Banking and Multinational Finance: The Role of Incentives and Institutions

To my grandfather Hayri Tokay.

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Munich, February 18th, 2009   Basak Akbel

Contents

List of Figures

Preface

Global credit markets find themselves in major upheaval since August 2007. The current turmoil was triggered by problems on the U.S. sub-prime mortgage markets. A year after the onset of the crisis, banks around the world have written down almost 500 billion USD and no end is in sight. Before August 2007, the sub-prime crisis was perceived to be a local problem on U.S. markets. By July 2008, it has turned out that European banks account for almost half of the resulting write-downs (International Monetary Fund (2008)).

The global spread of the crisis shows the downside potential of financial market integration. The sub-prime crisis could only reach this global dimension because investors all over the world channeled funds into asset- (mortgage-)backed securities that were issued by U.S. financial institutions on a large scale.

These modern instruments of credit risk transfer have been strongly criticized in the current debate about the sub-prime crisis. In particular, their incentive effects on the banks' role as relationship lenders are questioned. Bank regulatory capital requirements are central in this debate since they create an incentive to transfer risks out of the banks' balance sheets. As the current crisis highlights in the context of financially integrated markets, national regulatory and legal settings have an impact on financial market participants reaching far beyond a country's borders.

The goal of the present dissertation is to clarify how regulatory and legal settings influence financial market participants' incentives and decisions. While the first part of the dissertation focuses on the suppliers of funds, i.e. banks and institutional investors, the second part is dedicated to the analysis of the demand side, i.e. borrowing firms.

I develop theoretical models that take into account informational problems on financial markets and investigate the interplay between incentives and the regulatory or legal environment. Chapter 1 considers institutional investors and analyzes a bank's choice of a credit risk transfer instrument. Chapters 2 and 3 focus on the borrowing

firm's financing decisions. Chapter 2 investigates the optimal debt allocation within a multinational corporation. Chapter 3 considers a firm's cross-listing decision and derives its impact on the firm's home market competitors.

In the remainder of this preface, I present a brief overview of the three following chapters and highlight their main contributions. Each chapter consists of a self-contained paper and can be read independently.

Chapter 1 is directly related to the current credit crisis. Overcoming regulatory capital requirements is a central goal in banks seeking the use of credit risk transfer instruments. The model developed in this chapter helps to explain how a bank's primary role as a relationship lender is affected by its decision to transfer credit risks by (partially) selling off its existing debt. I consider both the bank's monitoring incentives as well as its incentive to liquidate non-performing loans. Furthermore, the analysis identifies circumstances under which a bank might inefficiently securitize its debt instead of choosing a more traditional instrument of credit risk transfer like syndication.

Common belief among practitioners and economists is that keeping the junior part of the debt in the securitization process, the so-called equity tranche, provides a bank with strong monitoring incentives. In fact, I find that, as long as markets are doing well and the liquidation value of the debt is high, securitization entails no adverse incentive effects. In this case, keeping the equity tranche perfectly solves all potential incentive problems associated with securitization.

However, if the liquidation value is intermediate or low, the opposite result emerges. In this case, the originator has inefficiently low monitoring incentives, even if he holds the equity tranche. In particular, the model shows that the originator's monitoring incentives are lower than with syndication. Furthermore, for intermediate liquidation values securitization (as opposed to syndication) generates an incentive to "gamble for resurrection", i.e. to inefficiently continue non-performing loans. These results give a possible explanation for why it was in the downturn of housing prices that banks' incentives were negatively affected.

A second major result of this paper relates to the regulation of institutional investors. To increase social efficiency and to protect individuals, institutional investors like pension funds and insurance companies are made subject to restrictive investment regulations. However, as shown in the model, applying these regulations solely to selective investor groups introduces inefficiencies on debt resale markets. This in-

sight constitutes a new aspect in the current discussion on financial market regulation: Rather than focusing on the tightness of capital requirements for banks only, more attention should be paid to the harmonization of regulatory requirements for all financial market participants including banks, pension funds and hedge funds.

In an extension to the model, I investigate the effects of tightening capital requirements for securitization under Basel II. The tightening of capital requirements adversely influences both the originator's monitoring and liquidation incentives. On the other side, Basel II reduces the scope of inefficiently choosing securitization over syndication.

Finally, the paper conciliates two differing views on the role of the bank as the controlling debtholder: While the literature on the seniority of bank debt claims that a bank as the relationship lender should be the most senior debtholder, the literature on asset securitization claims that a bank as the relationship lender should keep a junior position. In an extension of my model I, reconcile these differing views on the bank as a controlling debtholder and derive who has stronger monitoring incentives under which circumstances. Precisely, I find that for high liquidation values the junior debtholder has stronger monitoring incentives but for low liquidation values monitoring should be undertaken by the senior debtholder.

Chapter 2, which is joint work with Prof. Dr. Monika Schnitzer, explores the financing decisions of multinational firms. Financial market integration implies the dismantling of restrictions on international asset holdings. This, in turn, increases the number and the importance of multinational corporations (MNCs): While in 1970 only about 7000 MNCs existed, this number increased to 30.000 by the 1990s and reached over 63.000 MNCs today (Gabel and Bruner (2003), p. 2).

Multinational corporations differ significantly from purely national stand-alone firms. First, they consist of several separate and often legally independent entities. This creates agency problems on internal markets – foremost between headquarters and subsidiary managers. Second, multinational corporations have a richer set of financing options as compared to national single entity firms. With respect to credit financing, they can choose between centralized and decentralized borrowing for their subsidiaries.

Only few existing papers acknowledge the possibility of substituting local borrowing with parental funds. Moreover, the focus of these papers lies mainly on tax issues. One notable exception is a recent paper by Desai, Foley and Hines (2004). The authors show

empirically that a host country's legal environment – more specifically the strength of creditor rights – is a key determinant of the financing structure for multinational affiliates. In addition, a large and growing literature on law and finance highlights the relevance of a country's legal environment for corporate finance. Despite this evidence, the impact of the legal environment on the borrowing structure of multinational corporations has not yet been analytically studied.

The dissertation's second chapter contributes to the existing literature by introducing country-specific legal environments into a model of internal capital markets. We identify how a multinational's choice between centralized or decentralized borrowing is affected by creditor rights and bankruptcy costs, taking into account managerial incentives and coinsurance considerations.

The model results are consistent with existing empirical evidence. Based on the model we derive further testable implications. In particular, we find that a partially centralized borrowing structure is optimal when creditor rights are either weak or strong. For intermediate levels of creditor rights, a fully decentralized (centralized) borrowing structure is optimal if managers have strong (weak) empire-building tendencies. In addition, decentralized borrowing becomes more attractive if a company focuses on short-term profitability. Finally, if the countries differ with respect to their legal environment, loans tend to be taken up in the country with better creditor rights and a more efficient insolvency system.

To summarize, our paper emphasizes the importance of an integrated view on multinationals' borrowing decision. Due to feedback effects on internal capital markets the borrowing choice for a subsidiary cannot be considered in isolation from the overall borrowing structure of the multinational corporation.

A further aspect of financial market integration, studied in Chapter 3, is the access to global financial markets. Liberalizing financial markets provides firms with the possibility to cross-list on foreign stock exchanges. Interestingly, firms from emerging countries often do cross-list even though they do not want to raise new funds. This is due to the informational value of cross-listing: Financial markets in emerging economies are typically characterized by strong informational problems. Cross-listing allows firms to credibly comply with stricter and better enforced regulatory and disclosure requirements as compared to those in their home countries. Thereby, firms are able to signal the quality of their projects.

I develop an adverse selection model that takes into account this informational value of cross-listing as a signaling device and investigate welfare effects of cross-listing in the home market. While most of the existing literature on cross-listing analyzes the underlying reasons for and the resulting effects of this decision on the cross-listing firm, little attention has been paid to the home market effects of cross-listing. Only a few empirical papers have stressed that cross-listing entails negative cost-of-capital and valuation spillover effects on non-cross-listing firms. Welfare effects have not been analyzed yet.

I compare cross-listing in financially integrated markets to the reference case of a closed emerging economy. Two types of investment inefficiencies in closed emerging economies have been identified by the existing literature: On the one hand, an underinvestment problem can arise due to credit-rationing on informationally opaque financing markets (Stiglitz and Weiss (1981)). On the other hand, the economy might be characterized by an overinvestment problem. This arises because bad investments cannot be distinguished from good investment opportunities and therefore also obtain financing (De Meza and Webb (1987)). The model developed in Chapter 3 allows analyzing the welfare effects of financial market liberalization for both types of inefficiencies in a unified framework.

My model predicts positive cost-of-capital and valuation effects for the cross-listing firm. These predictions are supported by empirical evidence.

I derive a surprising result with respect to the home market effects of cross-listing: Despite unambiguously negative spillovers on home market competitors, cross-listing can improve local welfare. This is due to the fact that cross-listing reduces the inefficiency related to an under- or overinvestment problem in the closed economy. Furthermore, local welfare is only reduced if the mitigation of an overinvestment problem is more than offset by the costs of cross-listing and the introduction of a new underinvestment problem; or if the overinvestment problem can not be mitigated at all. Thus, for an assessment of the home market effects of cross-listing it is not sufficient to consider the spillover effects on competing firms. Rather, the profitability and growth opportunities of these have to be taken into account as well.

Chapter 1

Securitization vs. Syndication: Credit Risk Transfer and the Originator's Incentives

1.1 Introduction

For a few decades modern instruments of credit risk transfer and in particular asset-backed securities (ABS) were on the rise. There was a six fold increase corresponding to a constant annual growth rate of 26 percent in total securitization issues on the European market between the years 2000 and 2007. This resulted in a total issuance volume of almost 500 billion EUR in 2007 (European Securitization Forum (2008a)).

However, since the beginning of the current subprime crisis in 2007, asset-backed securities have come under scrutiny and securitization issues dropped dramatically. Already in the second half of 2007 the issuance volume was down by almost 50 percent from the first two quarters. Also for 2008 the European Securitization Forum expects the total issuance volume to fall by 41 percent to 272 billion EUR from 2007 (European Securitization Forum (2008b)).[1] In public as well as academic debate the focus is now on the perils associated with the issuance of ABS. A major area of concern relates to agency problems. Besides the rating agencies, also the originator's incentives have

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[1]This exposition is to illustrate current changes in securitization markets. Globally, the total volume of securitization issues is much larger. The total issuance volume in 2007 amounted to about 6.5 trillion USD (including mortgage-backed securities) for the US market only (Securities Industries and Financial Markets Association (2008)).

recently been criticized.[2] The key question is how securitization affects the originator's primary function as a relationship lender, i.e. how his incentives to screen and monitor borrowers might have been altered by the resale decision.

Interestingly, another more traditional market for debt resale, the market for credit syndication, has not suffered as badly from the current turmoil in financial markets. According to a statistics of the Bank of International Settlement, the total global volume of signed international syndicated credit facilities amounted to 2,134 billion USD in 2007 as compared to 2,122 and 2,232 billion USD respectively in 2006 and 2005 (Bank of International Settlement (2008)). Only in the first quarter of 2008 a slight downturn is observable. Despite the magnitude of the market, syndication has received relatively little attention in the public and academic discussion as compared to modern instruments of credit risk transfer like securitization.

The goal of this paper is to analyze and compare the originator's incentives under these two structures, i.e. securitization and syndication. I first discuss the originator's monitoring incentives and his incentives to liquidate non-performing loans. Comparing these incentives to a situation without a debt resale allows me to distinguish possible inefficiencies associated with the two different instruments of credit risk transfer. Secondly, I analyze a bank's choice between the two instruments of credit risk transfer and point out potential inefficiencies from an ex-ante perspective. Finally, I investigate the impact of tightening regulatory capital requirements for ABS under Basel II. Overall, the analysis allows for a better understanding of a bank's choice of credit risk transfer instruments and the associated incentive effects. Furthermore, it highlights potential areas of concern from a regulatory agent's point of view.

I develop a simple model of a loan resale. In my model the originator can either choose a straightforward proportionate loan sale or the sale of a senior share in his debt, both to passive outside investors. A proportionate loan sale reflects the main characteristics of syndication: The originator sells off part of his debt, on average around 70 percent (Sufi (2007)), and keeps the remaining fraction. One important feature of a proportionate sale is that the originator and the outside investor have the same seniority and typically have a separate contract with the borrower each – even though generally only the originator has direct contact to the borrower.

Selling off a senior share reflects the typical structure of securitization: In a securitization process repayment claims are typically restructured such that securities of

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[2]The 'originator' is the bank that makes the loans, which are then resold. In this paper I use the originator and the bank interchangeably.

different priorities (called tranches) are generated. As a result, the holder of the most senior tranche is the first to receive interest payments and debt repayments out of the underlying loan pool, whereas the most junior tranche holder is the last to receive payments. Often, the originator keeps the most junior tranche, which consists of about 2-4 percent of the total loan volume, and sells off the more senior tranches to external investors (Murray (2002), Fabozzi and Kothari (2007)). Again, only the originator has direct access to the borrower and therefore mostly keeps the servicing and the monitoring function.[3] For both resale structures this (partial) separation of cash-flow rights from control-rights introduces a problem of moral hazard between the originator and external investors.

Following the decision on the resale structure, the originator has to choose his monitoring effort, which affects the probability of obtaining a full debt repayment. If the originator encounters repayment problems, he can decide whether to liquidate the debt at an early stage or try to obtain a full repayment by postponing the scheduled interest payments. The model derives how the choice of the resale structure shapes the originator's incentives to monitor and to liquidate non-performing loans.

Common intuition among many economists and practitioners is that holding the equity tranche in an ABS issue resolves the problems associated with moral hazard.[4] However, I show that this is not always the case. More precisely, the originator's monitoring incentives depend on the liquidation value of the debt pool.

If the liquidation value is very high, retaining the junior tranche in an ABS issue is indeed sufficient to give the originator optimal monitoring incentives. Interestingly, in that case, there is no free-riding in monitoring problem between the relationship bank and outside investors at all. The underlying intuition for the result is that with high liquidation values potential losses are relatively low and variations only affect the originator's junior tranche. For these liquidation values the senior tranche is safe. By monitoring more, the originator directly improves his own expected returns. In contrast, syndication always entails a free-riding in monitoring problem since all repayments are shared proportionately.

However, if the liquidation value is intermediate or low, the originator's monitoring incentives with securitization are very weak and even lower than with a proportionate

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[3]Recently, more and more ABS issues are also actively managed. This implies that the composition of the underlying pool is chosen by the originator, who can decide to add or withdraw assets from the underlying pool. With these actively managed pools, the monitoring function and the originator's associated incentives become more and more important for a closer analysis.

[4]See, for example, Franke and Krahnen (2005), Jobst (2002) and Buiter (2007).

sale. In an extension of the model I show that, in case of a very low liquidation value, senior tranche holders would have better monitoring incentives. This is due to the fact that potential losses in case of failure are so strong that they certainly wipe out the junior tranche and affect the senior tranche as well. Hence, it is the senior tranche holder whose expected returns might be improved by better monitoring. As I highlight in the section on the related literature, this insight of my model relates to the literature on the seniority of different forms of debt (bank debt vs. bonds) and allows reconciling the differing views on who should be given control to.

With respect to the liquidation decision, I show that the originator, who holds the junior part of the debt under securitization, has incentives to "gamble for resurrection" if the liquidation value is intermediate. "Gambling for resurrection" means that the originator does not liquidate a non-performing loan at an early stage even though liquidation would be efficient. Furthermore, also if control was given to the senior tranche holder, this would induce an inefficient liquidation strategy. The senior tranche holder would be too tough on the borrower and inefficiently liquidate the loan for relatively low values of the liquidation parameter. Surprisingly, under a proportionate sale, the originator's liquidation strategy is always efficient – independent of the liquidation value.

From an ex-ante point of view, the originator generally prefers the resale structure that allows him to commit to a higher monitoring level and a more efficient liquidation strategy. This is due to the higher resale price and eventually higher expected profits he can realize by doing so. However, as many institutional investors like pension funds and insurance companies are in search of secure and liquid investment opportunities (e.g. Duffie (2007)), the originator faces a stronger demand for the senior (often AAA-rated) tranche of an ABS issue as compared to syndication. Given this higher demand for ABS, the originator might have an interest in inefficiently choosing securitization whenever the expected liquidation value is low. This result highlights that restrictive investment regulations for institutional investors like pension funds, which are meant to protect individuals and increase social efficiency, can lead to inefficiencies on resale markets.

Finally, I analyze the change in regulatory capital requirements under Basel II. Even though the originator's incentives in case of an ABS issue are adversely affected for low liquidation values, the shift to Basel II is expected to improve the efficiency of the originator's resale structure choice.

The remainder of this paper is organized as follows: The next Section reviews

the related literature. Section 1.3 gives a brief overview of the securitization process and the institutional and regulatory environment. Section 1.4 introduces the model. Section 1.5 discusses the benchmark case without a debt resale. Section 1.6 presents the equilibrium outcomes of the model. Section 1.7 investigates the change to Basel II. Section 1.8 concludes.

1.2 Related Literature

My paper contributes to the existing literature by jointly analyzing the markets for securitization and syndication. To my knowledge there is no empirical or theoretical work explicitly considering the choice between the two instruments of credit risk transfer by loan sale. However, there is a growing yet relatively small body of research analyzing either the syndication or the securitization market.

Among the first authors investigating loan resales were Gorton and Pennacchi (1995). Based on a costly state verification model developed by Pennacchi (1988), the authors explain how a loan resale can be realized despite a moral hazard problem between the originator and external investors. In their model a bank has an incentive to resell loans because of the regulatory environment and expensive internal financing. However, the extent of the loan resale is limited by a moral hazard problem regarding the originator's monitoring incentives. The authors show that the originator of a loan resale optimally chooses to retain a fraction in the loan. The main findings of the model are also empirically tested. While the paper addresses the problem of moral hazard between the originator and external investors, it only allows for a proportionate sale. Incentive effects within senior/subordinate resale structures – which are typical for ABS issues – are not considered.

