derivation of welfare functions and effects see appendix.)

Welfare is determined by expected profits of investors and firms. Expected profits of good and bad firms are given by equations 1 and 2 respectively.[11] Note that as investors are fully competitive and have the outside option of investing into the risk-free asset, the representative investor will always realize an expected profit of $E\pi_I = R_0 - 1$.[12] For the following analysis, I will assume that $R_0 = 1$, hence $E\pi_I = 0$. Without loss of generality, this allows me to focus on relevant welfare effects by excluding expected profits of investors – which anyhow are the same for all settings and are not affected by financial market liberalization.

First of all consider the first best full information situation in the emerging economy. In the full information case, investors would be willing to provide good firms with financing at the risk-free interest rate, whereas the adequate interest

[11] As assumed above, from their ongoing business firms realize expected profits of zero.

[12] Note that this also holds for the situation with asymmetric information, as long as investors know the market shares and probability of success of good and bad firms. In the case of asymmetric information, expected profits for investors are given by: $E\pi_I = \alpha R_a + (1-\alpha)p_B R_a - 1 = (\alpha + (1-\alpha)p_B)\frac{R_0}{(\alpha+(1-\alpha)p_B)} - 1 = R_0 - 1$

rate they would require from firms disposing of NPV-negative investment projects would be prohibitively high. Thus in equilibrium, an investor either provides funds to a good firm, or invests into the risk-free asset. In any case investors realize expected profits of 0. In equilibrium, only good firms, thus the fraction α of all firms, invest and realize expected profits of $CF - R_0$. Bad firms do not invest at all. Thus, for the full-information case, expected welfare, WF^{FB} in average terms is given by

$$WF^{FB} = \alpha(CF - R_0) \tag{8}$$

Welfare in the first best consists only in weighted expected profits of good firms. In fact, in the first best, NPV-positive projects should be realized whereas investments in NPV-negative projects should not be undertaken.

Turn to the situation with asymmetric information now.
For the closed economy, welfare crucially depends on whether the economy is be characterized by an underinvestment or an overinvestment problem. In both cases inefficiencies arise, while the nature of these inefficiencies is quite different.

Consider the situation in the closed economy characterized by an underinvestment problem first. As shown before, the situation with underinvestment is characterized by a total breakdown of the local market. Hence, none of the firms is able to invest. In this case, in the closed economy with market breakdown, average welfare of the economy is given by

$$WF_C^{MBD} = 0 \tag{9}$$

Again investors' profits are normalized to zero. In the closed economy, market breakdown implies that none of the firms is able to invest and realize positive profits. Thus, in this case welfare as compared to the first-best case is lower by $\alpha(CF - R_0)$. This inefficiency arises as the fraction α of the projects, which are NPV-positive and should be undertaken from a welfare point of view, can not be realized due to the problem of asymmetric information. This reduces welfare by exactly $\alpha(CF - R_0)$.

If on the other hand, the closed economy is characterized by an overinvestment problem, thus a pooling equilibrium without market breakdown, average welfare is given by

$$WF_C^{NMBD} = (\alpha + (1-\alpha)p_B)CF - R_0 \tag{10}$$

In this case all of the firms are able to obtain funding and invest into their projects at the prevailing average interest rate. Welfare as compared to the first-best case is therefore lowered by exactly the expected average value of the investment into the NPV-negative projects, $(1-\alpha)(p_B CF - R_0)$. From a welfare point of view the investment into the NPV-negative project should not be undertaken, but due to the asymmetric information and the resulting average interest rate, bad firms have an incentive to invest as they get cross-subsidized by good firms. Note furthermore, that welfare in an equilibrium without market breakdown will always be higher as in the situation with market breakdown. Intuitively, this is due to the fact that good firms will only invest at the average interest rate, if they can realize positive profits by doing so.

Overall, for the situation in the closed economy it can be said, that welfare will be higher, the higher the average project quality in the country. On the one hand, it becomes more probable that the market will not break down, which exhibits higher welfare as compared to the situation with market breakdown. On the other hand, welfare in the situation with market breakdown is unchanged whereas in the situation without market breakdown it is unambiguously higher. This can either be due to a high return of the investment project, CF, a large share of good firms in the economy, α, or higher probability of success for the bad firms, p_B.

Next, consider welfare in the open economy. As analyzed in the section before, the open economy can also be either characterized by market breakdown or no market breakdown.

First consider welfare in an equilibrium with market breakdown. In this case, as derived in the above section, even if there is market breakdown in the open economy, some NPV-positive projects will be realized-by good firms which have

relatively low costs of cross-listing and therefore obtain a cross-listing on an international stock-exchange. As these firms voluntarily make use of this signaling device, we know that all of these firms realize positive expected profits. Otherwise they could decide not to invest at all. In this case, as derived in the appendix, welfare is given by

$$WF_O^{MBD} = \alpha \frac{F_i^*}{\overline{F}}(CF - R_0 - \frac{\alpha F_i^{*2}}{2\overline{F}}) \tag{11}$$

As compared to the first best case, there are two welfare reducing effects in this situation. First of all, only a smaller fraction $\alpha \frac{F_i^*}{\overline{F}}$ of good firms will indeed cross-list and invest into their NPV-positive projects. Secondly, these firms have to incur signaling costs, which reduce average expected profits of these firms by $\frac{\alpha F_i^{*2}}{2\overline{F}}$, thus the average costs of cross-listing. From a welfare point of view these costs constitute pure waste and should be avoided.