There are several papers that explicitly consider a senior/subordinate structure. Boot and Thakor (1993) were among the first to highlight the value of issuing several tranches of different seniorities. The intuition for their result lies in an ex-ante problem of asymmetric information between the originator and the external investor about the value of the investment opportunity.[5] By issuing informationally sensitive and insensitive tranches, the originator can raise the junior tranche investor's incentive to obtain (costly) information about the investment project and hence make informed trading more worthy. The analysis of Boot and Thakor introduces the relevance of security

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[5]The idea of investors with differing information levels exists also in other papers, e.g. by Gorton and Pennacchi (1990), Plantin (2004) and Plantin and Parlour (2008).

design and subordination in the context of asymmetric information. However, their concept of informed trading contradicts the reality of ABS issues, where typically the informationally poor senior tranches are traded and often the informationally valuable equity tranche is kept by the originator.

Riddiough (1997) and DeMarzo (2005) have both developed theoretical models which incorporate the idea of different informational sensitivities of the tranches in an ABS issue. Both papers explain why the originator should keep the equity tranche. Furthermore, both papers acknowledge risk-diversification effects of pooling. Riddiough (1997) shows that a senior/subordinate structure is the dominant resale structure for a pool of loans in the setting of asymmetric asset value information and non-verifiability of liquidation motives. It is the originator who should own the junior piece since he has better information and controls the renegotiation process. Therefore, he should also be given the right incentives to maximize bargaining pay-offs. However, the main results of the analysis rely on the assumption that senior tranches are completely safe. This assumption, as the current subprime crisis made evident, might be too strong. DeMarzo (2005) derives similar results without relying on the assumption of a secure senior tranche. In the model of DeMarzo (2005), which is closely related to and builds on DeMarzo and Duffie (1999), keeping the equity tranche has a signaling value. In his model pooling does not only generate positive risk-diversification effects, but has an information destruction effect. Hence, by holding the equity tranche, the originator is able to realize the positive diversification effect and to signal the quality of the underlying pool to external borrowers. DeMarzo considers a given loan quality and hence ignores how ex-post monitoring incentives of the originator might affect the optimal outcome.

Osano (2007) analyzes the originator's ex-ante monitoring incentives before securitization and his liquidation incentives after securitization. The originator obtains better information about asset values by monitoring. While unmonitored financing avoids an ex-ante adverse selection problem between the originator and external investors, it reduces the quality of the originator's liquidation strategy. A senior/subordinate structure allows the originator to reduce the adverse selection problem associated with a debt resale. Osano shows that, with strong liquidity requirements, the originator might have an incentive to choose unmonitored financing – even though it is socially inefficient. With respect to the liquidation strategy this implies a soft budgeting problem (excessive continuation). While it is similar to my liquidation strategy result, the excessive continuation in Osano's paper results from a parametric assumption which

renders continuation optimal under unmonitored financing. The excessive continuation problem in my model is endogenous and arises due to the subordination of the originator's junior share in the transaction. Two central but critical assumptions of Osano's model are that monitoring is undertaken before the securitization decision, and it is publicly observable. Therefore, Osano can only compare (completely) monitored vs. unmonitored finance. He cannot consider a continuous monitoring variable.

Empirical literature on informational issues of the securitization process is relatively scarce. However, there is one very recent article by Keys et al. (2008) investigating the effects of securitization on the originator's incentives.[6] Based on market data for U.S. mortgage markets, the authors show that, conditional on being securitized, a portfolio of mortgage loans is about 20 percent more likely to default as compared to another group of mortgage loans with similar risk characteristics and loan terms but a lower probability of being securitized. While the authors interpret their results as an adverse effect on the originator's screening incentives, the analysis they employ could also be interpreted as an adverse monitoring effect.

The empirical work on syndication markets highlights the relevance of informational problems as well. However, the focus of this empirical work is mainly on the characteristics and composition of the syndicate. As most authors confirm, syndicates tend to be more concentrated with the lead arranger keeping a larger share whenever informational problems are severe (Dennis and Mullineaux (2000), Lee and Mullineaux (2004), Sufi (2007)). Furthermore, despite the focus of the existing literature on the adverse selection problem, "moral hazard appears to be the more prominent feature of this market" (Sufi (2007), p. 635). Another insight generated by Sufi is that while the reputation of the lead arranger might help to mitigate problems of information asymmetry within the syndicate, it does not eliminate these problems.

Finally, my paper also relates to the literature on the seniority of debt contracts. This strand of the literature investigates why bank debt is typically senior to market debt (e.g. Longhofer and Santos (2000) and Park (2000)).[7] Taking into account the monitoring function of a bank, these papers derive that the bank should be the senior claimholder. The underlying idea in Longhofer and Santos (2000) is that the bank has

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[6]A few more papers confirm the relevance of informational issues for the securitization process: Firla-Cuchra and Jenkinson (2005) highlight the relevance of information asymmetries on the structure of the single tranches. Drucker and Puri (2008) find that loans which are resold in the following exhibit much more restrictive covenants. And finally, Franke, Hermann and Weber (2007) show that a lower asset pool quality induces the originator to retain a larger subordinate position.

[7]There are also other closely related papers, which are not discussed into detail here. See, for example, Diamond (1993) and Repullo and Suarez (1998).

stronger monitoring incentives during economic downturns as compared to bondholders. Similarly, Park's results are driven by the idea that single senior lenders have the strongest incentives to monitor as they can reap the full return from their monitoring activities. The result of this strand of the literature – i.e. the controlling debtholder should be given a senior position – seem to contradict the literature on securitization, where the originator, as the controlling debtholder, optimally keeps the junior part of the debt. In my model I reconcile these two views on the controlling debtholder and explain under which circumstances the senior debtholder can be expected to have stronger monitoring incentives as compared to the junior debtholder and vice versa.

1.3 Overview of Asset-Backed Securities

1.3.1 The Securitization Process

In a typical asset-backed security (ABS) transaction the originating bank bundles a group of very homogenous receivables – for example mortgages, or corporate loans, or car leases – into a single pool. This pool of receivables is then sold to a so-called Special Purpose Vehicle (SPV) which is founded only for this specific purpose and is legally independent of the bank. The SPV then issues securities which are backed by the underlying receivables in the pool. The proceeds of this security issue are used to pay for the asset pool. A very stylized overview of the securitization process is given by figure 1.1.[8]

As the SPV is basically a non-substantive shell entity, the handling and servicing function is typically kept by the originator in return for a servicing fee. Some of the deals are organized as a pass-through transaction. In pass-through transactions investors hold proportionate claims on the repayments. However, most of current ABS-transactions exhibit a pay-through structure.[9] In a pay-through transaction asset claims are restructured and securities are issued after a seniority ranking (tranching).

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[8]For a more detailed description see for example Fabozzi and Kothari (2007) or Jobst (2002).

[9]An exception are the securities issued by the three Federal Agencies which dominate the U.S. market for Mortgage Backed Securities: The Government National Mortgage Association ("Ginnie Mae"), the Federal Home Mortgage Corporation ("Freddie Mae") and the Federal National Mortgage Association ("Fannie Mae"). These are typically backed by mortgages to prime borrowers and are structured as pass-through transactions. However, most investors acted on the assumption that these were backed by implicit government guarantees. This assumption was proved to be right by the federal takeover of Fannie Mae and Freddie Mac on September 7, 2008. The incentive situation with an (implicit) government guarantee is quite different from the ABS structures considered in this paper. Therefore, I exclude these MBS from my analysis.
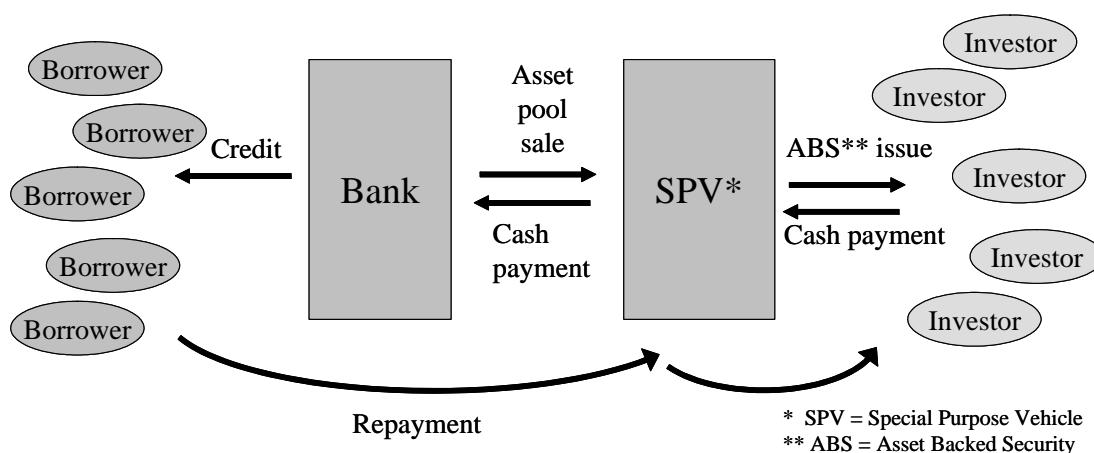
Figure 1.1: Stylized ABS-Transaction

The proceeds from the underlying pool are assigned according to a so-called waterfall principle: First, the most senior tranche receives payments (interest and repayment). Only when their claims are fully served, the next tranche is paid off, and so on. Thus, the most junior (and hence most subordinated) tranche – often referred to as the "equity tranche", "toxic waste" or "first loss piece" – is the last to receive payments. Conversely, the equity tranche is the first to bear potential losses. Only after this tranche is completely wiped out, other tranches can suffer any losses. This restructuring introduces different risk-return properties for the single tranches. Hence, the senior tranche is partially shielded against potential losses by the more junior classes and is very safe. According to their risk profiles the different tranches of an ABS issue receive varying ratings, ranging from AA(A) for the most senior tranche to unrated for the highly risky first loss piece. Even though there is a lack of publicly available data on actual shares, it is known that the first loss piece is often kept (repurchased) by the originator, and that it amounts to about 2-4 percent of the entire issue (Murray (2002), Fabozzi and Kothari (2007)).[10] A stylized (hypothetical) structure for an ABS issue is given by figure 1.2.

One major reason for the originating bank to issue ABS lies in its interest in attaining a regulatory capital relief.[11] This is important for several reasons: First of all, equity is very expensive. Thus, the originator might have an interest in reducing the exposure to lower the internal costs of capital. Secondly, the originator might be

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[10]Which typically corresponds to the calculated expected losses of the asset pool (see Rudolph et al. (2007), p. 46)

[11]Dennis and Mullineaux (2000) empirically verify that seeking regulatory capital relief is a driving force on the syndication market as well.
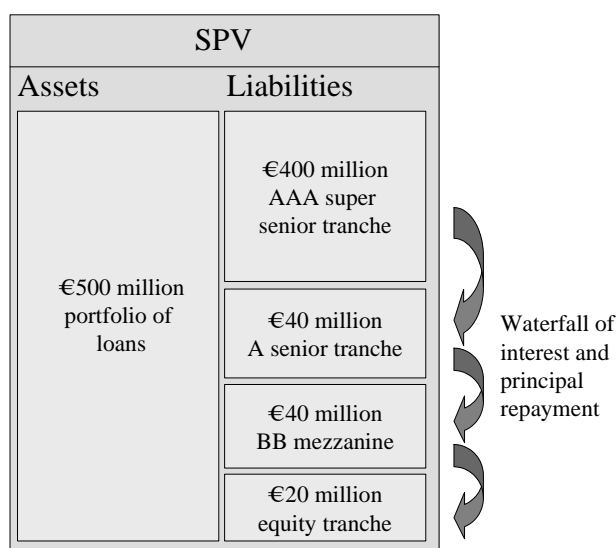
Source: John Murray „Where does the risk go?" (2002)

Figure 1.2: Overview Tranching

limited in his investment opportunities if all of his equity is already used up as regulatory capital for his existing business. In this case the originator might want to engage in securitization for realizing the necessary capital relief. This allows him to realize additional positive investment opportunities.

Further potential reasons for issuing ABS arise in the context of imperfect capital markets: better risk diversification; the separation of the assets from the bank's asset pool (bankruptcy remoteness);[12] access to new investor groups like pension funds and insurances; off-balance sheet financing for realizing balance sheet arbitrage under Basel I;[13] and liquidity requirements of the originator in fully funded transactions. However, there are several hints that the need of regulatory capital relief is (one of) the major forces driving the issue of ABS.[14]

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[12]Bankruptcy remoteness means that a SPV is not affected by an insolvency of the originating bank and vice versa.

[13]Before the adoption of Basel II, securitization allowed banks to realize regulatory capital arbitrage by exploiting differences in risk weighting for securitized assets. However, even under Basel II banks will be able to realize a regulatory capital relief (Jobst (2005)). See more detailed explanations in the next section.

[14]First, the increasing number of synthetic CDO transactions – without a true sale of tranches – suggests that liquidity needs are not the main reason for the issue (Lucas, Goodman and Fabozzi (2007)). Secondly, the reduction in the size of the equity tranche seems to have gone hand in hand with the shift in the regulatory risk-weighting requirements. This suggests that it is the regulatory capital that matters. And finally, the homogeneity of typical ABS pools, which reduces the scope of risk sharing opportunities, indicates that risk diversification might not be the single reason for securitization. If the main motive for an ABS issue was pure risk diversification, we should expect

It is important to understand the manifold compositions and structures of this credit risk instrument. Asset-backed securities can be classified into three major groups:[15] First, mortgage-backed securities (MBS), which can be backed by commercial or residential mortgages. Second, asset-backed securities (ABS) in a stricter sense, which can be backed by assets like credit cards, consumer or student loans and car leases. And third, collateralized debt obligations (CDOs). The variation in CDOs is enormous: Even though initially the underlying assets were either bank loans to small/medium-cap corporations or non-rated corporate bonds (so-called junk-bonds), an increasing number of CDOs are backed by other ABS, which sometimes are even backed by other ABS in turn. Moreover, while initially many transactions were fully funded in the sense that they consisted of a true sale transaction with securities issued and bought by external investors, more and more of the younger CDOs are synthetic. "Synthetic" refers to the fact that instead of truly selling securities, the originator transfers only the credit risk. By doing so, the originator can still realize a regulatory capital relief.[16]

1.3.2 The Institutional and Regulatory Environment

Starting with the First Basel Accord (Basel I) from 1988, banks were required to hold equity capital equal to 8% of their risk weighted assets. Basel I has been implemented by about 100 countries worldwide. However, the rise in financial innovation and the resulting complex interdependences in financial markets led to a perceived inadequacy of a standardized equity requirement approach. In particular, banks could obtain an inadequate capital relief by issuing ABS under Basel I. This is due to the fact that the maximum risk weighting was limited to 100%, which initially applied also for the highly risky equity tranche. An originator keeping the equity tranche had to hold regulatory equity amounting to only 8% of this fraction, even though the equity tranche gathered all the expected losses of the underlying pool (e.g. Deutsche Bundesbank (2001)). Hence, banks had a strong incentive to issue ABS in order to realize a so-called "regulatory capital arbitrage" (Lucas, Goodman and Fabozzi (2007)). This inadequacy led to an amendment of the First Basel Accord in 2001 and then to the publication of the New Basel Accords (Basel II) in 2004, which were finalized in

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very heterogeneous pools. However, we do not observe heterogeneous pools in practice.

[15] A more comprehensive classification of ABS is given by Rudolph and Scholz (2007).

[16] As a detailed description of the design of CDOs is beyond the scope of this paper, I relegate the interested reader to more comprehensive studies like for example Jobst (2002). How the current subprime crisis will affect the variety of ABS instruments remains an interesting question to be explored.

2006. The goal of Basel II is to better account for the real economic risks (including operational risks) in the banking sector. With respect to securitization this means that the "securitization exposure must be determined on its economic substance rather than its legal form" (Basel Committee on Banking Supervision (2006), p. 120). It implies that the originator should only be allowed to obtain a regulatory capital relief on the real economic extent of risks transferred. In the standardized ratings-based approach the originator has to apply the following risk weightings (according to S&P's rating categories):[17]

External Rating	AAA to AA-	A+ to A-	BBB+ to BBB-	BB+ to BB-*	B+ to unrated
Risk Weighting	20%	50%	100%	350%	Deduction (1250%)
Result. Equity Requirement	1,6%	4%	8%	28%	100%

Source: Basel Committee on Banking Supervision (2006), p.127
* Only applies to external investors. Originator has to fully deduct all retained exposure below BBB-.

Figure 1.3: Risk Weighting Categories

For example, if a bank keeps a BBB rated ABS, 100% risk weighting applies and it has to hold equity amounting to 8% of the security's value. If the bank keeps a AAA rated ABS, it has to hold only 20% of the 8% regulatory capital requirement, i.e. 1.6% of the security's value in equity.

Note that also under Basel II securitization is still attractive for obtaining a regulatory capital relief even though regulatory capital arbitrage is not possible (Jobst (2005)). The capital relief obtained under Basel II reflects a real transfer in credit risks. Consider the typical example of an ABS introduced above. In this example the originator retains the equity tranche and can reduce the regulatory capital requirement: If we assume that the underlying pool has a risk weight of 100%, the required regulatory capital is 40 Mio. EUR (=8% of 500 Mio. EUR). If, however, he decides to securitize, sell all senior tranches and keep the equity tranche, the regulatory capital requirement is reduced to 20 Mio. EUR (=100% of 20 Mio. EUR). This allows the originator to realize a capital relief of 20 Mio. EUR. While full compliance with Basel II is compulsory for European banks since 2007, the USA only approved the imple-

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[17]Under Basel II banks are also allowed to apply internal ratings if they have the approved systems in place. For details on the internal ratings based approach see Basel Committee on Banking Supervision (2006), p 133 ff.

mentation of Basel II at the end of 2007. Compliance with the regulatory framework (with a few amendments) is expected to be achieved by the end of 2009. The effects of a change in the capital requirements under Basel II are investigated in section 1.7.

1.4 The Model

MODEL SET-UP

Consider a risk-neutral bank with an existing debt portfolio.[18] The debt consists of a single loan and promises an interim interest payment of R_1 and an additional end-of-game debt repayment of R_2.[19] There is no discounting between the periods and the bank can reinvest the interim payment of R_1 at a short-term market interest rate of zero. The total outstanding debt repayment is therefore $D = R_1 + R_2$.

The interest payment of R_1 is only realized with a success probability of $q \in [0,1]$.[20] The bank has the possibility to monitor the borrower. Monitoring improves the success probability q of the outstanding loan but is costly for the bank. Without loss of generality, it can be assumed that the bank directly chooses the probability of success q at a monitoring cost of $C(q)$. The monitoring cost $C(q)$ increases in q, i.e. $C'(q) > 0$, at an increasing rate, i.e. $C''(q) > 0$. Together with the following properties of the cost function, this ensures the existence of an internal solution for the optimal monitoring effort: $C(0) = C'(0) = 0$ and $\lim_{q \to 1} C(q) = \infty$.

If the borrower meets the interest payment R_1 (with the probability of q), the bank also receives R_2 at the end of the game with certainty. This results in the total debt repayment of D. If the borrower cannot realize the interest payment R_1 (with the probability of $(1-q)$), the bank decides either to liquidate or to continue the loan. In case of liquidation the bank receives the enforceable liquidation value of βD, with $\beta \in [0;1)$ being the recovery rate for early liquidation. In case of continuation the interest

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[18]As in Gorton and Pennacchi (1995), Riddiough (1997) and also Osano (2007) the lending decision is not included in the model. A simple reason therefore could be that at the lending stage banks do not actually know whether they will need a capital relief in the future. Another possible reason for this separation is that different divisions decide on the origination and the resale of the loan.

[19]Considering a single loan allows to focus on incentive effects associated with the choice of the resale structure beyond risk diversification effects. This assumption also reflects the homogeneity of the underlying pools in ABS transactions: The part of the borrower's risk expected to be independent of the lender's monitoring effort should be highly correlated between the different borrowers in a pool. For the monitoring-dependent individual part of the risk, the originator should have identical monitoring incentives and hence influence the risk in the same way.

[20]It is assumed that the borrower never has an incentive to strategically default due to prohibitively high costs of default. Therefore, the borrower always pays back the loan whenever possible.

payment of R_1 is postponed and the bank receives full repayment of $R_2 + R_1 = D$ with an exogenous probability of p at the end of the game. With the probability of $(1 - p)$, the bank only obtains a total repayment of τD, with $0 \leq \tau < \beta$. The assumption $\tau < \beta$ ensures that the liquidation value decreases over time.[21] It follows for β that $\beta \in (\tau; 1)$. All exogenous parameters of the model are common knowledge.

In order to realize a certain regulatory capital relief, the bank wants to sell off part of its existing debt to a risk-neutral external investor.[22] The bank chooses between syndication and securitization. The pay-offs associated with these two resale structures are discussed next.

Credit Risk Transfer Instruments and Payoff Structures

Syndication. In case of syndication the originating bank sells a proportionate fraction α of the loan. All payments by the borrower are shared proportionately between the originator and the external investor, according to their fractions.

The general return characteristics for this debt resale structure are illustrated by the following simple example: Consider an enforceable standard debt contract between a bank and an entrepreneur without own funds, specifying the repayment of D. As long as the entrepreneur's business generates sufficient profits, i.e. profits above the promised debt repayment D, he will repay the amount of D. Whenever his returns fall short of D, the creditor obtains all the profits generated by the entrepreneur. This return structure is illustrated by the solid line in figure 1.4.

If the bank decides to sell a fraction α to an external investor and keep the fraction $(1 - \alpha)$, the return structure for the bank is given by the dashed line and for the external investor by the dotted line in figure 1.4 (ignoring any payments between bank and external investor). Thus, any debt repayment is proportionately shared between the originating bank and the external investor. I define this resale structure, typical for syndication, as a Proportionate Sale (PS).

Securitization. If the originator chooses a senior/subordinate resale structure, he

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[21]If $\tau \geq \beta$, continuing the loan would always be the dominant strategy.

[22]For focusing on the choice of the resale structure, I do not explicitly model the reason why the bank seeks a capital relief. However, one could think of a simple extension of the model in which the bank has an alternative outside investment opportunity. For realizing this investment opportunity, it needs to free up some regulatory equity. However, as the focus of my paper is on the choice of the resale structure and not on the optimal extent of capital relief the bank seeks, this extension is left out. I implicitly assume that the alternative investment opportunity is so profitable that a loan resale is always valuable.
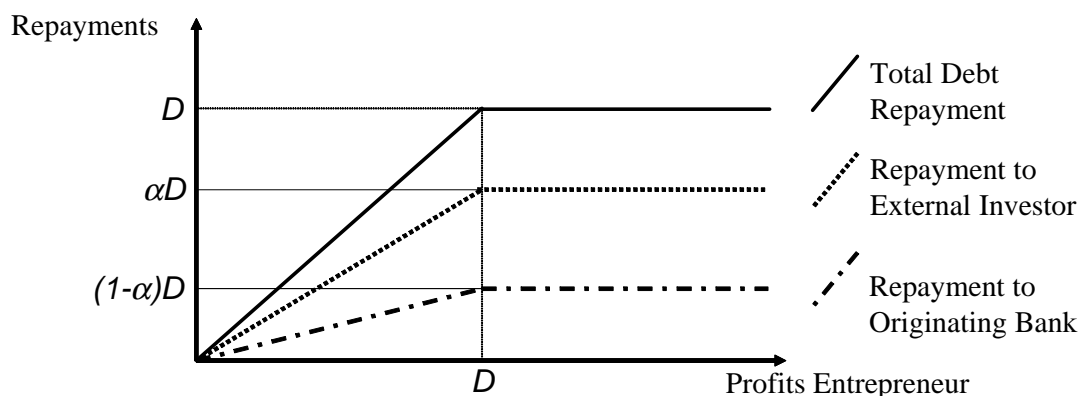
Figure 1.4: Repayments Proportionate Sale

sells off a fraction γ of the loan to the external investor and keeps $(1 - \gamma)$ to himself. However, debt repayments are not shared proportionately but it is agreed that the external investor has a priority claim. Figure 1.5 illustrates the payoff-structures for the simple example introduced above.
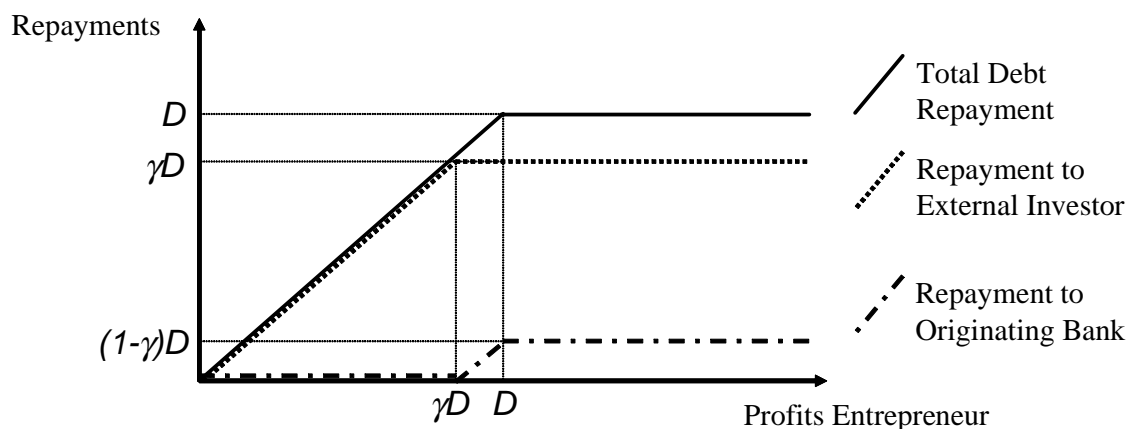
Figure 1.5: Repayments First Loss Provision

Again, the total debt repayment is given by the solid line. And again, both parties – the external investor and the originator – receive proportionate debt repayments according to their shares γ and $(1 - \gamma)$ as long as the entrepreneur's profits are above D. However, the situation is different if project returns fall short of D: If profits are very low, the external investor as the senior claimant receives all repayments. Only if the senior claimant is fully paid off, i.e. profits are above γD, does the originator participate in the repayments. The repayment structures for the senior external investor and the junior originator are given by the dotted and dashed lines in figure 1.5, respectively.

As the graph illustrates, this resale structure introduces an area (for profits below D) for which the originating bank exhibits a risk-loving behavior. I define this resale structure, typical for securitization, as a First Loss Provision (FLP).

ASSUMPTIONS AND TIMING

The fractions α and γ, which the originator has to sell under the two structures in order to realize his targeted regulatory capital relief, are context-specific and depend on the regulatory environment of the originator. The derivation of the exact fractions is beyond the scope of my analysis.

However, I do consider the following relationship between the fraction α under syndication (PS) and the fraction γ under securitization (FLP): Basel II prescribes risk-weighted regulatory capital requirements. Therefore, the equity tranche of an ABS issue has to be fully deducted from the equity base. Hence, for obtaining the same capital relief under securitization and syndication, the fraction sold under securitization has to be significantly larger than the fraction sold under syndication. This relationship is confirmed by empirical evidence and is captured by the following assumption:[23]

Assumption 1.1 *The fraction which the originator sells under a First Loss Provision is larger than the fraction he sells under a Proportionate Sale for obtaining the same regulatory capital relief, i.e. $\gamma > \alpha$.*

Additionally, I make the following assumption with respect to the recovery rate in case of an unsuccessful continuation of the loan:

Assumption 1.2 *The recovery rate in case of unsuccessful continuation τ is very low. In particular, $\tau < \min\left\{\alpha; \frac{\gamma-\alpha}{1-\alpha}; 2\gamma - 1\right\}.$*

Assumption 1.2 is needed to capture the idea that if the continuation of a non-performing loan is not successful, most of the repayment value is lost.

The timing of the model is as follows:
At date 0, the originator decides about the resale structure – either securitization or syndication – and accordingly makes a "take it or leave it" offer to an external investor. The "take it or leave it" offer specifies the price I for the share to be sold. At date 1,

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[23]The originator typically keeps a fraction of approximately 30 percent of the underlying debt in a loan syndicate (Sufi (2007)). The equity tranche typically amounts to 2-4 percent of the total loan volume of a securitization pool (Murray (2002), Fabozzi and Kothari (2007)).

the originator decides about his monitoring effort. The originator's monitoring effort is not observable and hence non-contractible. This gives rise to a classical moral hazard problem between external investors and the originator. At date 2, the scheduled interest payment R_1 is realized with the probability q. If at date 2 interest payments are not realized, the originator decides whether to liquidate or continue the loan. At date 3, final repayments are realized. The timing of the model is summarized in figure 1.6. The model is solved by backward induction.
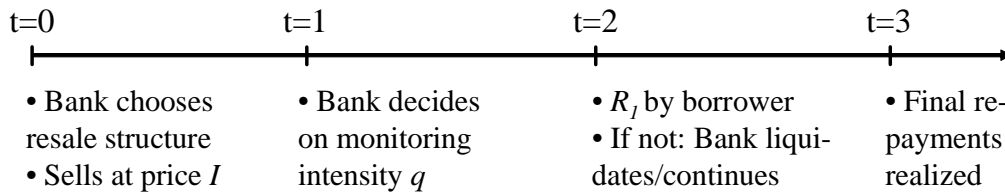
Figure 1.6: Time Structure

1.5   Benchmark Case: No Debt Resale

In this section I derive the bank's optimal monitoring and liquidation incentives in a situation without a debt resale (No Sale). In this case the originator holds a standard debt contract, which gives him a constant repayment without control rights in case of the borrower's success and a variable repayment with control rights if the borrower fails to meet scheduled payments.

In the literature on security design the standard debt contract we consider has shown to be the optimal (second best) contract solving managerial moral hazard problems between the borrower and the lender in the presence of bank monitoring.[24] Given this optimality of the bank's monitoring incentives vis-à-vis the borrower with a standard debt contract, we consider the situation without debt resale as the most efficient benchmark and focus on moral hazard problems associated with the resale. As can be shown, the expected total value of the debt is highest at each point in time in this benchmark case without a debt resale.

The timing in the benchmark case is as above, with date t=0 being omitted.

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[24]See Townsend (1979) and Gale and Hellwig (1985) for the solution of the "costly state verification" problem with a standard debt contract and Dewatripont and Tirole (1994) for the role of debt in disciplining the borrower.

Consider the bank's liquidation strategy in t=2, given that the borrower failed to pay R_1. The bank's incentives to liquidate the loan depend on the bank's date 2 expected profits, which are given by

$$E\pi_{NS,L}^{t=2} = \beta D, \tag{1.1}$$

$$E\pi_{NS,C}^{t=2} = [p + (1-p)\tau] D \tag{1.2}$$

for liquidation and continuation, respectively. If the bank liquidates the loan, it obtains the liquidation value for sure. If, however, the bank decides to reschedule interest payments and continue the loan, it will be able to receive full repayment of D in t=3 with a probability of p. Otherwise, the bank will only obtain $\tau D < \beta D$. The bank liquidates the loan whenever $E\pi_{NS,L}^{t=2} \geq E\pi_{NS,C}^{t=2}$.

At date 1, the bank chooses the monitoring effort q to maximize date 1 expected profits, which are given by

$$E\pi_{NS}^{t=1} = qD + (1-q)\max\{\beta; p + (1-p)\tau\} D - C(q). \tag{1.3}$$

If the borrower successfully repays R_1 in t=2 (with probability q), the bank receives the total scheduled amount of D. The first term in equation 1.3 reflects this part of the bank's expected profits. If the borrower cannot meet the scheduled interest payment in t=2 (with probability $(1-q)$), the bank's expected profits depend on the liquidation strategy as introduced above. This is represented by the second term in the expected profit function. The last term in the expected profit function captures the monitoring costs.

The results for the benchmark case are summarized in Proposition 1.1.

Proposition 1.1 *Without a debt resale,*
1) The bank's optimal monitoring level q^{NS} in t=1 is uniquely characterized by

$$[1 - \max\{\beta; p + (1-p)\tau\}] D = C'(q^{NS}).$$

2) The bank liquidates a non-performing loan in t=2 whenever $\beta \geq \widetilde{\beta}_{NS} = p + (1-p)\tau$.

Proof: Straightforward by *1)* solving the date 1 optimization problem and *2)* comparing date 2 expected profits and solving for β.[25]

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[25] With $C'' > 0$, the Second Order Condition for the optimization problem is always fulfilled.

Part 2) of the proposition is evident. The intuition of part 1) is as follows: The bank employs a constant monitoring effort independent of β as long as the liquidation value is below $\widetilde{\beta}_{NS}$. This is due to the fact that the bank always continues the debt for these low values of β and hence expected date 2 profits are independent of β. If the liquidation value β is above the threshold $\widetilde{\beta}_{NS}$, the monitoring effort decreases in β: The higher β, the smaller is the difference in repayments between the situation with full repayment and liquidation. Hence, the smaller is the benefit of monitoring in terms of expected returns. As, however, monitoring costs are independent of the liquidation value, monitoring becomes less attractive for higher values of β.

1.6 Equilibrium Outcome of the Model

1.6.1 The Liquidation Decision

In this section I analyze the originator's liquidation strategy at date 2 for both resale structures. Like in the benchmark case, the originator obtains control and has to decide whether to liquidate the loan whenever the borrower fails to meet its interest payments at date 2. I want to answer the following questions in this section: Are there any differences in the liquidation decision between the two structures? And, will there be any inefficient behavior as compared to the benchmark case? To answer these questions I first derive the originator's date 2 expected profits and then compare the liquidation decisions under syndication (Proportionate Sale) and securitization (First Loss Provision).

With a Proportionate Sale (PS), date 2 expected profits are given by

$$E\pi_{PS,L}^{t=2} = (1-\alpha)\beta D, \tag{1.4}$$

$$E\pi_{PS,C}^{t=2} = (1-\alpha)\left[p + (1-p)\tau\right]D. \tag{1.5}$$

Note that the originator's date 2 expected profits with PS are proportionate to the expected profits in the benchmark case. This is due to the fact that the originator holds a proportionate fraction $(1-\alpha)$ of the total loan.

With a First Loss Provision (FLP), date 2 expected profits are given by

$$E\pi_{FLP,L}^{t=2} = \max\left\{0; (\beta-\gamma)D\right\}, \tag{1.6}$$

$$E\pi_{FLP,C}^{t=2} = p(1-\gamma)D. \tag{1.7}$$

As the originator's share $(1 - \gamma)$ in the loan is subordinate to the external investor's share γ, liquidation only entitles him to the surplus of the liquidation value after the external investor has been paid off. If the liquidation value is too low, the originator receives nothing. Continuing the loan, on the other hand, gives the originator the chance (with probability p) of a full repayment; with the probability of $(1 - p)$ he obtains nothing, since $\tau < \gamma$.

In this section I introduce a further hypothetical resale structure, which I call a Last Loss Provision (LLP). The LLP structure differs from the FLP structure only in that the originator keeps the senior part of the debt and sells the junior equity tranche.[26] As will become clear further down, considering LLP leads to a better understanding of the incentive effects associated with a senior/subordinate structure.[27]

With a Last Loss Provision, the originator's profits would be given by

$$E\pi_{LLP,L}^{t=2} = \min\{\beta; \gamma\} D, \tag{1.8}$$

$$E\pi_{LLP,C}^{t=2} = [p\gamma + (1-p)\tau] D. \tag{1.9}$$

Liquidating the debt yields the originator a safe payment of at least $\min\{\beta; \gamma\} D$. If the liquidation value is relatively high, his fraction γ in the debt is completely safe. On the other hand, if the originator decides to continue the loan, he runs the risk (with probability of $(1 - p)$) of obtaining the lower payment of $\tau D < \beta D$.

Under all resale structures the originator chooses the action (to liquidate or to continue) that maximizes his date 2 expected profits. Hence, he liquidates a non-performing loan at date 2 whenever $\beta \geq \widetilde{\beta}_i$, with $i = PS, FLP, LLP$ (derivation see Appendix). $\widetilde{\beta}_i$ is given by

$$\widetilde{\beta}_{PS} = \widetilde{\beta}_{NS} = p + (1-p)\tau, \tag{1.10}$$

$$\widetilde{\beta}_{FLP} = p + (1-p)\gamma, \tag{1.11}$$

$$\widetilde{\beta}_{LLP} = \gamma p + (1-p)\tau. \tag{1.12}$$

By comparing these threshold levels I derive the following Proposition (for a graphical

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[26]In order to keep the modeling as simple as possible, I assume that the sizes of the tranches are the same under LLP and FLP. Of course, in this case, the regulatory capital relief under LLP would not be the same as under FLP. However, as the main insights derived here carry forward to a modeling with more accurate fractions, it suffices to consider identical fractions.