On the other hand, if there is no market breakdown in the open economy, good firms with relatively low cross-listing costs do cross-list and obtain financing at the risk-free interest rate R_0, while the remaining good and bad firms all obtain financing at the average interest rate in the home pool, which due to the worsened pool quality is higher than in the closed economy. In this case, as derived in the appendix, welfare is given by

$$WF_O^{NMBD} = (\alpha + (1-\alpha)p_B)CF - \frac{\alpha^2 F_i^{**3}}{2\overline{F}^2} - R_0 \tag{12}$$

As compared to the first best benchmark case there are again two welfare reducing effects. First of all, also in this case there is the welfare reduction resulting from the overinvestment problem, thus the financing of NPV-negative projects, which should not be undertaken in the first-best case. This effect is identical to the one in the closed economy and given by $(1-\alpha)(p_B CF - R_0)$. The additional welfare reducing effect in the open economy is given by $\frac{\alpha^2 F_i^{**3}}{2\overline{F}^2}$. This term reflects the average costs of cross-listing $\frac{\alpha F_i^{**2}}{2\overline{F}}$ incured by the fraction $\frac{\alpha F_i^{**}}{\overline{F}}$ of the firms,

which are the good firms which indeed do cross-list. Note that apart from these cross-listing costs the cross-listing decision does not have any effect on welfare. From a welfare point of view the lower interest rate cross-listing firms obtain is perfectly off-set by the increase in interest rate firms in the home pool have to pay.

After having set up welfare functions for the different possible resulting equilibria, I can now turn to the main point of my analysis – the effects of financial market liberalization on local welfare. In the next section I investigate under which circumstances financial market liberalization has a welfare improving effect and under which circumstances it reduces welfare and therefore should be accompanied by regulatory interventions by part of the government. We have seen in the above section, that the resulting equilibrium of financial market liberalization crucially depends on the situation in the closed economy, in particular on whether the economy is characterized by an underinvestment or an overinvestment problem. In the following, I will derive welfare effects of financial market liberalization separately for both cases.

Starting from an economy characterized by an underinvestment problem, thus a pooling equilibrium with market breakdown, we have seen that financial market liberalization will reduce the underinvestment problem in the sense that now at least some good firms can cross-list and will obtain funding at the risk-free interest rate. For this case there is still market breakdown on the local market.

Proposition 6 *In an economy characterized by an underinvestment problem, thus for* $E\pi_G = CF - R_a \leq 0$*, financial market liberalization will definitely increase local welfare.*

$$WF_O^{MBD} - WF_C^{MBD} = \alpha \frac{F_i^*}{\overline{F}}(CF - R_0 - \frac{\alpha F_i^{*2}}{2\overline{F}}) > 0 \tag{13}$$

Proof: see Appendix.

By making use of the signaling device of cross-listing, some good firms will now be able to obtain financing and invest. Therefore a positive number of NPV-positive projects is realized. As firms voluntarily decide to cross-list and invest,

they will only do so as long as they make positive profits. Thus, the welfare reducing costs of cross-listing are more than off-set by the profits of this investment. Therefore, welfare increases as compared to the situation in the closed economy.

If the closed economy is characterized by an overinvestment problem, I have shown that financial market liberalization might either lead to market breakdown or not. The resulting equilibrium and hence welfare effects differ for both cases. Consider the situation without market breakdown in the closed and open economy first.

Proposition 7 *If an economy is characterized by an overinvestment problem before financial market liberalization, thus* $E\pi_G = CF - R_a > 0$*, and financial market liberalization does not induce market breakdown, thus if* $F_i^{**} \leq \widehat{F}$*, liberalizing financial markets will definitely reduce local welfare.*

$$WF_O^{NMBD} - WF_C^{NMBD} = -\frac{\alpha^2 F_{i2}^{**3}}{2\overline{F}^2} < 0 \tag{14}$$

Proof: see Appendix.

As shown in proposition 7, financial market liberalization does not only have an unambiguous welfare decreasing effect, but furthermore this effect consists only in the average costs of cross-listing good firms which do indeed cross-list have to incur. Intuitively, this result is due to the following: Financial market liberalization does not alleviate the overinvestment problem of the closed economy. Also in the open economy all firms obtain financing and invest. Thus, investments into NPV-negative projects, which from a welfare point of view should not be financed, are still undertaken by bad firms. Basically, the only difference between the open and the closed economy is that some good firms, namely the ones with relatively low costs of cross-listing, incur these costs in order to obtain financing at the lower risk-free interest rate R_0 and realize higher profits. But while these firms now realize higher profits, all other firms will realize lower profits as compared to the closed economy. They now have to pay the higher average interest rate $\widetilde{R} > R_a$, as rational investors anticipate the decrease in the average project quality of the

pool. As shown in proposition 7 apart from the costs of cross-listing, which are fully welfare-reducing, all other profit effects are purely redistributional. The profit increase due to the lower risk-free interest rate for good firms, which do cross-list, is perfectly offset by the reduction in profits of all other firms in the local pool. The shifts in the interest rates and the resulting changes in expected profits of the firms are just a reallocation of profits from non-cross-listing good and bad firms to good firms, which do cross-list. The only additional welfare effect results from the cost of cross-listing, which is pure waste from a welfare point of view.

Welfare effects however are substantially different for the case of market breakdown induced by financial market liberalization.

Proposition 8 *If an economy is characterized by an overinvestment problem before financial market liberalization, thus for* $E\pi_G = CF - R_a > 0$*, and financial market liberalization does induce market breakdown, thus if* $F_i^{**} > \widehat{F}$*, welfare effects of financial market liberalization are given by*

$$WF_O^{MBD} - WF_C^{NMBD} = -\frac{\alpha^2 F_i^{*3}}{2\overline{F}^2} - \alpha(1 - \frac{F_i^*}{\overline{F}})(CF - R_0) + (1-\alpha)(p_B CF - R_0) \quad (15)$$

While for $\frac{\alpha^2 F_i^{*3}}{2\overline{F}^2} + \alpha(1 - \frac{F_i^*}{\overline{F}})(CF - R_0) < (1-\alpha)(p_B CF - R_0)$ *welfare will be reduced, thus*

$$WF_O^{MBD} - WF_C^{NMBD} \leq 0 \quad (16)$$

for $\frac{\alpha^2 F_i^{*3}}{2\overline{F}^2} + \alpha(1 - \frac{F_i^*}{\overline{F}})(CF - R_0) > (1-\alpha)(p_B CF - R_0)$ *welfare increases, thus*

$$WF_O^{MBD} - WF_C^{NMBD} > 0 \quad (17)$$

Proof: See appendix.

Here is a trade-off between welfare increasing and decreasing effects on the local market and the overall effect crucially depends on the market structure of the emerging economy. What are the different effects driving the result in this case? As compared to the equilibrium without market breakdown, in this case the overinvestment problem is mitigated. Due to the market breakdown on the local pool

none of the bad firms is able to obtain financing and invest into the NPV-negative project. This welfare enhancing effect of financial market liberalization is captured by the last term in equation 15, where $(1-\alpha)$ is the fraction of bad firms in the economy and $(p_B CF - R_0)$ the negative NPV for their investment projects, which can be avoided in the open economy. On the other hand two welfare reducing effects arise: First of all, there are again, the fixed costs of cross-listing, which cross-listing good firms have to incur in order to obtain financing at the risk-free interest rate R_0. These average cross-listing costs are captured by the first term in equation 15, a fraction $\alpha\frac{F_i^*}{\overline{F}}$ of the firms incur these costs, which are on average given by $\frac{\alpha F_i^{*2}}{2\overline{F}}$.[13] The additional welfare reducing effect is due to the fact, that now good firms with relatively high costs of cross-listing will not be able to obtain financing in the open economy, as opposed to the situation in the closed economy. For these firms, the costs of cross-listing as well as the interest rate at the home market pool are prohibitively high. Thus, they will not obtain any financing at all and will not invest into their NPV-positive projects. Investments, which should be undertaken from a welfare point of view. This new underinvestment problem is captured by the term in the middle of equation 15, where the fraction of these firms is given by $\alpha(1-\frac{F_i^*}{\overline{F}})$ and the NPV of their bygone investment opportunity by $(CF - R_0)$.

Overall it can be said, that welfare effects crucially depend on the relevant market structure and especially on whether the emerging market economy is characterized by an overinvestment or an underinvestment problem. In particular, I have shown, that for an economy characterized by an underinvestment problem financial market liberalization has a welfare enhancing effect even though negative spillovers on domestic firms take place. Also if in this case the costs of cross-listing have welfare reducing effects, these are more than offset by the positive effects of the mitigation of the underinvestment problem. This problem will arise in a DeMeza-Webb-type of economy, affected by an overinvestment problem.

Furthermore, I have shown that for an economy characterized by an overinvestment problem financial market liberalization can have a detrimental effect on

[13] Note that this expression is very similar to the one in equation 14. Nevertheless, the average costs of cross-listing for the two cases are not the same, as the threshold cost-level for cross-listing and thus the number of firms actually cross-listing is not the same either.

national welfare-especially if financial market liberalization does not help to alleviate the overinvestment problem. In this case, the welfare reducing effect is driven by the costs of cross-listing good firms have to incur in order to be identified as a firm with a NPV-positive investment project. If financial market liberalization leads to a breakdown of the local market, this welfare reducing effect can be off-set. Even though at a first glance it might seem contra-intuitive that market-breakdown can improve welfare, the reasoning is straightforward. Market breakdown avoids inefficient investments in NPV-negative firms. Thus, the overinvestment problem is reduce, which indeed improves national welfare.

6 Conclusions

In the above analysis I have derived, within a model of adverse selection, the effects of cross-listing after financial market liberalization on the domestic market. Furthermore, I derived welfare effects, which can be positive or negative, depending on the quality of investment projects and the corporate governance levels in the emerging economy. The results of my model are mainly driven by the fact that firms with profitable investment opportunities differ with respect to their costs of cross-listing. The costs of cross-listing are in turn affected by the corporate governance and disclosure practices of the single firms. Thus also the attractiveness of cross-listing is differs for profitable firms, even though they might all dispose of an equally profitable investment opportunity. This difference leads to an equilibrium situation, in which only part of the good firms decides to cross-list, while all other good firms remain on the home market pool together with firms, which dispose of NPV-negative investment opportunities. In this set-up, financial market liberalization has a negative spillover effect on the local financial market, as the local costs of capital increase. Nevertheless, allowing firms to cross-list, does in many cases have a welfare increasing effect. This is due to the fact that it reduces the inefficiency related to an under- or overinvestment problem in the closed economy. In a situation characterized by underinvestment, liberalizing financial markets gives at least some good firms the opportunity to obtain financing. In a situation with overinvestment if the introduction of this signaling device leads to

a market breakdown on the local market, significantly reduces the overinvestment problem. NPV-negative firms are not able to invest anymore. Only if in a situation characterized by an overinvestment problem, cross-listing does not alleviate the inefficiency of overinvestment, financial market liberalization will reduce local welfare.