[27]Interestingly, there is no real world instrument of credit risk transfer which resembles this LLP structure in its pure form. However, in the context of synthetic CDOs there are arrangements which incorporate elements of this structure. These are discussed in more detail at the end of chapter 1.6.2.

illustration see Appendix):

Proposition 1.2 *The originating bank's liquidation strategy is always efficient under a Proportionate Sale (PS). Under a First Loss Provision (FLP) the originator inefficiently continues the loan for $\widetilde{\beta}_{NS} \leq \beta < \widetilde{\beta}_{FLP}$. Under a Last Loss Provision (LLP) he inefficiently liquidates the loan for $\widetilde{\beta}_{LLP} \leq \beta < \widetilde{\beta}_{NS}$.*

Proof: See Appendix.

For very low and very high liquidation values all resale structures lead to efficient continuation (for $\beta < \widetilde{\beta}_{LLP}$) or liquidation (for $\beta \geq \widetilde{\beta}_{FLP}$) as in the benchmark case. In these cases the liquidation profits are so low (high) that it is optimal to continue (liquidate) the loan – irrespectively of the resale structure employed.

However, Proposition 1.2 shows that for intermediate levels of β the originator's liquidation incentives are distorted for senior/subordinate resale structures. Consider FLP first: The originator inefficiently continues the loan under FLP whenever $\widetilde{\beta}_{NS} \leq \beta < \widetilde{\beta}_{FLP}$. For this intermediate level of the liquidation value he has an incentive to "gamble for resurrection". What is the underlying reason? Consider for example the originator's liquidation decision at $\widetilde{\beta}_{NS} = p + (1-p)\tau$. At $\widetilde{\beta}_{NS}$ expected total repayments are equal under liquidation and continuation and hence both strategies are equally efficient. Under FLP, the originator holds the junior tranche and only receives the surplus $\max \{0; [p + (1-p)\tau - \gamma] D\}$ in case of liquidation. With $\tau < \gamma$ and hence $p + (1-p)\tau < p + (1-p)\gamma$, this is unambiguously lower than his expected profits under continuation of $p(1-\gamma)D$. Thus, if the liquidation value is not too large, liquidating the debt would give the originator only negligible profits (if any at all). For these liquidation values he prefers to play for the (small) chance of a full repayment under continuation instead of settling for the negligible certain liquidation profit.

Under LLP, the originator inefficiently liquidates the loan for $\widetilde{\beta}_{LLP} \leq \beta < \widetilde{\beta}_{NS}$. In this case he is the first to be repaid and prefers to enjoy his certain intermediate repayment rather than running the risk of the very low repayment of τD. Thus, as opposed to FLP, the originator would intervene and liquidate the debt too often.

Both for FLP and LLP the distortions in the liquidation decision arise due to the senior/subordinate structure of the debt. As the senior debtholder is paid off first, holding a subordinate fraction in the loan renders the bank too soft on the borrower, whereas holding a senior fraction makes him too tough.

Interestingly, under PS, the efficient liquidation strategy is attained irrespective of the liquidation value. This is due to the fact that under PS the originator has a proportionate share in the underlying debt and hence prefers the structure generating higher overall returns.

1.6.2 The Monitoring Effort

Let us consider the bank's optimal monitoring effort at t=1 next. The originator chooses his monitoring effort to maximize date 1 expected profits. Date 1 expected profits under the different resale structures are as follows:

$$
\begin{aligned}
E\pi_{PS}^{t=1} &= \left[q + (1-q)\max\left\{\beta; p + (1-p)\tau\right\}\right](1-\alpha)D - C(q), \quad (1.13)\\
E\pi_{FLP}^{t=1} &= q(1-\gamma)D + \\
&\quad (1-q)\max\left\{(\beta - \gamma); p(1-\gamma)\right\}D - C(q), \quad (1.14)\\
E\pi_{LLP}^{t=1} &= q\gamma D + \\
&\quad (1-q)D\max\left\{\min\left\{\beta;\gamma\right\}; p\gamma + (1-p)\tau\right\} - C(q). \quad (1.15)
\end{aligned}
$$

The first part of the expected profit functions gives the originator's profit share whenever he does not encounter any debt repayment problems in t=2 (with probability q). If the borrower cannot repay R_1 (with probability $(1-q)$), the originator's profits depend on his liquidation strategy and he receives the expected payments exposed in the second part of the above functions. The last term in the above functions reflects the originator's monitoring costs under the different resale structures. With identical cost functions the only cost difference between the structures will be caused by different choices of q.

The originator's date 1 optimization problem is given by

$$
\max_{q} E\pi_i^{t=1}, \quad (1.16)
$$

with $i = PS, FLP, LLP$.

First, consider the originator's optimization problem under a Proportionate Sale.

Proposition 1.3 *Under a Proportionate Sale (PS), the unique optimal monitoring effort q^{PS} is characterized by*

$$
\left[1 - \max\left\{\beta; p + (1-p)\tau\right\}\right](1-\alpha)D = C'(q^{PS}).
$$

The originator chooses an inefficiently low monitoring effort as compared to the benchmark case, i.e. $q^{PS} < q^{NS}$, $\forall \beta \in (\tau; 1)$.

Proof: See Appendix.

The originator employs a constant monitoring level independent of β, as long as $\beta < \widetilde{\beta}_{NS}$. For $\beta \geq \widetilde{\beta}_{NS}$ monitoring decreases in β. As the originator only holds a fraction $(1 - \alpha)$ of the outstanding debt but bears the total monitoring costs, his monitoring incentives fall short of the efficient level. This is a classical free-riding in monitoring problem.

With respect to the originator's monitoring incentives under a FLP, I derive the following Proposition:

Proposition 1.4 *Under a First Loss Provision (FLP), the unique optimal monitoring effort q^{FLP} is characterized by*

$$[1 - \max\{\beta; p + (1-p)\gamma\}] D = C'(q^{FLP}).$$

1) While the originator chooses an inefficiently low monitoring level $q^{FLP} < q^{NS}$ for $\beta < \widetilde{\beta}_{FLP}$, monitoring is efficient, i.e. $q^{FLP} = q^{NS}$ for $\beta \geq \widetilde{\beta}_{FLP}$.

2) Compared to a Proportionate Sale, monitoring is higher under FLP, i.e. $q^{FLP} \geq q^{PS}$ whenever $\beta \geq \beta_{FLP/PS}$. For $\beta < \beta_{FLP/PS}$ it follows that $q^{FLP} < q^{PS}$.

With $\beta_{FLP/PS} = 1 - \frac{(1-p)(1-\gamma)}{(1-\alpha)}$, and $\widetilde{\beta}_{FLP} = p + (1-p)\gamma$.

Proof: See Appendix.

The results for a First Loss Provision are surprising: For values of β below $\widetilde{\beta}_{FLP}$ (for which the originator chooses to liquidate the loan in case of failure) there is a free-riding in monitoring problem. However, this free-riding problem completely disappears for $\beta \geq \widetilde{\beta}_{FLP}$ and the monitoring effort under FLP is efficient. The intuition for this result lies in the subordination of the originator's share: If the liquidation value is relatively high ($\beta \geq \widetilde{\beta}_{FLP}$), the external investor's fraction in the debt is completely safe (as in this case it holds that $\gamma < \beta$). Therefore, an increase in the monitoring level directly increases the originator's own expected returns and provides him with strong monitoring incentives.

Note that for low liquidation values, i.e. $\beta < \widetilde{\beta}_{FLP}$, the originator's monitoring incentives are even lower than under PS. This is due to the fact that his fraction under FLP is smaller than under PS and the return in case of unsuccessful continuation, i.e. τD, is not too high (both ensured by the assumption $\tau < \frac{\gamma-\alpha}{1-\alpha}$).[28] Thus, the free-riding problem under FLP is more severe than under PS.

For a better understanding of the incentive effects under a senior/subordinate structure, I consider the (theoretical) LLP structure as well.

Proposition 1.5 *Under a Last Loss Provision (LLP), the unique optimal monitoring effort q^{LLP} is characterized by*

$$[\gamma - \max\left\{\min\left\{\beta;\gamma\right\};p\gamma + (1-p)\tau\right\}]D = C'(q^{LLP}).$$

1) The originator always chooses an inefficiently low monitoring level as compared to the benchmark case, i.e. $q^{LLP} < q^{NS}$ $\forall \beta \in (\tau;1)$.

2) Compared to a First Loss Provision, monitoring is higher under LLP, i.e. $q^{LLP} > q^{FLP}$, for $\beta < \beta_{FLP/LLP}$. For $\beta \geq \beta_{FLP/LLP}$ it follows that $q^{LLP} \leq q^{FLP}$.

3) Compared to a Proportionate Sale (PS), monitoring is higher under LLP, i.e. $q^{LLP} > q^{PS}$, for $\beta < \beta_{LLP/PS}$ if either $\alpha \geq 0.5$ or $\alpha < 0.5 \wedge \tau < \frac{\gamma-(1-\alpha)}{\alpha}$. In all other cases, LLP is dominated by PS.

With $\beta_{FLP/LLP} = \gamma - (1-p)(1-\gamma)$ and
$\beta_{LLP/PS} = \max\left\{\gamma - (1-\alpha)(1-p)(1-\tau);\ \frac{\gamma-(1-\alpha)}{\alpha}\right\}.$

Proof: See Appendix.

There are three different ranges with respect to the monitoring effort under LLP: First, for liquidation values $\beta > \gamma$, the originator's senior fraction of the debt is completely safe and he has no incentive to monitor the underlying loan. Second, for intermediate values of β, i.e. $\widetilde{\beta}_{LLP} = p\gamma + (1-p)\tau < \beta \leq \gamma$, potential losses affect the originator's share in the debt and he can improve his expected repayments by monitoring more. Note that the smaller the liquidation value β is, the stronger this effect becomes. Therefore, the originator has stronger monitoring incentives for lower values

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[28]A higher value of τ reduces the originator's monitoring incentives under PS as it implies higher repayments for the originator even in the case of total failure.

of β. And finally, for $\beta \leq \widetilde{\beta}_{LLP}$ the originator decides to continue the loan and his monitoring level is at its maximum; independent of the liquidation value β. Note that in this range the free-riding in monitoring problem is also present under LLP, but it is less pronounced than under FLP as the monitor keeps a larger fraction of the loan.[29]

A major insight we obtain by comparing the senior/subordinate structures FLP and LLP is that monitoring incentives are strong under FLP whenever they are weak under LLP and vice versa: If the liquidation value is expected to be low (high), the senior (junior) debtholder has better monitoring incentives. The stakeholder whose stakes are at risk is always most active. The stakeholder whose stakes cannot be influenced – either because they are perfectly safe or lost for sure – has no incentive to intervene. If the liquidation value is expected to be very high, the junior debtholder has better monitoring incentives as potential losses are expected to be low and hence affect only his fraction of the loan. In this case the senior debtholder has no (negligible) incentives for monitoring as his share is not (barely) at stake. If, on the other hand, the liquidation value is expected to be low, the senior debtholder has a strong interest in monitoring as potential losses directly affect his share.[30] This result of my model contributes to the literature on the seniority of debt as it reconciles both views on the allocation of control rights between junior and senior debtholders and explains the optimality of both under different circumstances.

For high liquidation values LLP is also dominated by PS. This is due to the fact that an increase in β triggers a stronger decrease in incentives under LLP than under PS. Note that if the required capital relief is not too large ($\alpha < 0.5$) and the recovery rate in case of total failure is relatively high ($\tau \geq \frac{\gamma-(1-\alpha)}{\alpha}$), LLP is completely dominated by PS. This is due to the following two effects: First, with $\alpha < 0.5$, monitoring incentives are relatively strong under PS. Secondly, the relatively high value of τ, which the originator as the senior shareholder completely receives for sure under LLP, adversely affects his monitoring incentives in this case. Overall, for $\alpha < 0.5 \wedge \tau \geq \frac{\gamma-(1-\alpha)}{\alpha}$, the originator's incentives are always lower as compared to PS – despite the larger share of the debt he keeps in this case.

The above analysis highlights two possible reasons for not observing the LLP structure in its pure form in practice.[31] First, if the required capital relief is not too large

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[29]This stems from the assumption $\tau < 2\gamma - 1$, which implies that $\gamma > 0.5$.

[30]Note that with the option to continue the debt and "gamble for resurrection" also the junior debtholder has some (weaker) incentives to monitor. However, these would completely disappear, if there was no continuation option and the loan was liquidated for sure.

[31]One exception to this can be seen in the case of single-tranched synthetic CDOs. In a single-

$(\alpha < 0.5)$, it might be the case that the certain recovery rate τ is typically too high to make LLP attractive. Secondly, even if τ is not prohibitively high and the required capital relief is large, it is possible that the expected liquidation value β is never as low as to render the LLP structure an attractive alternative.

As LLP is not observed (in its pure) form in practice, I again exclusively focus on the two real world resale structures, securitization and syndication, in the subsequent analysis of the resale decision in t=0. The relevant threshold values for β under NS, PS and FLP are summarized in the following figure.
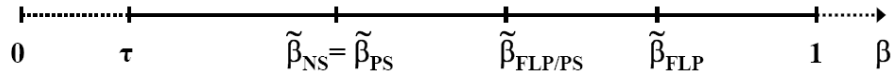
Figure 1.7: Overview Thresholds for β

1.6.3   The Debt Resale Structure and Ex-Ante Efficiency

In this section I consider the resale decision of the originator at date 0. I want to answer the following questions: When does the originator choose syndication (PS) over securitization (FLP) and when vice versa? And, is the originator's choice efficient from an ex-ante perspective?

To answer these questions we have to consider the external investor first. As mentioned in the introduction, the external investor with syndication is typically another bank, whereas investors who buy the senior tranche of an ABS issue are often institutional investors like pension funds and insurance companies. Generally, institutional investors are de facto limited in their investment possibilities. They have to stick to rel-

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tranched synthetic CDO issue, the originator only transfers the risk of the mezzanine tranche of the pool. The originator keeps the equity tranche and the most senior part of the debt pool. The pool can be highly customized and consists of a relatively small number of (often unrated) corporate bonds or loans, and more and more often of other ABS. In terms of my model, this structure resembles a combination of FLP and LLP. A possible reason for the employment of this combination could be that ex-ante expectations about the liquidation value are bi-polar, i.e. the liquidation value is expected to be either very high or very low, but not in an intermediate range. Even though this interpretation is speculative, it does not seem implausible, given the very volatile and highly correlated nature of the underlying assets of these CDOs.

atively secure, liquid and highly rated investment opportunities – like the senior tranche of an ABS issue (was perceived to be).[32] This limitation has two major implications: First of all, these institutional investors do not participate in a Proportionate Sale. Secondly, they are expected to accept lower returns due to their limited investment profile.[33] In my model these limitations translate into the following: If the originator chooses a Proportionate Sale, the external investor is another bank and, given its investment alternatives, requires an expected rate of return of at least $r_H > 0$. If the originator chooses a First Loss Provision and sells the senior tranche, the external investor can either be a bank or a pension fund. The pension fund requires an expected rate of return r_L, with $0 \le r_L < r_H$. The originator makes a "take it or leave it" offer, asking for a price I_{FLP} which leaves the external investor with an expected return of $r_L I_{FLP}$. As this corresponds to the outside-option of the pension fund, it accepts the offer. As a (risk-neutral) external bank can also invest into riskier investment opportunities yielding a higher expected return of $r_H I_{FLP} > r_L I_{FLP}$, the bank will prefer to do so and not accept the originator's offer.

Having introduced the external investors, I investigate the originator's resale decision. Consider a Proportionate Sale first. Under PS, the originator's date 0 expected profits are given by

$$E\pi_{PS}^{t=0} = \left[q^{PS} + (1 - q^{PS}) \max\{\beta; p + (1-p)\tau\} \right] (1 - \alpha)D - C(q^{PS}) + I_{PS}. \quad (1.17)$$

I_{PS} is the payment for the fraction α sold to the external investor. As stated above the external investor in case of a Proportionate Sale is a bank and requires an expected rate of return of r_H. The external investor's ex-ante expected profit is given by

$$E\pi_{PS}^I = \left[q^{PS} + (1 - q^{PS}) \max\{\beta; p + (1-p)\tau\} \right] \alpha D - I_{PS}, \quad (1.18)$$

which is his proportionate fraction α in expected debt repayments minus the price

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[32] Fiduciary requirements, as for example set by the Employee Retirement Income Security Act (ERISA) for US pension funds, prevent pension funds from investing in non-investment grade funds and holding low-rated or very junior ABS (Elul (2005), Kregel (2008)). Similar investment restrictions apply also for German institutional investors (Maurer (2004)). These restrictions, in turn, boost the demand for very highly rated investment opportunities (Duffie (2007)) and make institutional investors more conservative (Blome et al. (2007)).

[33] This could be interpreted also as an effect of higher total demand for secure investments in a more complex setting with bargaining: The higher the total demand, the better is the bargaining position of the originator and hence the larger is the share the originator can extract of the total surplus. In fact, due to the high demand for secure and liquid investments, highly rated corporate debt instruments often commanded a price premium associated with liquidity (Duffie (2007), p. 10).

paid to the originator. As the investor has the outside option of r_H and the originator makes a "take it or leave it" offer, the following has to hold: $E\pi_{PS}^I \overset{!}{=} (1+r_H)I_{PS} - I_{PS}$. Solving for I_{PS} yields

$$I_{PS} = \frac{\left[q^{PS} + (1 - q^{PS})\max\{\beta; p + (1-p)\tau\}\right]\alpha D}{(1 + r_H)}. \tag{1.19}$$

Plugging equation 1.19 into equation 1.17 yields, after some algebraic simplification, the following ex-ante expected profits for the originator under PS (see Appendix):

$$E\pi_{PS}^{t=0} = \widetilde{D}^{PS} - C(q^{PS}) - \left[\frac{r_H \alpha \widetilde{D}^{PS}}{1 + r_H}\right], \tag{1.20}$$

with $\widetilde{D}^{PS} = \left[q^{PS} + (1 - q^{PS})\max\{\beta; p + (1-p)\tau\}\right]D$.

Note that a higher outside-option rate of return r_H results in a larger fraction of total profits that goes to the external investor. Hence, the originator's expected profits decrease in r_H, i.e. $\frac{\partial E\pi_{PS}^{t=0}}{\partial r_H} < 0$.

Consider a First Loss Provision next. For FLP the external investor is a pension fund requiring a rate of return of r_L. The originator's ex-ante profits are given by

$$E\pi_{FLP}^{t=0} = q^{FLP}(1-\gamma)D + (1 - q^{FLP})\max\{(\beta - \gamma); p(1-\gamma)\}D - C(q^{FLP}) + I_{FLP}. \tag{1.21}$$

Again, the originator's date zero expected profits consist of the sum of his date 1 expected profits and the external investors's payment I_{FLP}. In case of a FLP, I_{FLP} is given by

$$I_{FLP} = \begin{cases} \frac{\gamma D}{(1+r_L)} & if \quad \beta \geq \widetilde{\beta}_{FLP}, \\ \frac{\left\{\left[q^{FLP} + (1-q^{FLP})p\right]\gamma + (1-q^{FLP})(1-p)\tau\right\}D}{(1+r_L)} & if \quad \beta < \widetilde{\beta}_{FLP}, \end{cases} \tag{1.22}$$

with $\widetilde{\beta}_{FLP} = p + (1-p)\gamma$.

If $\beta \geq \widetilde{\beta}_{FLP}$, the external investor's fraction is completely safe.[34] If $\beta < \widetilde{\beta}_{FLP}$, the external investor is only completely paid off if interest payments can be met in t=1 (with probability q^{PS}) or if the full amount is repaid at the end of t=2 (with probability $(1 - q^{PS})p$). If, however, the loan cannot be repaid at all (with probability

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[34]This stems from the liquidation condition $\beta \geq p + (1-p)\gamma = \gamma + \underbrace{(1-\gamma)p}_{>0} > \gamma$.

$(1 - q^{PS})(1 - p))$, he receives the total remaining value of τD.

The originator's expected ex-ante profits under FLP are given by (see Appendix)

$$
E\pi_{FLP}^{t=0} = \begin{cases}
\left[q^{FLP} + (1 - q^{FLP})\beta\right] D - C(q^{FLP}) - \frac{r_L \gamma D}{(1 + r_L)} & if \quad \beta \geq \widetilde{\beta}_{FLP}, \\
\left[q^{FLP} + (1 - q^{FLP})(p + (1 - p)\tau)\right] D - C(q^{FLP}) \\
\quad - \frac{r_L \left\{\left[q^{FLP} + (1 - q^{FLP})p\right]\gamma + (1 - q^{FLP})(1 - p)\tau\right\} D}{(1 + r_L)} & if \quad \beta < \widetilde{\beta}_{FLP}.
\end{cases}
$$

(1.23)

Again, the originator's ex-ante expected profits correspond to the total ex-ante value of expected debt repayments minus the fraction in the expected profits he has to cede to the external investor, amounting to $r_L I_{FLP}$.

Consider the originator's choice of the resale structure at date 0. For the sake of simplicity, I normalize the outside option of the pension fund to zero, i.e. $r_L = 0$. The originator's ex-ante choice of the resale structure is given by the following Proposition:

Proposition 1.6 *Suppose that $\frac{C''(q^{PS})}{C'(q^{PS})} > \frac{\alpha}{(1 - q^{PS})}$ for $\beta \geq p + (1 - p)\tau$.[35]*
1) If $r_H < \overline{r}$, the originator chooses a First Loss Provision (FLP) for $\beta \geq \widetilde{\beta}_{FLP}$ and a Proportionate Sale (PS) for $\beta < \widetilde{\beta}_{FLP}$.

2) If $\overline{r} \leq r_H < \overline{\overline{r}}$, he only chooses PS for $\overline{\beta} \leq \beta < \widetilde{\beta}_{FLP}$ and FLP otherwise.

3) If $r_H \geq \overline{\overline{r}}$, he always chooses FLP.

$\overline{\beta}$ is characterized by $\widetilde{D}_C^{FLP} - C(q^{FLP}) - (\frac{1 + (1 - \alpha)r_H}{1 + r_H})\widetilde{D}_L^{PS} + C(q^{PS}) = 0$,
with $\widetilde{D}_C^{PS} = \left[q^{PS} + (1 - q^{PS})(p + (1 - p)\tau)\right] D$, $\widetilde{D}_L^{PS} = \left[q^{PS} + (1 - q^{PS})\beta\right] D$,
$\widetilde{D}_C^{FLP} = \left[q^{FLP} + (1 - q^{FLP})(p + (1 - p)\tau)\right] D$, $\widetilde{\beta}_{FLP} = p + (1 - p)\gamma$,
$\overline{r}_H = \frac{\widetilde{D}_C^{PS} - C(q^{PS}) - \widetilde{D}_C^{FLP} + C(q^{FLP})}{\widetilde{D}_C^{FLP} - C(q^{FLP}) - (1 - \alpha)\widetilde{D}_C^{PS} + C(q^{PS})}$
and $\overline{\overline{r}}_H = \frac{\left[q^{PS} + (1 - q^{PS})\widetilde{\beta}_{FLP}\right] D - C(q^{PS}) - \widetilde{D}_C^{FLP} + C(q^{FLP})}{\widetilde{D}_C^{FLP} - C(q^{FLP}) - \left[q^{PS} + (1 - q^{PS})\widetilde{\beta}_{FLP}\right](1 - \alpha)D + C(q^{PS})}$.

Proof: See Appendix.

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[35]This assumption is only needed in order to keep the implicit form of the profit functions. It ensures that under PS expected profits are increasing in β, .i.e. $\frac{\partial E\pi_{PS}^{t=0}}{\partial \beta} \geq 0$.
An increase in β has two effects on expected profits of liquidation under PS: First of all, it has an direct effect by enhancing the liquidation repayments. This in turn reduces the originator's monitoring incentives. If the direct effect dominates the indirect effect, an increase in β has a positive total impact on expected profits. In the appendix I show for several explicit cost functions that the direct effect unambiguously dominates the indirect effect and $\frac{\partial E\pi_{PS}^{t=0}}{\partial \beta} \geq 0$. This suggests that the above assumption is not binding.

Note that external investors anticipate the monitoring and liquidation decision of the originator and adjust their willingness to pay accordingly. Therefore, it is eventually the originator who bears the agency costs induced by inefficient monitoring or liquidation choices.

First, consider the originator's resale decision in the absence of an outside option for both external investors, i.e. for $r_H = r_L = 0$. Investigating this case facilitates the understanding of the above Proposition. With $r_H = r_L = 0$, both types of external investors realize expected profits of zero. Therefore, the originator's ex-ante profits correspond to the total ex-ante value of the debt, given by $\widetilde{D}_C^{PS} - C(q^{PS})$ for a Proportionate Sale and $\widetilde{D}_C^{FLP} - C(q^{FLP})$ for a First Loss Provision.

If $r_H = r_L = 0$, the originator prefers FLP over PS for very high values of β, i.e. $\beta \geq \widetilde{\beta}_{FLP}$. For this range the originator chooses efficient liquidation under both structures but has a higher monitoring effort under FLP. Even though choosing FLP causes higher monitoring costs, it allows him to realize higher ex-ante expected profits.

Interestingly, with $r_H = r_L = 0$, the originator prefers PS over FLP for all values of $\beta < \widetilde{\beta}_{FLP}$. As for $\beta < \beta_{FLP/PS}$ monitoring incentives are higher and the liquidation decision always efficient under PS, it is straightforward that the originator prefers PS for this range. Surprisingly, he prefers PS also for the range $\beta_{FLP/PS} \leq \beta < \widetilde{\beta}_{FLP}$, for which monitoring incentives are higher under FLP. In this range the originator liquidates a non-performing loan under PS but inefficiently continues it under FLP. Therefore, one would expect the threshold to be determined by the trade-off between these two effects. However, the loss in expected profits due to the inefficient continuation under FLP outweighs the positive monitoring incentives. The intuition for this result lies in the following: For this parameter range monitoring and expected profits under FLP are independent of β because the originator does not liquidate a non-performing loan. As he liquidates a non-performing loan under PS, an increase in β affects expected profits under PS in this range: It has a direct effect due to an increase in the liquidation value and an indirect effect since this increase in the liquidation value reduces the originator's monitoring incentives. Overall, the direct effect dominates the indirect effect and expected profits under PS increase in β. With increasing expected profits under PS and constant expected profits under FLP, PS dominates FLP for the whole range $\beta < \widetilde{\beta}_{FLP}$.

Now consider the existence of an outside option for the external bank, i.e. $r_H > r_L = 0$. With $r_L = 0$, the pension fund still realizes expected profits of zero and the originator's expected profits correspond to the total ex-ante value of the debt under

FLP. Under PS, the originator has to share expected profits with the external bank. The better the bank's outside option as compared to the pension fund's, i.e. the higher r_H, the larger is the fraction of expected profits that the external investor receives. This profit-sharing effect reduces the attractiveness of PS compared to FLP.

For $\beta \geq \widetilde{\beta}_{FLP}$ the originator prefers FLP over PS even in the absence of an outside option for the external bank. Thus, the optimality of FLP for this range is reinforced for $r_H > r_L = 0$. Consider the parameter range $\beta < \widetilde{\beta}_{FLP}$: As long as the outside option of the external investor is not too good, i.e. $r_H < \overline{r}$, PS remains the optimal choice. But as soon as $r_H \geq \overline{r}$, the profit share of the external investor under PS is very large and the originator prefers FLP for at least very low values of $\beta < \overline{\beta}$. As expected profits under PS increase in β but expected profits under FLP do not, PS is still attractive for $\overline{\beta} \leq \beta < \widetilde{\beta}_{FLP}$. However, for very high values of r_H, i.e. $r_H \geq \overline{\overline{r}}$, the originator always prefers FLP irrespective of the liquidation value β. In this case, the costs of profit-sharing are prohibitively high.

Let us consider the efficiency of the two resale structures next: The more efficient resale structure is determined by comparing the ex-ante total expected value of the debt, i.e. the total expected debt repayments minus the monitoring costs. The resale structure that generates a higher ex-ante value of the total debt is the more efficient one.[36] Ex-ante expected values of the debt are given by

$$EV_{PS}^{t=0} = \left[q^{PS} + (1 - q^{PS}) \max \left\{ \beta; p + (1-p)\tau \right\} \right] D - C(q^{PS}) \qquad (1.24)$$

for the PS structure and by

$$EV_{FLP}^{t=0} = \begin{cases} \left[q^{FLP} + (1 - q^{FLP})\beta \right] D - C(q^{FLP}) & if \quad \beta \geq p + (1-p)\gamma, \\ \left[q^{FLP} + (1 - q^{FLP})(p + (1-p)\tau) \right] D - C(q^{FLP}) & if \quad \beta < p + (1-p)\gamma \end{cases}$$
$$(1.25)$$

for the FLP structure. Note that these values correspond to the sum of the originator's and the external investor's profits.

The efficiency results are summarized in the following Proposition:

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[36]It can be shown that the benchmark case exhibits higher ex-ante values of the debt as compared to both resale structures (or equal to FLP for $\beta \geq \widetilde{\beta}_{FLP}$). However, I do not stress this result as it is implicitly assumed that the investor prefers the resale as it for example allows him to invest in alternative projects which yield very high expected profits. Hence, expected profits from the alternative investment opportunity are high enough to cover the inefficiencies resulting from a resale. This basically implies that overall a resale is efficient and the question is rather which structure to employ.

Proposition 1.7 *Suppose that $\frac{C''(q^{PS})}{C'(q^{PS})} > \frac{\alpha}{(1-q^{PS})}$ for $\beta \geq p + (1-p)\tau$.[37]*
Then, a First Loss Provision (FLP) is more efficient than a Proportionate Sale (PS)
for all $\beta \geq \widetilde{\beta}_{FLP} = p + (1-p)\gamma$ and less efficient than PS for all $\beta < \widetilde{\beta}_{FLP}$.

Proof: See Appendix.

The intuition for Proposition 1.7 is identical to the intuition of the above discussed
case with $r_H = r_L = 0$. This is due to the fact that with $r_H = r_L = 0$, both external in-
vestors realize expected profits of zero and the originator's expected profits correspond
to the total expected values of the debt.

Comparing the originator's choice with the efficient resale structure reveals a po-
tential ex-ante inefficiency: The originator's choice of FLP for high values of β, i.e.
$\beta \geq \widetilde{\beta}_{FLP}$, is always efficient. However, the originator has an incentive to inefficiently
choose FLP for lower values of β whenever $r_H \geq \overline{r}$. Intuitively, one would expect that
this preference is a marginal effect and hence the incentive to inefficiently choose FLP
is stronger for parameter ranges close to the efficient choice of FLP; thus, for interme-
diate values of β. Yet surprisingly, these incentives are strongest for low values of β.
The intuition for this lies in the liquidation strategy of the originator for intermediate
ranges of β: As for intermediate values of β the originator's expected profits under PS
increase in β, but under FLP they do not, it becomes less attractive to renounce to
the large total value under PS.

This result has an interesting implication for the financial sector: Regulatory invest-
ment restrictions for institutional investors like pension funds and insurance companies
are meant to protect individuals and enhance social efficiency. However, if these (uni-
lateral) restrictions are too strong (i.e. $r_H \geq \overline{r}$), they introduce inefficiencies in another
part of financial markets, i.e. the market for credit risk transfer. The reason therefore
is that they distort the investment decisions of only some market participants (e.g.
pension funds and insurance companies) but not of others (e.g. banks or hedge funds).
This in turn influences the profits which the originator can extract from different in-
vestor groups distorting his resale decision.

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[37]This assumption is the same as in proposition 1.6 and is only needed in order to keep the implicit
form of the profit functions. It ensures that under PS the expected total value of the debt is increasing
in β, i.e. $\frac{\partial EV_{PS}^{t=0}}{\partial \beta} \geq 0$. Again, it can be shown that for explicit cost functions this assumption is not
needed (see Appendix).

1.7 Increased Regulatory Capital Requirements for Asset-Backed Securities under Basel II

A major change introduced by Basel II is the adjustment of the regulatory capital requirements for ABS.[38] As compared to the capital requirements under Basel I, the risk-adjusted capital rules under Basel II attach a higher risk weight to the equity tranche. Therefore, under FLP, the originator has to sell a larger (senior) fraction to external investors in order to realize the same capital relief as under Basel I. In terms of my model, the shift from Basel I to Basel II translates into an increase in the fraction γ sold under FLP for a given fraction α sold under PS.

In the following I analyze the equilibrium effects of tightening the regulatory capital requirements under Basel II, i.e. an increase in γ.

Proposition 1.8 *The originator's monitoring and liquidation incentives under a First Loss Provision are adversely affected by an increase in the fraction γ sold to external investors. The originator's incentives under a Proportionate Sale are not affected.*

Proof: See Appendix.

Clearly, the originator's incentives under PS are not affected as the amendments do not regard a Proportionate Sale, leaving α unchanged. The adverse effects on the originator's incentives under FLP are due to the following: After the shift to Basel II, the originator holds a smaller share $(1 - \gamma')$ of the debt and only participates in the liquidation repayments if they are very high.[39] Therefore, the threshold value $\widetilde{\beta}_{FLP}$ increases and, with $\widetilde{\beta}_{NS}$ not being affected, it enlarges the range for which the originator inefficiently continues the loan under FLP. Thus, an increase in γ enlarges the range for which the originator "gambles for resurrection" under FLP.

The originator's monitoring incentives for very high values of β, i.e. $\beta \geq \widetilde{\beta}'_{FLP}$, are not altered by a change in the regulatory capital requirements. But, for lower values of β, i.e. $\beta < \widetilde{\beta}'_{FLP}$, the originators monitoring incentives are adversely affected: As the originator holds a smaller fraction in the debt now, his monitoring incentives are weakened; the free-riding in monitoring problem is exacerbated. Furthermore, the

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[38]In this section, Basel II is meant comprehensively, including all amendments of the initial regulatory capital requirements under Basel I.

[39]All parameters with an index $'$ indicate the parameter values after the change to Basel II.

range for which the originator chooses an inefficiently low monitoring level is larger as $\widetilde{\beta}_{FLP}$ increases to $\widetilde{\beta}'_{FLP}$.

The following Proposition summarizes the effects of an increase in γ to γ' on the efficiency of the originator's choice of the resale structure:

Proposition 1.9 *An increase in γ increases the scope for an ex-ante inefficient choice of a First Loss Provision (FLP) only if $r_H \geq \overline{\overline{r}}$ and the resulting fraction γ' is not very large. Otherwise the scope for an inefficient choice of FLP is reduced.*

Proof: See Appendix.

An increase in γ has two effects: First, it shifts the threshold value for liquidation under FLP, $\widetilde{\beta}_{FLP}$, to a higher value $\widetilde{\beta}'_{FLP} > \widetilde{\beta}_{FLP}$. Second, it reduces the attractiveness of choosing FLP for $\beta < \widetilde{\beta}'_{FLP}$ as his monitoring incentives deteriorate. Generally, this leads to a more efficient ex-ante choice of the resale structure: For $\beta > \widetilde{\beta}'_{FLP}$, the originator (still) chooses efficiently FLP. Furthermore, as the attractiveness of FLP vs. PS is reduced for lower values of β, the scope for an inefficient choice of FLP is reduced. However, there is one exception, which arises if prior to the regulatory change FLP completely dominated PS, i.e. $r_H \geq \overline{\overline{r}}$, and the increase in γ is not too large, thus FLP still dominates PS for $\beta > \widetilde{\beta}_{FLP}$. In this case, the only effect of the increase in γ to γ' is to shift out the upper limit of the range for which FLP is inefficiently chosen.