My analysis makes evident, that for an assessment of the effects of cross-listing on the domestic market it is not sufficient to consider only the spillover effects on local firms. But in addition, the profitability and growth opportunities of these have to be taken into account.

My findings are also consistent with a number of empirical analyses, which find a positive relationship between financial market liberalization and local development on an aggregate level (e.g., Bekaert, Harvey and Lundblad (2001) find that equity market liberalizations, on average, lead to a one percent increase in annual real economic growth of an economy.). In both equilibria of my model, in which welfare is increased by financial market liberalization, relatively more profitable firms obtain financing, which in turn leads to higher growth rates for the economy.

Therefore, a major contribution of my model is to explain contemporarily, how cross-listing can have negative spillover effects on domestic rival firms, and at the same time increase local welfare and contribute to an accelerated growth of the emerging economy.

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8 Appendix

Proof of Proposition 1

In the closed economy only pooling equilibria can arise. A separating equilibrium, in which only good projects obtain financing, can not exist. Bad firms would always have an incentive to imitate good firms. As long as good firms accept a given interest rate, bad firms will find it even more attractive to invest at the prevailing interest rate. On the other hand, a separating equilibrium, in which only bad firms obtain funding, can not exist as well. As soon as there are only bad firms on the market, investors will adjust their beliefs accordingly and require an interest rate of $R_B = \frac{R_0}{p_B}$, which gives them expected profits of R_0. Given this interest rate, bad firms will not find it attractive to raise funds and invest, as $p_B(CF - \frac{R_0}{p_B}) < 0$. Thus, the only possible equilibria in pure strategies are pooling equilibria.

If all firms are on the market, the required interest rate will fulfill the following equation

$$R_0 = \alpha R_a + (1 - \alpha) p_B R_a$$

Solving for R_a yields

$$R_a = \frac{R_0}{\alpha + (1 - \alpha) p_B}$$

At this interest rate, firms will only raise funds, if they make positive expected profits, thus if $CF - R_a > 0$. In this case, there will be a pooling equilibrium with all firms investing at R_a. If on the other hand $CF - R_a < 0$, none of the firms want to invest and thus there will be market breakdown.

Proof of Proposition 2

A firm will cross-list and leave the local market, as long as it makes positive profits by doing so, thus, as long as $CF - R_0 - F_i > 0$. On the local market, there will still be market breakdown, as with the worsening pool the average interest rate increases further and therefore remaining firms will even find it less attractive than before to invest at the prevailing interest rate.

Proof of Condition 1 and Proposition 3

The interest rate investors require on the local pool, $\widetilde{R}$, is determined by the zero profit condition for investors

$$R_0 = \frac{(1-\alpha)p_g\widetilde{R}}{1-\frac{\alpha}{\overline{F}}F_i^{**}} + \frac{(\alpha-\frac{\alpha}{\overline{F}}F_i^{**})\widetilde{R}}{1-\frac{\alpha}{\overline{F}}F_i^{**}}$$

where $(\alpha-\frac{\alpha}{\overline{F}}F_i^{**})$ is the fraction of good firms to cross-list and F_i^{**} the threshold level of fix-costs for good firms to cross-list.

Solving for $\widetilde{R}$ yields

$$\widetilde{R} = \frac{R_0(1-\frac{\alpha}{\overline{F}}F_i^{**})}{p_B(1-\alpha)+\alpha-\frac{\alpha}{\overline{F}}F_i^{**}}$$

The resulting equilibrium situation depends on the profits on the local market.

Two cases can be distinguished:

1) If profits on the local market are high enough, the threshold level for good firms to cross-list is determined by

$$\begin{aligned} E\pi_G^{O,H} &= E\pi_G^{O,Cl} \\ CF-\widetilde{R} &= CF-R_0-F_i^{**} \end{aligned}$$

Combining the two conditions yields

$$F_{i1}^{**} = \frac{\overline{F}}{2\alpha}\left[p_B(1-\alpha)+\alpha+\sqrt{[p_B(1-\alpha)+\alpha]^2-\frac{4\alpha}{\overline{F}}R_0(1-\alpha)(1-p_B)}\right]$$

$$F_{i2}^{**} = \frac{\overline{F}}{2\alpha}\left[p_B(1-\alpha)+\alpha-\sqrt{[p_B(1-\alpha)+\alpha]^2-\frac{4\alpha}{\overline{F}}R_0(1-\alpha)(1-p_B)}\right]$$

Both values for F_i^{**} are potential equilibria. However, as shown in the following, only the second candidate F_{i2}^{**} is stable and pareto-dominates the other equilibrium F_{i1}^{**}. Thus, F_{i1}^{**} will therefore be excluded from the rest of the analysis.

First note that $F_{i2}^{**} < F_{i1}^{**}$.

With

$$\frac{\partial E\pi_G^{O,Cl}}{\partial F_i^{**}} = -1 < 0$$

and

$$\frac{\partial E\pi^{O,H}}{\partial F_i^{**}} = \frac{R_0\alpha(1-\alpha)(p_B-1)}{\overline{F}(p_B(1-\alpha)+\alpha(1-\frac{F_i^{**}}{\overline{F}}))} < 0$$

both profits on the home market and with cross-listing are decreasing in F_i^{**}. Thus, with $F_{i2}^{**} < F_{i1}^{**}$ expected profits will be higher at F_{i2}^{**}, implying that the equilibrium with F_{i2}^{**} pareto-dominates the equilibrium with F_{i1}^{**}.

While profits of cross-listing are linearly decreasing in F_i^{**}, $E\pi_G^{O,H}$ is a convex function in F_i^{**}, with.

$$\frac{\partial^2 E\pi^{O,H}}{\partial F_i^{**2}} = \frac{2R_0\alpha^2(1-\alpha)(p_B-1)}{\overline{F}^2(p_B(1-\alpha)+\alpha(1-\frac{F_i^{**}}{\overline{F}}))^3} < 0$$

Note that, at $F_i^{**} = 0$, and given a positive market share of bad firms, $\alpha < 1$, and lower probability of success for the bad firm $p_B < 1$ the following will hold:

$CF - \widetilde{R} = CF - R_a < CF - R_0$

Thus, we can follow that, with $F_{i2}^{**} < F_{i1}^{**}$, expected profits by cross-listing will be higher to the left of F_{i2}^{**} and to the right of F_{i1}^{**}, whereas expected profits on the local market will be higher for values between F_{i2}^{**} and F_{i1}^{**}. Therefore, only the equilibrium with F_{i2}^{**} is stable. Given the stability and the pareto-dominance arguments, F_{i1}^{**} will be excluded from the analysis in the following.

2) If profits on the local market are relatively low, such that at F_{i2}^{**} firms would make expected losses, opening up induces market breakdown on the local market and the equilibrium threshold level for good firms to cross-list is like in 2 determined by

$$CF - R_0 - F_i^* \geq 0$$

The critical cost level for market breakdown is given by

$$CF - \frac{R_0(1 - \frac{\alpha}{\overline{F}}\widehat{F})}{p_B(1-\alpha) + \alpha - \frac{\alpha}{\overline{F}}\widehat{F}} = 0$$

Solving for $\widehat{F}$ yields

$$\widehat{F} = \overline{F}(1 + \frac{(1-\alpha)(p_B CF - R_0)}{\alpha(CF - R_0)})$$

Proof of Proposition 4

Consider the part of the proposition with respect to F_i^{**} first.

First note that for an interior solution, $F_i^{**} \leq \overline{F}$, thus
$[p_B(1-\alpha) + \alpha]^2 - \frac{4\alpha}{\overline{F}} R_0(1-\alpha)(1-p_B) \geq 0$

which can be simplified to
$\overline{F} p_B \geq R_0(1 - p_B)$

Next, I find for the derivative with respect to α
$\frac{\partial F_{i2}^{**}}{\partial \alpha} = \frac{1}{2\alpha^2\sqrt{[p_B(1-\alpha)+\alpha]^2 - \frac{4\alpha}{\overline{F}}R_0(1-\alpha)(1-p_B)}}$
$\left(\overline{F}p_B^2 - 2R_0\alpha - \overline{F}\alpha p_B^2 - \overline{F}p_B\sqrt{[p_B(1-\alpha)+\alpha]^2 - \frac{4\alpha}{\overline{F}}R_0(1-\alpha)(1-p_B)} + \overline{F}\alpha p_B + 2R_0\alpha p_B\right)$

With $[p_B(1-\alpha)+\alpha]^2 - \frac{4\alpha}{\overline{F}}R_0(1-\alpha)(1-p_B) \geq 0$ for an interior solution it follows that
$\frac{\partial F_{i2}^{**}}{\partial \alpha} < 0$, if $\overline{F}p_B^2 - 2R_0\alpha - \overline{F}\alpha p_B^2$
$-\overline{F}p_B\sqrt{[p_B(1-\alpha)+\alpha]^2 - \frac{4\alpha}{\overline{F}}R_0(1-\alpha)(1-p_B)} + \overline{F}\alpha p_B + 2R_0\alpha p_B < 0$

thus
$(\frac{1}{\overline{F}p^2}(\overline{F}p_B^2 - 2R_0\alpha - \overline{F}\alpha p_B^2 + \overline{F}\alpha p_B + 2R_0\alpha p_B))^2$
$< \alpha^2(p_B^2 - 2p_B + 1 + \frac{4}{\overline{F}}R_0 - \frac{4}{\overline{F}}R_0 p_B) + \alpha(\frac{4}{\overline{F}}R_0 p_B - 2p_B^2 + 2p_B - \frac{4}{\overline{F}}R_0) + p_B^2$

which can be simplified to

$\frac{4}{\overline{F}^2} R_0 \frac{\alpha^2}{p_B^2} (p_B - 1) \left(\overline{F} p_B - R_0 + R_0 p_B \right) < 0$

This holds, given the above derived condition for an internal solution $\overline{F} p_B \geq R_0(1 - p_B)$ and $(1 - p_B) > 0$.