This result has an interesting implication for the debate on the relationship between the subprime crisis and Basel II: Basel II curbs the originator's monitoring incentives and increases its incentives to "gamble for resurrection" with non-performing loans. However, as the change in regulatory capital requirements under Basel II is relatively drastic, it is plausible to assume that from an ex-ante perspective it increases efficiency because it reduces the originator's interest in inefficiently choosing FLP over PS. But if the inefficient choice of FLP is not completely eliminated, it becomes clear why the originator's incentives might deteriorate for these deals.

1.8 Conclusion

As shown by the analysis above, the two different forms of a debt resale – securitization and syndication – lead to quite different ex-post inefficiencies. While syndication always implies an efficient liquidation strategy, it is associated with adverse monitoring

incentives due to free-riding in monitoring. Under securitization ex-post inefficiencies can be completely avoided if the liquidation value of the underlying debt is very high. However, with intermediate or lower liquidation values, securitization exhibits stronger monitoring inefficiencies as compared to syndication. Additionally, for intermediate liquidation values, the originator has an incentive to "gamble for resurrection", i.e. inefficiently continue a non-performing loan. Note that in practice this problem is exacerbated by the servicing fee the originator receives for his servicing and handling function.

The comparison with a hypothetic situation in which the senior tranche holder is given control rights allows reconciling the two differing views on the seniority of the debtholder: Whenever the liquidation value is expected to be relatively high (low), monitoring should be undertaken by the junior (senior) debtholder.

From an ex-ante perspective, the only possible inefficiency exists for low to intermediate liquidation values. In this case, the originator might have an interest in inefficiently preferring securitization over syndication since this allows him to appropriate a large share of the expected total value of the debt. This is due to the fact that with securitization he is able to sell the senior tranche to institutional investors like pension funds and insurance companies who are limited in their investments by regulatory provisions and are willing to pay a higher price for safer investment opportunities.

The liquidation value of the debt can be affected by different factors. First, it depends on inherent characteristics of the underlying debt. Secondly, the extent to which a borrower will be able to reap the liquidation value depends on the prevailing creditor rights and their enforcement. And finally, as we have seen for the case of the U.S. housing market, general macroeconomic conditions can influence the liquidation value of a loan. In the remainder of this conclusion, I briefly discuss empirical implications of my model with respect to these determinants.

Syndicates are typically formed for the financing of large stand-alone entities. Often, these loans are given to project finance vehicles or used to finance takeovers. Given the characteristics of these loans – highly specific assets in the case of project finance and a high risk of unsuccessful takeover – it seems plausible to assume that the associated liquidation values are expected to be intermediate or low. The most notorious securitization market is the subprime mortgage market. In these transactions, mortgages made to borrowers with questionable creditworthiness were bundled and resold. As over the last decades housing prices kept rising, the liquidation value of these loans was very high – irrespective of the borrowers' creditworthiness. Thus, the securitization

of these loans was efficient. However, with the stagnation and following fall of housing prices on the U.S. markets, the liquidation value deteriorated. It is plausible to assume that for a while, originators continued to securitize subprime mortgages even though it was not efficient to do so any more.

With respect to creditor rights we would expect securitization to prevail in countries with strong creditor rights and syndication in countries with weak creditor rights. This seems close to what can be observed in practice: Dennis and Mullineaux (2000) find that the extent to which a loan can be syndicated increases as the loan lacks collateral. According to Lee and Mullineaux (2004), syndicates are smaller when the loan is secured. In a similar vein, Esty and Megginson (2003) find that syndicates in countries with weak creditor rights and poor legal enforcement are larger. Even though these papers focus on the size and structure of syndicates and do not consider the market for securitization, they indicate that syndication seems to be associated with low collateral value and weak creditor rights.

With respect to general macroeconomic or sector specific conditions, Shleifer and Vishny (1992) show how in economic downturns the liquidation value for a firm is expected to be adversely affected. This is due to the fact that also the firm's peers might not have sufficient funds for buying the assets.

However, more work needs to be done in this area. For example, an interesting extension of the above analysis might be to introduce a base-line success probability for the borrower which is independent of monitoring. Depending on whether monitoring has a substitutive or a complementary relationship with this monitoring-independent probability of success, we should expect opposite effects on the originator's monitoring incentives.

Chapter 2

Creditor Rights and Debt Allocation within Multinationals[*]

2.1 Introduction

Multinational companies (MNCs) have a wide range of financing options when they set up a foreign subsidiary. They can rely on capital transferred from the parent company, but they can also raise local credits. How do multinational firms finance their foreign subsidiaries? To what extent do they rely on local financing and why? Empirical evidence suggests that only part of the subsidiaries is financed internally, with capital from the parent company. Furthermore, multinationals seem to choose a different financing strategy depending on where their foreign subsidiary is located. Kang et al. (2004) report that in industrial countries 29 percent of the financing of subsidiaries come from parents and 42 come from host residents, while in developing countries 45 percent of the financing come from U.S. parents and 34 percent come from host country residents.

In this paper we focus on one particular aspect of a multinational's financing decision: the credit financing. If (at least) part of the financing has to be done through credits, the question arises whether these should be raised locally in the foreign subsidiary's host country or via the parent company. The aim of our paper is to determine the optimal debt allocation within a multinational corporation. For this purpose we develop a model of multinational borrowing that explicitly considers agency problems in internal capital markets, the existence of bankruptcy costs and the role of creditor

rights.

In our model the trade-off between decentralized (local) and centralized (parent) debt financing is driven by two main effects, the incentive and the coinsurance effect. Centralizing the borrowing structure allows the multinational corporation to realize a so-called coinsurance effect.[40] In this case the CEO of a MNC can use the net profits of all its subsidiaries to repay debt and avoid costly bankruptcy. Only if the sum of net profits is not sufficient to cover all debt repayments, bankruptcy occurs. Thus, one subsidiary "coinsures" another subsidiary and bankruptcy becomes less likely. This is the positive effect associated with debt centralization.

However, debt centralization also entails negative incentive effects. These arise because the coinsurance of the subsidiaries attenuates the disciplining effect of debt. Consider a multinational with two subsidiaries A and B. If, say, the manager of subsidiary A borrows locally, he is directly liable to his debtors. This gives him strong immediate incentives to work hard and avoid the bankruptcy of his subsidiary – at least if he enjoys private benefits of control and does not want to lose his job (Aghion and Bolton (1992)).[41]

Centralizing the borrowing for subsidiary A weakens manager A's incentives because it reduces the direct link between his success and the liquidation of his subsidiary: Even if he fails, subsidiary A will not be liquidated as long as subsidiary B is successful because he "is coinsured" by subsidiary B.

Similarly, centralizing the borrowing for subsidiary B, thus "coinsuring" subsidiary B entails negative incentive effects for the subsidiary manager A as well. Now, internal capital market considerations come into play: If subsidiary B is coinsured and fails but manager A is successful, the profits generated by manager A are used to meet the debt repayments of subsidiary B. As managers are typically interested in having

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[40]This coinsurance capacity has also been recognized by a different strand of the literature dealing with the boundary of the firm and the optimality of conglomeration. Lewellen (1971) was among the first to focus on this coinsurance aspect in view of the large mergers wave in the US of the 1960s. Even though this strand of the literature has thoroughly investigated the differences between stand-alone firms and conglomerates (e.g. Inderst and Müller (2003), Berkovitch et al. (2006), Li and Li (1996) and Faure-Grimaud and Inderst (2005)), the authors mainly focus on the effects on investments in internal capital markets and the valuation of conglomerates. These articles neither consider the debt allocation within the multi-entity firm nor the possibility of employing mixed borrowing structures nor the relevance of creditor rights explicitly.

[41]The disciplining effect of bankruptcy is especially important in countries in which it is difficult or very costly to write contracts with subsidiary managers about a performance-based dismissal. For example, this might be the case in countries with very strong employer rights, like Germany and other Western European countries. Furthermore, managerial entrenchment might reduce the credibility of contract enforcement.

large empires, taking away these funds reduces a manager's benefits and hence his incentives. This is the downside of reallocating funds within internal capital markets (see for example Brusco and Panunzi (2005)). To summarize, both "being coinsured" by and "coinsuring" the other subsidiary entail adverse incentive effects. These negative incentive effects countervail the positive risk-reducing effect of coinsurance.

The trade-off between coinsurance and incentive effects differs for various host countries depending on the strength of creditor rights.[42] Stronger creditor rights imply more control rights for the creditor in case of insolvency. As creditors are interested in liquidating insolvent firms, the liquidation of unsuccessful firms becomes more likely when creditor rights are stronger.[43] When creditor rights are weak, the threat of liquidation in case of insolvency and hence the disciplining effect of debt is less present than with strong creditor rights. This affects the overall trade-off.

We determine the optimal debt structure depending on firm characteristics and the specific legal and institutional settings. In the first part of our analysis we disregard differences in the legal environment of host and home countries. In the second part of the paper we introduce these differences and derive how they affect the optimal borrowing structure.

Our main findings are as follows: For MNCs operating in countries with very weak or very strong creditor rights, mixed borrowing structures are optimal. A "mixed borrowing structure" indicates a borrowing structure with centralized borrowing for one subsidiary and decentralized borrowing for the other subsidiary. The optimality of the borrowing structure for intermediate ranges of creditor rights depends on managerial incentives: If managerial empire-building tendencies are weak, a fully centralized borrowing structure is optimal. If empire-building tendencies are strong, a fully decentralized borrowing structure is optimal because it becomes more attractive to provide

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[42]In practice insolvency regimes and bankruptcy procedures are very complex. For example, often, an insolvent firm does not have to file for bankruptcy but can reach an out-of-court settlement with its creditors. Even if an insolvent firm is declared bankrupt, it can still be either liquidated or reorganized. Overall, there are a multitude of possible outcomes for an insolvent firm depending on the specific institutional environment and bankruptcy legislation. It is beyond the scope of our paper to include the multitude of insolvency regimes. We only focus on the link between creditor rights and the probability of liquidation in case of insolvency.

[43]See also Dewatripont and Tirole (1994). We do not know of any empirical paper directly investigating the relationship between creditor rights and firm liquidation. However, a recent paper by Claessens and Klapper (2005) finds a positive relationship between the strength of creditor rights and bankruptcy. Based on the plausible assumption that more bankruptcy filings are associated with more liquidation, this paper provides support for our modeling. See also Acharya et al. (2005) for the positive relationship between creditor orientation and liquidation. This aspect requires further investigation.

incentives.

Stronger creditor rights increase the attractiveness of substituting parental borrowing with local debt in the foreign affiliate's country. Furthermore, we find that, due to agency problems, weak creditor rights are associated with higher risk levels and higher interest rates for foreign affiliates' local borrowing. Higher bankruptcy costs increase the attractiveness of centralized borrowing.

If the two countries in which the multinational operates differ with respect to bankruptcy costs, the CEO prefers to borrow in the country with a more efficient bankruptcy system. Differences in creditor rights do not have any direct effect on expected profits under any of the borrowing structures. However, as they affect the disciplining effect of debt, they influence managerial incentives and indirectly expected profits. More specifically, weaker creditor rights in the foreign country decrease the attractiveness of a (partially) decentralized borrowing structure.

The remainder of this paper is structured as follows: Section 2.2 gives an overview of the related literature. Section 2.3 lays out the set-up and basic mechanisms of our model. In section 2.4 we derive the equilibrium outcome and optimality conditions in a national setting. Section 2.5 analyzes the comparative statics and introduces differences in the legal environment between the affiliate's and the parental country. Section 2.6 highlights the empirical findings of our model. Section 2.7 concludes.

2.2   Related Literature

The borrowing decision of multinational corporations (MNCs) has attracted increasing attention over the last years. A major focus is on the comparison between multinational corporations and national firms on an aggregated level. Several authors investigate whether the overall leverage of MNCs is higher or lower as compared to national corporations (see for example Doukas and Pantzalis (2003), Fatemi (1988), Lee and Kwok (1988), Mittoo and Zhang (2005) and Burgman (1996)). Another strand of the multinational finance literature explicitly considers the determinants of foreign affiliates' borrowing structures. Even though these papers account for the possibility of profit shifting within multinationals and the opportunity to substitute external with internal funds, the primary focus is on tax issues (Hodder and Senbet (1990), Chowdhry and Nanda (1994), Chowdhry and Coval (1998) and Huizinga et al. (2008)). Empirical evidence suggests that a major determinant of the multinational's and its subsidiaries'

borrowing structure is the institutional and legal environment of the host country (Errunza (1979)). The relevance of political risk as a determinant has been investigated extensively over the last years.[44]

The only paper explicitly considering the effect of host country creditor rights on the leverage of multinational affiliates is Desai et al. (2004). The authors find a positive relationship between creditor rights and local borrowing of the affiliate. Their second finding of a negative relationship between creditor rights and interest rates is confirmed by Aggarwal and Kyaw (2004), who also investigate the effects of the host country environment on the capital structure of MNC affiliates. Similarly, Laeven and Majnoni (2005) find that judicial efficiency is negatively correlated with interest rate spreads across countries. Finally, Kang et al. (2004) identify a positive relationship between the degree of financial market development – which, as other authors show, is closely related to creditor rights and their enforcement – and the extend of local borrowing for multinational affiliates. The findings of our model are confirmed by these empirical studies. However, overall there is still very little work done on the effect of creditor rights on multinational capital structure.

In contrast, there is a large and growing body of mainly empirical literature on law and finance. Starting with La Porta et al. (1997, 1998) this strand of the literature provides ample evidence of the central role legal institutions and creditor rights play for capital markets. Both laws and their enforcement matter in credit markets (Safavian and Sharma (2007)). Demirguc-Kunt and Maksimovic (1998, 1999) show that in countries with more efficient legal systems, more firms use long-term external finance (1998) and firms do use more long-term external debt relative to assets (1999). Similarly, also Giannetti (2003) finds that firms in countries with better creditor protection have higher leverage. Safavian and Sharma (2007) provide evidence on how (enforced) creditor rights allow for a better access to bank credit.

The only other theoretical paper which incorporates creditor rights in a multinational finance model is Noe (2000). The author shows how, in a setting with differences in the creditor rights between the parental country and the host country of the subsidiary, bargaining over the debt in case of bankruptcy determines the optimal debt allocation within a multinational. Similar to our work, the author recognizes the

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[44]Aggarwal and Kyaw (2004) identify that for US multinational affiliates among others low political risks were associated with high external debt ratios. Hooper (2002) and Desai et al. (2008), on the other hand, find significantly higher (local) debt ratios for affiliates in politically riskier countries. Kesternich and Schnitzer (2007) show, theoretically and empirically, how different forms of political risks affect the multinational capital structure.

trade-off the CEO of a multinational faces between reducing the occurrence of costly bankruptcy and agency costs associated with weak creditor rights and finds a positive relationship between local borrowing and the strength of creditor rights in the host country. However, we can show how creditor rights influence the optimal borrowing decision even in the absence of differences between the legal setting of both countries – as it is the case for nationally operating business groups as well as multinationals operating in countries with similar legal environments. Furthermore, we take our analysis one step further, as we do not only focus on the borrowing decision of a single subsidiary but take into account the existence of internal capital markets. As we show in our analysis, a comprehensive view of the multinational with all its subsidiaries is essential to understanding the borrowing decision of and debt allocation within a multinational corporation. The reason lies in the feedback effects on managerial incentives, which were identified by the literature on internal capital markets.[45]

Starting with Gertner et al. (1994) and Stein (1997) the literature on internal capital markets did pioneering work in corporate finance by identifying incentive problems within large corporations. Rajan et al. (2000) find evidence for inefficient internal cross-subsidization between divisions. Brusco and Panunzi (2005), Gautier and Heider (2002), Inderst and Laux (2005) and Inderst and Müller (2003) all develop models with managerial incentives of empire-building, in which they highlight adverse incentive effects associated with the reallocation of internally generated funds. Even though their focus is typically on the trade-off between efficiency and incentive aspects of "winner-picking", the underlying incentive mechanisms are the same as for our modeling of the incentive effects associated with coinsuring the other subsidiary. Inderst and Müller (2003) are the only ones who do not only focus on the reallocation of existing internal funds but include the effects on external funding and account for the coinsurance effect of conglomeration.

And finally, a separate but related strand of the corporate finance literature considers the financing of nationally operating business groups. The focus of this literature is mainly on corporate governance issues and the explanation of concentrated, often pyramidal and family controlled ownership structures, while taking into account different legal environments. However, there are a few papers explicitly investigating the debt structure within business groups. Bianco and Nicodano (2006) acknowledge the richer debt structure choice of business groups as compared to stand-alone firms and the relevance of limited liability in determining the optimal debt allocation within

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[45] A good survey of the internal capital markets literature is given by Stein (2003).

business groups. Finally, Gopalan et al. (2007) find evidence for cross-subsidization after weak performance and lower bankruptcy rates for group affiliates as compared to stand-alone firms.

2.3   The Model

Consider a multinational corporation (MNC) that consists of a non-operating parent company and two legally independent subsidiaries. All units are run by risk-neutral managers. While one of the subsidiaries (B) is located in the same country as the parent company, the other subsidiary (A) operates in a foreign country. Each subsidiary manager has the opportunity to invest into a project.[46]

Each investment project yields a return of X in case of success and zero otherwise. Project returns are uncorrelated. The probability of success for the investment project in the foreign subsidiary A is directly determined by the effort level of the subsidiary manager. In particular, if the manager chooses the effort level q_A, the corresponding probability of success is q_A. As effort is costly, the manager chooses the probability of success $q_A \in [0, 1]$ that maximizes his utility, given the borrowing structure of the multinational corporation. We will discuss the underlying managerial incentives in more detail below. To keep the analysis concise, we focus on the incentives of manager A in the foreign country and therefore fix the probability of success for the investment project in subsidiary B at an exogenously given level of q_B with $q_B \in [0, 1]$.[47] By introducing this asymmetry between the two subsidiaries, we also take into account in a stylized way the empirical finding that monitoring becomes more difficult with distance.[48]

Both projects generate further profits beyond the first period. These additional profits are identical for both subsidiaries and denoted by F. F can be interpreted as the sum of discounted future profits of a subsidiary and it is independent of managerial effort and the first period outcome.