The derivative with respect to p_B is given by
$\frac{\partial F_{i2}^{**}}{\partial p_B} = \frac{1}{2\alpha \sqrt{[p_B(1-\alpha)+\alpha]^2 - \frac{4\alpha}{\overline{F}} R_0(1-\alpha)(1-p_B)}} (\alpha - 1)$
$\left(\overline{F}\alpha - \overline{F} \sqrt{[p_B(1-\alpha)+\alpha]^2 - \frac{4\alpha}{\overline{F}} R_0(1-\alpha)(1-p_B)} + 2R_0\alpha + \overline{F} p_B - \overline{F}\alpha p_B \right)$

with $\alpha < 1$ and $[p_B(1-\alpha)+\alpha]^2 - \frac{4\alpha}{\overline{F}} R_0(1-\alpha)(1-p_B) \geq 0$ for an interior solution it follows that
$\frac{\partial F_{i2}^{**}}{\partial p_B} < 0$,
if $\overline{F}\alpha - \overline{F} \sqrt{[p_B(1-\alpha)+\alpha]^2 - \frac{4\alpha}{\overline{F}} R_0(1-\alpha)(1-p_B)} + 2R_0\alpha + \overline{F} p_B - \overline{F}\alpha p_B > 0$

Thus,
$(\alpha + 2\frac{R_0\alpha}{\overline{F}} + p_B - \alpha p_B)^2 > [p_B(1-\alpha)+\alpha]^2 - \frac{4\alpha}{\overline{F}} R_0(1-\alpha)(1-p_B)$

which can be rearranged to
$\frac{4}{\overline{F}^2} Ra \left(F + Ra \right) > 0$

Now turn to the part of the proposition regarding $\widehat{F}$.
The derivative of $\widehat{F}$ with respect to α is given by
$\frac{\partial \widehat{F}}{\partial \alpha} = \overline{F} \left(\frac{-(p_B CF - R_0)\alpha(CF - R_0) - (1-\alpha)(p_B CF - R_0)(CF - R_0)}{\alpha^2 (CF - R_0)^2} \right)$

which can be simplified to
$\frac{\partial \widehat{F}}{\partial \alpha} = -\overline{F} \left(\frac{p_B CF - R_0}{\alpha^2 (CF - R_0)} \right)$

As bad projects are NPV-negative whereas good projects are NPV-positive, $p_B CF - R_0 < 0$, whereas $CF - R_0 > 0$.
Thus $\frac{\partial \widehat{F}}{\partial \alpha} < 0$.

The derivative of $\widehat{F}$ with respect to p_B is given by
$\frac{\partial \widehat{F}}{\partial p_B} = \frac{\overline{F} CF}{\alpha(CF - R_0)} (1 - \alpha)$

Hence, with $CF - R_0 > 0$ and $\alpha < 1$ it follows that
$\frac{\partial \widehat{F}}{\partial p_B} < 0$ as well.

Proof of Proposition 5

The derivative of F_i^{**} with respect to $\overline{F}$ is given by
$\frac{\partial F_{i2}^{**}}{\partial \overline{F}} = -\frac{1}{2\overline{F}\alpha\sqrt{[p_B(1-\alpha)+\alpha]^2-\frac{4\alpha}{\overline{F}}R_0(1-\alpha)(1-p_B)}}$
$(\overline{F}\alpha^2+2R_0\alpha^2+\overline{F}p_B^2-2R_0\alpha-2\overline{F}\alpha p_B^2-2\overline{F}\alpha^2 p_B-2R_0\alpha^2 p_B+\overline{F}\alpha^2 p_B^2+2\overline{F}\alpha p_B+2R_0\alpha p_B$
$-\overline{F}(\alpha+p_B-\alpha p_B)\sqrt{[p_B(1-\alpha)+\alpha]^2-\frac{4\alpha}{\overline{F}}R_0(1-\alpha)(1-p_B)})$

Thus, with $[p_B(1-\alpha)+\alpha]^2-\frac{4\alpha}{\overline{F}}R_0(1-\alpha)(1-p_B) \geq 0$,
$\frac{\partial F_{i2}^{**}}{\partial \overline{F}} < 0$, if $\overline{F}\alpha^2+2R_0\alpha^2+\overline{F}p_B^2-2R_0\alpha-2\overline{F}\alpha p_B^2-2\overline{F}\alpha^2 p_B-2R_0\alpha^2 p_B+\overline{F}\alpha^2 p_B^2+2\overline{F}\alpha p_B+2R_0\alpha p_B$
$-\overline{F}(\alpha+p_B-\alpha p_B)\sqrt{[p_B(1-\alpha)+\alpha]^2-\frac{4\alpha}{\overline{F}}R_0(1-\alpha)(1-p_B)} > 0$

Thus
$\frac{(\overline{F}\alpha^2+2R_0\alpha^2+\overline{F}p_B^2-2R_0\alpha-2\overline{F}\alpha p_B^2-2\overline{F}\alpha^2 p_B-2R_0\alpha^2 p_B+\overline{F}\alpha^2 p_B^2+2\overline{F}\alpha p_B+2R_0\alpha p_B)^2}{\overline{F}^2(\alpha+p_B-\alpha p_B)^2}$
$-[p_B(1-\alpha)+\alpha]^2-\frac{4\alpha}{\overline{F}}R_0(1-\alpha)(1-p_B) > 0$

which can be simplified to
$\frac{4}{\overline{F}^2}R_0^2\alpha^2(\alpha-1)^2\frac{(p_B-1)^2}{(\alpha+p_B-\alpha p_B)^2} > 0$

Therefore$\frac{\partial F_{i2}^{**}}{\partial \overline{F}} < 0$.

The derivative of $\widehat{F}$ with respect to $\overline{F}$ is given by
$\frac{\partial \widehat{F}}{\partial \overline{F}} = \frac{\alpha(CF-R_0)+(1-\alpha)(p_BCF-R_0)}{\alpha(CF-R_0)}$

If in the closed economy there is no market breakdown, this means that the weighted NPV of an average project is positive. That is,
$\alpha(CF-R_0)+(1-\alpha)(p_BCF-R_0) > 0$.

Thus,
$\frac{\partial \widehat{F}}{\partial \overline{F}} > 0$

Derivation of Welfare functions

Welfare, given in average terms, consists in the sum of average expected profits of investors and firms. As rational and fully competitive investors allways realize expected profits of $E\pi_I = R_0 - 1$ and for this section it is assumed, that $R_0 = 1$, investors allways realize expected profits of 0.and can therefore be excluded from the following analysis.

1. **Welfare in the closed economy with market breakdown**

   Expected profits of good firms:

   $E\pi_G = 0$

   Expected profits of bad firms:

   $E\pi_B = 0$

   Welfare:

   $WF_C^{MBD} = \alpha E\pi_G + (1-\alpha)E\pi_B = \alpha 0 + (1-\alpha)0 = 0$

2. **Welfare in the closed economy without market breakdown**

   with $R_a = \frac{R_0}{\alpha+(1-\alpha)p_B}$

   Expected profits of good firms:

   $E\pi_G = CF - R_a$

   Expected profits of bad firms:

   $E\pi_B = p_B(CF - R_a)$

   Welfare:

   $WF_C^{NMBD} = \alpha(CF - R_a) + (1-\alpha)p_B(CF - R_a) = (\alpha + (1-\alpha)p_B)CF - (\alpha + (1-\alpha)p_B)\frac{R_0}{(\alpha+(1-\alpha)p_B)} = (\alpha + (1-\alpha)p_B)CF - R_0$

3. **Welfare in the open economy with market breakdown**

   Expected profit of average cross-listing good firm:

$$E\pi_G^{Cl} = CF - R_0 - \int_0^{Fi^*} F_i \frac{\alpha}{\overline{F}} dF_i = CF - R_0 - \frac{\alpha F_i^{*2}}{2\overline{F}}$$

Expected profit of average non-cross-listing good firm:

$E\pi_G^{NCl} = 0$

Expected profit of average non-cross-listing bad firm:

$E\pi_B^{NCl} = 0$

Welfare:

$WF_O^{MBD} = \alpha \frac{F_i^*}{\overline{F}}(CF - R_0 - \frac{\alpha F_i^{*2}}{2\overline{F}}) + (\alpha - \alpha \frac{F_i^*}{\overline{F}})0 + (1-\alpha)0$

$= \alpha \frac{F_i^*}{\overline{F}}(CF - R_0 - \frac{\alpha F_i^{*2}}{2\overline{F}})$

4. **Welfare in the open economy without market breakdown**

with $\widetilde{R} = \frac{R_0(1-\frac{\alpha}{\overline{F}}F_i^{**})}{p_B(1-\alpha)+\alpha-\frac{\alpha}{\overline{F}}F_i^{**}}$

Expected profit of average cross-listing good firm:

$$E\pi_G^{Cl} = CF - R_0 - \int_0^{Fi^{**}} F_i \frac{\alpha}{\overline{F}} dF_i = CF - R_0 - \frac{\alpha F_i^{**2}}{2\overline{F}}$$

Expected profit of average non-cross-listing good firm:

$E\pi_G^{NCl} = CF - \widetilde{R}$

Expected profit of average non-cross-listing bad firm:

$E\pi_B^{NCl} = p_B(CF - \widetilde{R})$

Welfare:

$WF_O^{NMBD} = \alpha \frac{F_i^{**}}{\overline{F}}(CF - R_0 - \frac{\alpha F_i^{**2}}{2\overline{F}}) + (\alpha - \alpha \frac{F_i^{**}}{\overline{F}})(CF - \widetilde{R}) + (1-\alpha)p_B(CF - \widetilde{R})$

$= \alpha \frac{F_i^{**}}{\overline{F}}(CF - R_0 - \frac{\alpha F_i^{**2}}{2\overline{F}}) - (p_B(1-\alpha) + \alpha - \alpha \frac{F_i^{**}}{\overline{F}})(CF - \frac{R_0(1-\frac{\alpha}{\overline{F}}F_i^{**})}{p_B(1-\alpha)+\alpha-\frac{\alpha}{\overline{F}}F_i^{**}})$

$= (\alpha + (1-\alpha)p_B)CF - \frac{\alpha^2 F_i^{**3}}{2\overline{F}^2} - R_0$

Comparative statics for welfare levels in the closed economy

First of all, as shown before, the local market does not break down if:

$CF - R_a > 0$

With

$\frac{\partial R_a}{\partial \alpha} = R_0 \frac{p_B - 1}{(p_B + \alpha - p_B \alpha)^2} < 0$

and
$\frac{\partial R_a}{\partial p_B} = R_0 \frac{\alpha - 1}{(p_B + \alpha - p_B \alpha)^2} < 0$

and given that for an interior solution $\alpha < 1$ and $p_B < 1$, R_a decreases in α and p_B.