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[46] In the following analysis, we only consider investment projects with a positive net present value.

[47] In doing so we follow Boot and Schmeits (2000) in their main analysis, who in a similar set-up investigate the effects of coinsurance and incentives on the optimality of conglomeration.

[48] See Doukas and Pantzalis (2003) and Wright et al. (2002). In a similar vein, Burgman (1996) finds that MNCs have higher agency costs as compared to national corporations.

Borrowing Structures and Bankruptcy

Financing an investment project requires a certain amount of external debt D. Outside investors provide the necessary funds. The market interest rate is normalized to zero, so the investors' opportunity cost is zero. Investors are risk-neutral and fully competitive. They will therefore realize expected profits of zero. Interest rates for the investment projects are determined endogenously. The manager of the parent company, i.e. the CEO of the multinational firm, decides on the debt allocation within the MNC. The CEO maximizes total expected profits for the multinational firm. For each subsidiary he decides whether the borrowing is undertaken centrally by the parent company or decentrally by the subsidiary. Thus, he can choose among the following four borrowing structures:

1. A fully decentralized debt structure, with decentralized borrowing in both subsidiaries, denoted by dd.

2. A mixed debt structure, with decentralized borrowing in subsidiary A and centralized borrowing for subsidiary B, denoted by dc.

3. A mixed debt structure with centralized borrowing for subsidiary A and decentralized borrowing in subsidiary B, denoted by cd.

4. A fully centralized debt structure, with centralized borrowing for both subsidiaries, denoted by cc. In this case, the CEO borrows the total amount of $2D$ from a single creditor.[49]

Figure 2.1 gives an overview of these debt structures.[50] The first letter always indicates the borrowing in the foreign subsidiary A, whereas the second letter refers to the borrowing for subsidiary B, c stands for centralized borrowing by the parent company and d for decentralized borrowing by the subsidiary itself.

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[49]Borrowing from a single investor is in the interest of the CEO because it allows him to credibly convey the information to the creditor that the debt structure is completely centralized. It furthermore is a reasonable presumption if we consider transaction cost motives.

[50]The question might arise, why the CEO could not decide to mix centralized and decentralized borrowing for each subsidiary. In fact, the model does not preclude these kind debt structures but rather focuses in a stylized way on the effects of a sufficiently high level of local borrowing. Thus, one can think about the necessary amount of external debt, D, as the crucial amount of (additional) borrowing, which would induce difficulties in payment in case of failure.

		B	
		Central.	Decentral.
A	Central.	cc	cd
	Decentral.	dc	dd

Figure 2.1: Overview Borrowing Structures

If debt repayments cannot be met, the borrowing unit is insolvent and a bankruptcy process is initiated.[51] Initiating a bankruptcy process entails costs that reduce the future value of the corresponding subsidiary to αF, $\alpha \in [0,1]$. These bankruptcy costs are independent of whether the insolvent borrowing unit is continued or liquidated.[52] Thus, we refrain from considering further value-destroying inefficiencies in case of liquidation of the firm. These further costs would complicate the analysis without changing the qualitative results of our model.

In order to capture the effect of creditor rights on the bankruptcy process, we introduce a parameter $p \in [0,1]$. The parameter p reflects the probability of liquidation for the borrowing unit in case of insolvency. If liquidated, the assets of the subsidiary, i.e. the future value αF, are transferred to the debtor. With the probability of $(1-p)$, liquidation does not take place. In this case debtors obtain nothing and αF remains within the corresponding subsidiary. Creditor rights affect the probability of liquidation p insofar as a stronger creditor-orientation typically leads to a relatively high probability of liquidation p. Conversely, in countries with weak creditor rights and/or a more debtor-oriented legal environment the liquidation of an insolvent firm is less probable, resulting in a lower value for p.[53]

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[51]In the following we use the expressions insolvency and bankruptcy synonymously in referring to the situation that a debtor is not able to meet its debt repayments. Hence, 'bankruptcy process' is meant in a comprehensive way including also possible out of court settlements.

[52]These might include direct bankruptcy costs, like filing and administrative costs but especially consist of indirect bankruptcy costs like the loss of future business and profits due to high insecurity and bad reputation associated with the rumors about the corporation's insolvency independent of whether it is actually declared bankrupt. Due to the relevance of missed profits, we prefer to consider proportional bankruptcy costs $(1-\alpha)F$ in our model. However, our results also hold in a setting with additive bankruptcy costs in the form of $-C$. For empirical research on the costs of bankruptcy see also Altman (1984). As also Djankov et al. (2006) find in a case study, bankruptcy costs are c.p. higher, thus α lower, the less developed the country is.

[53]In a simplified way we could think about the difference between a creditor-oriented legal environment like in Germany and a typically more debtor-oriented legal system like the US system. For empirical evidence on this relationship see for example Claessens and Klapper (2005). Even though

We start by analyzing a set-up that does not allow for differences in the legal setting, in particular for the parameters α and p, between the two countries. This setting applies to purely nationally operating business groups as well as multinationals operating in countries with similar legal environments like Germany and Italy. However, differences in the legal environment introduce further effects on the optimality of the debt structure. These effects, which are especially present in multinational corporations operating in very different countries like Germany and India, will be investigated in section 2.5.

THE COINSURANCE EFFECT

To capture the effect of coinsurance in our model, we make the following assumption:[54]

Assumption 2.1 *The return X, which a single investment project generates if successful, is high enough to cover the debt repayments of both investment projects whenever needed.*

Assumption 2.1 ensures that debt repayments are feasible. Furthermore, it ensures that in case of (partially) centralized borrowing the parent company is able to meet both debt repayments and thus avoid a costly bankruptcy process as long as at least one of the subsidiaries is successful.[55] This introduces the possibility of coinsurance: Centralizing the borrowing structure c.p. reduces the occurrence of costly bankruptcy. To see this we consider the different borrowing structures in more detail.

1. Fully decentralized debt structure (dd)

    In this case, each subsidiary manager borrows on his own. For each subsidiary the project can either be successful and debt can be repaid, or it can be unsuccessful and the insolvency of the subsidiary has to be declared.[56] In case of insolvency,

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they only investigate the relationship between filing for bankruptcy and creditor rights, their finding of a positive relationship gives suggestive support for our modeling. See also Acharya et al. (2005) for the positive relationship between creditor orientation and liquidation.

[54]For keeping the exposition of our model as simple as possible, the formal delineation of this assumption is only introduced when needed in the further analysis.

[55]This is in line with empirical evidence on inefficient cross-subsidization in business groups (Gopalan et al. (2007)).

[56]This can only be an equilibrium outcome if the parent company does not have any incentives to bailout the subsidiary concerned. This is the case if the following condition holds: $F - DR_k^{ij} \leq (1-p)\alpha F$, with $i, j \in \{c; d\}$, $k \in \{A, B\}$, and R_k^{ij} as the equilibirum interest rate. This can be

liquidation occurs with probability p.[57]

2./3. Mixed debt structures (dc, cd)

Consider dc first. Under dc subsidiary A (in the foreign country) borrows locally whereas the parent company borrows on behalf of subsidiary B (in the parental country). A bankruptcy process will be initiated for subsidiary A if $A's$ project fails. However, subsidiary B benefits from the coinsurance by subsidiary A: Even if $B's$ project fails, the parent company is able to repay the debt, as long as subsidiary A is successful.[58] Only if $A's$ project fails as well, the parent company has to declare bankruptcy. The reasoning for cd follows the same lines.

4. Fully centralized debt structure (cc)

If the borrowing is completely centralized, both subsidiaries coinsure each other and the parent company has to declare bankruptcy only if both fail simultaneously. In this case, the whole MNC is liquidated with the probability p.

Thus, for given effort levels, centralizing the borrowing structure reduces the occurence of bankruptcy.

MANAGERIAL INCENTIVES

We now turn to managerial incentives. The manager of subsidiary A derives private benefits of control. These "classical" managerial benefits of control are denoted by $M \geq 0$ and reflect the psychic benefits of running the subsidiary, having a prestigious job, etc. (Aghion and Bolton (1992)). The manager can enjoy M as long as he is the manager of the subsidiary. This is definitely the case if his investment project is successful. However, even if his project fails, he may be able to enjoy these benefits: Either because he is helped-out by subsidiary B or because weak creditor rights prevent the liquidation of subsidiary A.

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rearranged to $DR_k^{ij} \geq F[1 - (1-p)\alpha]$. The condition states that the necessary debt repayments have to be larger than the increase in the expected future value for the MNC if the local debt is repaid. In case of debt repayment, the future value within the MNC would be F with certainty. In case of insolvency, there is a chance that the subsidiary will not be liquidated resulting in the expected future value of $(1-p)\alpha F$ at the end of $t = 1$. The cost of debt repayment is DR_k^{ij}.

[57] If for example both subsidiaries fail, the multinational will either continue with both subsidiaries, or with only one subsidiary, or in the worst case scenario both subsidiaries are liquidated, which corresponds to the liquidation of the whole MNC as the parent company is non-operative.

[58] We implicitly assume that the funds can be frictionless passed on to the parent company if needed.

Furthermore, the manager's private benefits increase with the resources under his control, i.e. the manager enjoys empire-building.[59] To capture this effect, we introduce the benefit variable, $E \geq 0$. The manager enjoys E, whenever he is successful and does not have to bailout subsidiary B.[60]

Finally, we assume that effort is costly for the manager. Effort costs are captured by the following quadratic cost function $\frac{1}{2}q_A^2$.[61]

The manager's expected utility for the different borrowing structures are given by the following functions:

$$EU(dd) \quad = \quad q_A(M + E) + (1 - q_A)(1 - p)M - \frac{1}{2}(q_A)^2, \tag{2.1}$$

$$EU(dc) \quad = \quad q_A q_B(M + E) + [q_A(1 - q_B) + (1 - q_A)(1 - p)]\,M - \frac{1}{2}(q_A)^2, \tag{2.2}$$

$$EU(cd) \quad = \quad q_A(M + E) + \{(1 - q_A)\,[q_B + (1 - q_B)(1 - p)]\}\,M - \frac{1}{2}(q_A)^2, \tag{2.3}$$

$$EU(cc) \quad = \quad q_A q_B(M + E) +$$
$$\{q_A(1 - q_B) + (1 - q_A)\,[q_B + (1 - q_B)(1 - p)]\}\,M - \frac{1}{2}(q_A)^2. \tag{2.4}$$

The first two terms capture the expected managerial benefits and the last term the monitoring costs. Note that the wage of the manager is normalized to his outside option of zero. This reflects the problem that the manager does not react to financial incentives due to problems of incomplete contracts.[62] We expect cultural and geographical distance between the parent company and a foreign subsidiary to aggravate the problem of contractual incompleteness, making it particularly relevant in the present context of a multinational corporation. Furthermore, we implicitly assume a fully entrenched subsidiary manager. This implies that the investment project and thus first and second period profits can only be realized by the specific subsidiary manager in

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[59]Note that in the following we use the term "empire-building" slightly different from other authors. While with "empire-building" some previous papers referred to the resulting problem of inefficient overinvestment, we focus on the underlying managerial incentives. Throughout our paper "empire-building" refers to the interest of the manager in having more assets under management. Even though we exclude overinvestment in our model, we show that these managerial preferences induce additional inefficiencies in a conglomerate setting.

[60]If the borrowing for subsidiary B is undertaken centrally and subsidiary B fails, the profits generated by the investment project in subsidiary A (in case of success) are used by the parent company to meet the debt repayments of subsidiary B. In this case, the manager of subsidiary A is not able to enjoy E, even though he is successful.

[61]This simple functional form for the effort costs allow us to keep the analysis explicit. However, we could generalize the cost function without loss of generality as long as it is increasing and convex in q_A.

[62]See for example Dewatripont and Tirole (1994).

charge at the beginning of period $t = 1$. Overall, this implies that the CEO has to use the debt structure in order to provide the manager with incentives. Given that external contracts are enforceable, decentralized debt and bankruptcy are a credible commitment device as the CEO is not able to influence the continuation decision for an insolvent subsidiary with decentralized borrowing.[63]

EXPECTED PROFITS

We now derive expected profits for the MNC under the different borrowing structures. As shown in the Appendix, these are given by

$$E\pi(dd) = (q_A^{dd} + q_B)X - 2D + \left[2 - (2 - q_A^{dd} - q_B)(1 - \alpha)\right]F, \qquad (2.5)$$

$$E\pi(dc) = (q_A^{dc} + q_B)X - 2D + \left[2 - (2 - q_B)(1 - q_A^{dc})(1 - \alpha)\right]F, \qquad (2.6)$$

$$E\pi(cd) = (q_A^{cd} + q_B)X - 2D + \left[2 - (1 - q_B)(2 - q_A^{cd})(1 - \alpha)\right]F, \qquad (2.7)$$

$$E\pi(cc) = (q_A^{cc} + q_B)X - 2D + \left[2 - 2(1 - q_A^{cc})(1 - q_B)(1 - \alpha)\right]F. \qquad (2.8)$$

All four expected profit functions have the same structure:

The first term reflects first period expected returns from the investment. They depend on the probabilities of success, and are higher with higher managerial effort levels and thus probabilities of success for subsidiary A. $q_A^{dd}, q_A^{dc}, q_A^{cd}$ and q_A^{cc} denote the optimal effort levels under the different borrowing structures and will be derived in section 2.4.1.

The second term is the total amount of investment needed, reflecting the real economic costs of the investment projects, which is D for each subsidiary and independent of managerial effort.

The last term reflects the expected second period profits of the investment projects. Recall that $2F$ is the value of second period profits in the absence of bankruptcy costs. As bankruptcy reduces the second period profits of a subsidiary to αF, the resulting economic loss in case of bankruptcy is $(1 - \alpha)F$ per subsidiary. For each borrowing structure this economic loss is multiplied with the corresponding probability of bankruptcy. For example, under a fully decentralized borrowing structure each subsidiary will declare bankruptcy with the probability $(1 - q_i)$ with $i = A, B$, resulting

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[63]Even if the CEO could avoid insolvency for a decentrally borrowing subsidiary as long as the other subsidiary is successful, this is now costly. As discussed above, we only consider cases in which these costs are prohibitively high and the CEO has no incentive to bailout the subsidiary. Note further that our results are not affected by the possibility of monitoring. With a fully entrenched manager, introducing monitoring in our model does not change any of the results.

in the overall expected bankruptcy loss of $(2 - q_A^{dd} - q_B)(1 - \alpha)F$. Similarly expected bankruptcy costs can be derived for all four settings.

The differences between the four borrowing structures are driven by the coinsurance effect and managerial incentives. Apart from these two effects the choice of the borrowing structure does not influence expected profits. In particular, as investors make zero expected profits, interest rates are irrelevant for ex-ante expected profits.

THE TIME STRUCTURE

In period $t = 0$, the CEO of the multinational corporation decides on the debt structure of the MNC and borrowing is undertaken. In the beginning of period $t = 1$, the manager of subsidiary A in the foreign country decides on his effort level. At the end of this period, project returns are realized and debt is repaid if possible. If a borrowing unit is insolvent at this stage, the corresponding subsidiary will be liquidated at the beginning of $t = 2$ with the probability of p. At the end of period $t = 2$, future firm values are realized and the game ends. The time structure of the model is summarized in figure 2.2.

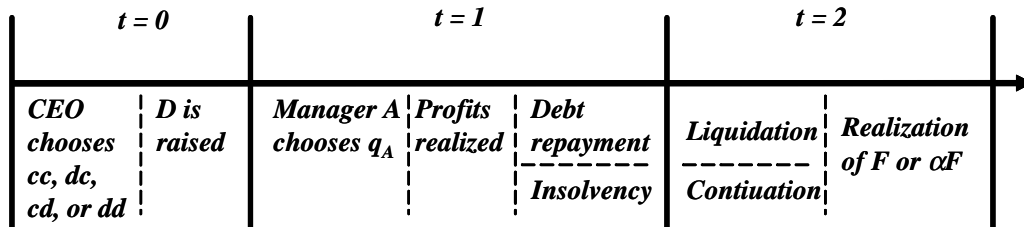| $t = 0$		$t = 1$			$t = 2$	
CEO chooses cc, dc, cd, or dd	*D is raised*	*Manager A chooses q_A*	*Profits realized*	*Debt repayment* / *Insolvency*	*Liquidation* / *Contiuation*	*Realization of F or αF*

Figure 2.2: Time Structure

2.4 Equilibrium Outcome of the Model

2.4.1 Optimal Managerial Effort Level

To solve the model, we first derive the optimal managerial effort level under the different borrowing structures. The optimization problem of the manager of the foreign

subsidiary A is:

$$Max_{q_A} EU^{ij}(q_A) \tag{2.9}$$

$$s.t.\ 0 \leq q_A \leq 1,$$

with $i, j \in \{c; d\}$. Again, i refers to subsidiary A while j relates to subsidiary B. Solving this optimization problem for all four debt structures yields the optimal managerial effort levels and hence probabilities of success for subsidiary A.[64] The internal solutions for the different borrowing structures are given by

$$q_A^{dd} = pM + E, \tag{2.10}$$

$$q_A^{dc} = pM + q_B E, \tag{2.11}$$

$$q_A^{cd} = (1 - q_B)pM + E, \tag{2.12}$$

$$q_A^{cc} = (1 - q_B)pM + q_B E. \tag{2.13}$$

By comparing these probabilities of success, we derive Proposition 2.1.

Proposition 2.1 *The more centralized the debt structure, the lower is c.p. the probability of success for subsidiary A. In particular:*

1) $q_A^{dd} \geq q_A^{dc} \geq q_A^{cd} \geq q_A^{cc}$ *if $\frac{pM}{E} \geq \frac{(1-q_B)}{q_B}$,*

2) $q_A^{dd} \geq q_A^{cd} \geq q_A^{dc} \geq q_A^{cc}$ *if $\frac{pM}{E} < \frac{(1-q_B)}{q_B}$.*

Proof: Straightforward by comparing the optimal effort levels q_A^{ij} with $i, j \in \{c; d\}$.