A decrease in R_a relaxes the above condition. Thus it becomes less likely that there will be market breakdown in the closed economy.

With $CF - R_a > 0$ it can be derived that $WF_C^{NMBD} = (\alpha + (1-\alpha)p_B)(CF - R_a) > 0 = WF_C^{MBD}$.

For welfare in the case without market breakdown, I find
$\frac{\partial WF_C^{NMBD}}{\partial \alpha} = CF\,(1 - p_B) > 0$

and
$\frac{\partial WF_C^{NMBD}}{\partial p_B} = CF\,(1 - \alpha) > 0.$

Comparative statics for welfare levels in the open economy with market breakdown

For welfare in the situation with market breakdown I find with $F_i^* = CF - R_0$:
$\frac{\partial WF_O^{MBD}}{\partial \alpha} > 0$

The proof is as follows:
With $WF_O^{MBD} = \alpha \frac{F_i^*}{\overline{F}}(CF - R_0 - \frac{\alpha F_i^{*2}}{2\overline{F}}) = \alpha \frac{CF - R_0}{\overline{F}}(CF - R_0 - \frac{\alpha (CF - R_0)^2}{2\overline{F}})$
$= \alpha \frac{(CF - R_0)^2}{\overline{F}} - \frac{\alpha^2 (CF - R_0)^3}{2\overline{F}^2}$

the derivative with respect to α is
$\frac{\partial WF_O^{MBD}}{\partial \alpha} = \frac{(CF - R_0)^2}{\overline{F}} - \frac{2\alpha (CF - R_0)^3}{2\overline{F}^2}$

This can be simplified to
$\frac{(CF - R_0)^2}{\overline{F}}(1 - \frac{\alpha (CF - R_0)}{\overline{F}})$,

where $\frac{(CF - R_0)^2}{\overline{F}} > 0$.

Thus it remains to be shown that
$(1 - \frac{\alpha(CF-R_0)}{\overline{F}}) > 0$

As $(CF - R_0) = F_i^*$ it follows that $\frac{(CF-R_0)}{\overline{F}} < 1$
and as for an interior solution $\alpha < 1$ it has to hold unambigously that
$\frac{\alpha(CF-R_0)}{\overline{F}} < 1$, such that
$\frac{\partial WF_O^{MBD}}{\partial \alpha} > 0$

As welfare in the open economy with market breakdown is independent of p_B, it follows immediately that

$\frac{\partial WF_O^{MBD}}{\partial p_B} = 0$

With respect to the level of cross-listing costs, determined by $\overline{F}$ I find
$\frac{\partial WF_O^{MBD}}{\partial \overline{F}} = -\frac{\alpha(CF-R_0)^2}{\overline{F}^2} + \frac{2\alpha^2(CF-R_0)^3}{2\overline{F}^3} = \frac{\alpha(CF-R_0)^2}{\overline{F}^2}(-1 + \frac{\alpha(CF-R)}{\overline{F}}) < 0$

Comparative statics for welfare levels in the open economy without market breakdown

With respect to α I find:

TBD

With respect to p_B I find
$\frac{\partial WF_O^{MBD}}{\partial p_B} = (1-\alpha)CF - \frac{3\alpha^2 F_i^{**2}}{2\overline{F}^2}\frac{\partial F_i^{**}}{\partial p_B}$

with $\frac{\partial F_i^{**}}{\partial p_B} < 0$ it immediately follows that

$\frac{\partial WF_O^{MBD}}{\partial p_B} > 0$

With respect to $\overline{F}$ I find
TBD

Comparison welfare with and without market breakdown TBD

Proof of Proposition 6

For an interior solution it has to hold that $F_i^* < \overline{F}$ and $\alpha < 1$.

It can be followed that $\frac{\alpha F_i^*}{2\overline{F}} < 1$

and therefore, $\frac{\alpha F_i^{*2}}{2\overline{F}} < F_i^*$.

Thus
$WF_O^{MBD} - WF_C^{MBD} = \alpha\frac{F_i^*}{\overline{F}}(CF - R_0 - \frac{\alpha F_i^{*2}}{2\overline{F}}) - 0 > \alpha\frac{F_i^*}{\overline{F}}(CF - R_0 - F_i^*) = \alpha\frac{F_i^*}{\overline{F}}(CF - R_0 - CF + R_0) = 0$

and it follows that
$WF_O^{MBD} - WF_C^{MBD} > 0$

Proof of Proposition 7

$WF_O^{NMBD} - WF_C^{NMBD} = (\alpha + (1-\alpha)p_B)CF - \frac{\alpha^2 F_i^{**3}}{2\overline{F}^2} - R_0 - ((\alpha + (1-\alpha)p_B)CF - R_0) = -\frac{\alpha^2 F_{i2}^{**3}}{2\overline{F}^2} < 0$

Proof of Proposition 8

TBD