The underlying intuition is the following: Managerial incentives and thus effort levels are driven by benefits of control (given by the first term of the optimal effort levels) and benefits of empire-building (given by the second term of the optimal effort levels). Being coinsured by subsidiary B reduces manager $A's$ optimal effort level, as manager A anticipates a potential bailout by B. This effect relates to the disciplining effect of debt (Grossman and Hart (1982), Hart and Moore (1995)), which is stronger with local borrowing. Similarly, coinsuring subsidiary B reduces $A's$ effort: A anticipates that even if he is successful, he may not be able to keep the additionally generated funds in his subsidiary but have to bailout subsidiary B. This effect is in the vein

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[64]Differentiating with respect to q_A and with $\frac{\partial^2 EU^{ij}}{\partial q_A^2} < 0\ \forall i, j = c, d$ yields these internal solutions for the optimal effort level. Potential corner solutions are analyzed further down in Corollary 2.1.

of the negative incentive effects associated with the reallocation of funds in internal capital markets. If we now compare the different borrowing structures, the results of Proposition 2.1 become clear:

Under a fully decentralized structure dd neither subsidiary A nor subsidiary B are coinsured, so none of the adverse incentive effects is present. The manager chooses the highest effort level q_A^{dd}. Under a fully centralized structure cc both of the subsidiaries are coinsured and both adverse incentive effects are present. Thus, the manager chooses the lowest effort level q_A^{cc}. Under the mixed borrowing structures dc and cd only one of the two adverse incentive effects of coinsuring or of being coinsured is present. The ordering between the two mixed structures is not conclusive. Whether the borrowing structure dc or cd is associated with a higher effort level depends on the relative strength of the two incentive effects. The stronger the effective disciplining effect of bankruptcy pM as compared to the managerial empire-building tendencies E, and the lower the probability of success for subsidiary B, i.e. q_B, the stronger are the incentives under dc as compared to cd: With higher values for pM, the incentives from decentralizing the borrowing for subsidiary A are very valuable, while with lower values for E, the loss in incentives by decentralizing B are less severe. Similarly, a high value of q_B reduces the disadvantage of centralizing the borrowing for subsidiary B while it reinforces the disadvantage of centralizing the debt for subsidiary A.[65]

Finally, note that the optimal effort levels depend on the prevailing creditor rights p. As p reflects the threat of liquidation in case of bankruptcy, stronger creditor rights, i.e. higher values of p, induce higher effort levels. With strong creditor rights, the manager of subsidiary A knows that whenever a bankruptcy process is initiated the probability of remaining the manager of subsidiary A is small. This gives him a strong incentive to exert high effort and avoid bankruptcy. This effect is strongest for borrowing structures with decentralized debt in subsidiary A.

2.4.2   Optimal Borrowing Structure and Creditor Rights

As we have seen in section 2.3, centralizing the borrowing structure allows the CEO of the multinational corporation to reallocate internal funds in order to c.p. reduce the occurrence of bankruptcy and hence expected bankruptcy costs. However, coinsuring the subsidiaries entails adverse incentive effects. These incentive effects reduce

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[65]The low probability of failure for subsidiary B $(1 - q_B)$ makes it less probable that subsidiary A will have to bailout subsidiary B in case of coinsurance of B. However, the manager of subsidiary A can comfortably rely on being bailed out by subsidiary B, in case of coinsurance of subsidiary A.

the probability of success in case of debt centralization and thus c.p. lower expected returns and increase expected bankruptcy costs. Based on this trade-off, we now derive the optimal borrowing structure for the multinational corporation. The focus of our analysis is on creditor rights. For the following analysis, we only allow for parameter ranges resulting in positive net interest rates, thus $R_A^{ij} \geq 1$ and $R_B^{ij} \geq 1$ with $i, j = c, d$.[66]

CASE 1: EQUILIBRIUM WITHOUT EMPIRE-BUILDING TENDENCIES

First, we consider the situation without empire-building tendencies, i.e. $E = 0$. In this case the following Proposition holds:

Proposition 2.2 *Without empire-building tendencies, i.e. $E = 0$, the borrowing structures dd and cd are never optimal. The CEO of the multinational prefers a fully centralized borrowing structure when creditor rights are weak and the mixed borrowing structure dc when creditor rights are strong. The optimal borrowing structure is*
1) cc   for $p < p_1$,
2) dc   for $p \geq p_1$,

with $p_1 = \frac{(1-\alpha)F}{[X+(3-2q_B)(1-\alpha)F]M}$.

Proof: See Appendix.

The intuition of the result is as follows: First of all, note that without empire-building tendencies, i.e. $E = 0$, coinsuring subsidiary B entails no adverse incentive effects on the foreign subsidiary manager A. Thus, centralizing the borrowing for subsidiary B reduces expected bankruptcy costs and is the dominant borrowing strategy for subsidiary B. The fully decentralized borrowing structure dd is always dominated by the mixed borrowing structure dc with local borrowing in the foreign subsidiary A and centralized borrowing in the subsidiary B. Similarly, the mixed borrowing structure cd is always dominated by the fully centralized borrowing structure cc.

Consider the extreme case in which creditor rights are practically inexistent, i.e. $p = 0$. In this situation, local borrowing entails no disciplining effect as even in case of insolvency the subsidiary will not be liquidated. Thus, decentralizing the borrowing

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[66]This assumption excludes implausible situations in which investors are willing to pay the MNC for lending money. Investors would only want to pay for lending in the unrealistic situation that their expected pay-offs in case of bankruptcy were higher than debt repayments.

of subsidiary A would not enhance managerial effort but induce additional expected bankruptcy costs. So for $p = 0$, decentralizing the debt of subsidiary A cannot be optimal. Similarly, for very low levels of creditor rights, the increase in managerial incentives by decentralizing the borrowing for subsidiary A is negligible as opposed to the reduction in expected bankruptcy costs which, due to the coinsurance effect, can be achieved by centralizing the borrowing for subsidiary A. Increasing creditor rights enhance the disciplining effect of local borrowing and thus the incentives of subsidiary A manager. Thus, the opportunity cost of centralizing the borrowing for subsidiary A increases with creditor rights and at p_1 dominates the coinsurance advantage of centralizing the borrowing for subsidiary A.

Case 2: Equilibrium with Weak Empire-Building Tendencies

For small tendencies of empire-building the following Proposition holds:

Proposition 2.3 *When empire-building tendencies are weak, i.e. $0 < E < \overline{E}$, the optimal borrowing structure is*
1) cd *for $p < p_2$,*
2) cc *for $p_2 \le p \le p_3$,*
3) dc *for $p > p_3$,*

with $\overline{E} = \frac{(1-q_B)(1-\alpha)^2 F^2}{X^2 + 4(1-q_B)(1-\alpha)FX + (3+3q_B^2 - 7q_B)(1-\alpha)^2 F^2}$; $p_2 = \frac{[X+(1-2q_B)(1-\alpha)F]E}{(1-q_B)(1-\alpha)FM}$ and $p_3 = \frac{(1-\alpha)F(1-Eq_B)}{[X+(3-2q_B)(1-\alpha)F]M}$.

Proof: See Appendix.

The intuition for the result is as follows: Again, when creditor rights are very weak, decentralizing the borrowing for subsidiary A entails negligible incentive effects. Therefore, the borrowing for subsidiary A should be undertaken centrally in order to exploit the coinsurance effect without any significant loss in incentives. However, decentralizing the borrowing for subsidiary B entails some incentive effects for the manager of subsidiary A. Furthermore, with weak empire-building tendencies and weak creditor rights, the coinsurance of subsidiary B by subsidiary A is not very valuable. Hence, it is optimal to decentralize the borrowing for subsidiary B in order to at least exploit the associated incentive effects, as these are relatively valuable with a low overall incentive level. With intermediate levels of creditor rights, however, the disciplining effect of bankruptcy is stronger; enhancing the incentives and probabilities

of success associated both with local and centralized borrowing for subsidiary A. As now the part of incentives associated with empire-building becomes negligible but the coinsurance of subsidiary B becomes more attractive, it is optimal to centralize B as well and fully exploit the coinsurance effect. With very strong creditor rights, incentives due to the discipling effect of debt are very strong, and hence the probability of success for subsidiary A is relatively large. This renders the coinsurance of subsidiary A unnecessary but the coinsurance of subsidiary B even more valuable, resulting in the optimal borrowing structure dc.

CASE 3: EQUILIBRIUM WITH STRONG EMPIRE-BUILDING TENDENCIES

If empire-building tendencies are very strong, the following Proposition holds:[67]

Proposition 2.4 *Consider the case when empire-building tendencies are strong, i.e.*
$E > \overline{\overline{E}}$. *Then the optimal borrowing structures with very low and very strong creditor rights are mixed structures, cd and dc respectively. For intermediate levels of creditor rights a fully decentralized borrowing structure is optimal. Thus,*
1) *cd   for $p < p_4$,*
2) *dd   for $p_4 \leq p \leq p_5$,*
3) *dc   for $p > p_5$,*

with $\overline{\overline{E}} = \frac{(1-\alpha)^2 F^2}{X^2 + (3-2q_B)(1-\alpha)FX + (3-3q_B+q_B^2)(1-\alpha)^2 F^2}$; $p_4 = \frac{(1-\alpha)F(1-E)}{[X+(2-q_B)(1-\alpha)F]M}$ *and*
$p_5 = \frac{[X+(1-q_B)(1-\alpha)F]E}{(1-\alpha)FM}$.

Proof: See Appendix.

For weak creditor rights the intuition is similar to the case with small empire-building tendencies: The CEO wants to exploit the incentive effects associated with decentralizing the borrowing for subsidiary B. These are now even more valuable, as empire-building tendencies are strong. As for weak creditor rights (decentralized) debt entails no major direct incentive effects, it is again optimal to exploit the coinsurance effect for subsidiary A and hence choose the borrowing structure cd. For very strong

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[67]With intermediate levels of empire-building tendencies $\overline{E} \leq E \leq \overline{\overline{E}}$, the optimal borrowing structure will always be a mixed structure. For very low creditor rights the optimal structure is cd, with very high creditor rights, the optimal structure is dc. Note further that the comprehensive set of optimal borrowing structures $cd \rightarrow dd \rightarrow dc$ only exists if the benefits of empire building are not indefinitely high. In particular, for having a full set, the benefits of empire-building are limited above by $E \leq E^* = \frac{(1-\alpha)FM}{X+(1-q_B)(1-\alpha)F}$ in order to ensure $p_5 \leq 1$.

creditor rights the intuition is also identical to the case with weak empire-building tendencies: As the incentives associated with the disciplining effect of debt are very high, exploiting this incentive effect by decentralizing the borrowing for subsidiary A is optimal. As with the decentralization of the borrowing for subsidiary A, the probability of success for subsidiary A increases, the coinsurance of subsidiary B becomes very valuable as well and is exploited by decentralizing the borrowing for subsidiary B.

But what changes for the intermediate level of creditor rights now? Again, stronger creditor rights increase the attractiveness of the coinsurance effect for subsidiary B as well as the incentive effect of local borrowing for subsidiary A. With strong empire-building tendencies, however, local borrowing for subsidiary B is very valuable as it allows fully exploiting the corresponding incentive effects for subsidiary A. This effect dominates the attractiveness of coinsuring subsidiary B for a larger range of creditor rights. Thus, with strong empire-building tendencies, it is optimal to decentralize the borrowing for subsidiary A for lower values of creditor rights before decentralizing the borrowing for subsidiary B becomes attractive. Overall, a fully decentralized borrowing structure is optimal for intermediate levels of creditor rights.

Finally, an interesting implication for the optimal borrowing structure results from a closer look at the corner solutions of the managerial optimization problem (see Appendix). We summarize the findings in the following Corollary:

Corollary 2.1 *Irrespective of creditor rights, a fully centralized borrowing structure is optimal both in the absence of and with very strong private benefits for the manager of subsidiary A.*

The complete absence of private benefits, i.e. $M = E = 0$, means that the manager does not derive any private benefits - neither from being the manager of the subsidiary nor from having additional funds under control. Thus, neither decentralizing the borrowing for subsidiary A nor decentralizing the borrowing for subsidiary B entails any incentive effects. The project in subsidiary A fails for sure in $t = 1$.[68] Hence, the CEO of the multinational corporation centralizes the borrowing structure in order to optimally exploit the coinsurance effect.[69] Similarly, in case of very strong private benefits

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[68]Remember that the future profit F is generated irrespectively of the probability of success in t=1. Therefore, the NPV of the investment project can still be positive.

[69]Note that more precisely the CEO of the multinational corporation is indifferent between the borrowing structures *cc* and *cd*. This is due to the fact that in our basic model set-up the probability of success for subsidiary A is equal to zero if the manager exerts no effort. In a richer model set-up allowing for a base-line probability of success, which can be realized independent of managerial effort, choosing the borrowing structure *cc* would be unambiguously optimal.

of control, the manager of subsidiary A always exerts maximum efforts resulting in a probability of success of one under all borrowing structures. In this case, the manager's incentives are already strong enough with a fully centralized borrowing structure. Thus the CEO can perfectly well centralize the borrowing structure in order to optimally exploit the coinsurance effect without renouncing to managerial incentives. Surprisingly, even though we consider two completely different incentive situations, the optimal borrowing structure is the same and in both cases independent of the prevailing creditor rights.

CREDITOR RIGHTS AND INTEREST RATES

One interesting aspect we have not explicitly considered yet is the effect of creditor rights on equilibrium interest rates. Doing so allows us to derive empirically testable predictions, which can be used to verify the compliance of our model with real world data.

Proposition 2.5 *Foreign affiliates face lower interest rates for local borrowing if creditor rights are strong. That is $\frac{\partial R_A^{dc}}{\partial p} \leq 0$ and $\frac{\partial R_A^{dd}}{\partial p} \leq 0$.*

Proof: See Appendix.

The intuition for this Proposition is as follows: Stronger creditor rights reduce the agency problem between the CEO and the manager of subsidiary A. This implies a higher effort level for the manager of subsidiary A and hence higher probabilities of success for the investment project, which are reflected in the reduced interest rates. Desai et al. (2004) and Aggarwal and Kyaw (2004) find empirical evidence confirming this relationship.

2.5   Comparative Statics

In this section we investigate how firm and country characteristics influence the optimal borrowing structure. We consider the impact of profitability, of private benefits and of differences in the legal environment between the two countries in turn.

SHORT-TERM VS. LONG-TERM PROFITABILITY

How does the pay-off structure of the investment projects affect the degree of centralization of the borrowing structure? Do multinational corporations in industries

with relatively high immediate pay-offs to investment, i.e. high values of X, e.g. in the music industry, prefer a more decentralized borrowing structure? Or should we rather expect multinationals with investment opportunities exhibiting very long pay-off periods, like infrastructure projects, which have a high continuation value F, to prefer a more centralized borrowing structure? We provide the answer in the following two Propositions:

Proposition 2.6 *A higher first period profit in case of success X increases the parameter range for which a more decentralized borrowing structure is preferred. In particular,* $\frac{\partial p_1}{\partial X} \leq 0$, $\frac{\partial}{\partial X}(p_3 - p_2) \leq 0 \wedge \frac{\partial}{\partial X}(p_5 - p_4) \geq 0$ *and* $\frac{\partial \overline{E}}{\partial X} \leq 0$, $\frac{\partial \overline{\overline{E}}}{\partial X} \leq 0$.

Proof: See Appendix.

Proposition 2.7 *A higher future value of the firm F increases the parameter range for which a more centralized borrowing structure is preferred. In particular,* $\frac{\partial p_1}{\partial F} \geq 0$, $\frac{\partial}{\partial F}(p_3 - p_2) \geq 0 \wedge \frac{\partial}{\partial F}(p_5 - p_4) \leq 0$ *and* $\frac{\partial \overline{E}}{\partial F} \geq 0$, $\frac{\partial \overline{\overline{E}}}{\partial F} \geq 0$.

Proof: See Appendix.

Consider Proposition 2.6 first: A higher first period profit X makes the success of a subsidiary more valuable. Thus, it is more attractive to provide the manager of subsidiary A with stronger incentives by decentralizing the borrowing structure. This is reflected both in the reduced optimality range for cc in the cases 1 and 2 (without and with weak empire-building tendencies), and in the increased optimality range for dd in case 3 (with strong empire-building tendencies). Additionally, as compared to case 2, case 3 becomes relatively more likely.

In contrast, consider Proposition 2.7: An increase in the future value of the investment project F increases the attractiveness of realizing the coinsurance effect as there is more at stake if a borrowing unit goes bankrupt. Centralizing the borrowing structure has a negative impact on the probability of success for subsidiary A. However, we can show that this adverse effect is outweighed by the positive effect of coinsurance by centralizing the borrowing structure. Hence, in cases 1 and 2 the optimality range for cc increases, in case 3 the optimality range for dd decreases. Furthermore, as compared to case 3, case 2 becomes relatively more likely.

To summarize, we can say that while first period profits increase the relevance of the incentive effect, future profits – or rather the threat of losing them – increase the relevance of the coinsurance effect.

The Private Benefits of Control

Intuitively we would expect that the private benefits of control – E and M – have very clear cut and similar effects on the borrowing structure. Both types of private benefits should increase the attractiveness of a decentralized borrowing structure as incentives become more important: An increase in M implies stronger direct private benefits of being the manager. Therefore, we would expect an increase in the attractiveness of decentralized borrowing for subsidiary A in order to exploit these incentives. An increase in E implies stronger indirect benefits of empire-building. Thus, we would expect an increase in the attractiveness of decentralized borrowing for subsidiary B in order to exploit these incentives. Furthermore, we would not expect that an increase in M influences the borrowing structure for subsidiary B. Similarly, we would not expect that an increase in E influences the borrowing structure for subsidiary A. But this is not what we find.

Proposition 2.8 *Stronger empire-building tendencies E increase (decrease) the parameter range for which a decentralized (centralized) borrowing structure is optimal. However, higher benefits of control M increase the parameter range for which the mixed debt structure dc is preferred as compared to all other borrowing structures. That is for E: $\frac{\partial p_2}{\partial E} \geq 0$, $\frac{\partial p_3}{\partial E} \leq 0$ and $\frac{\partial p_4}{\partial E} \leq 0$ $\frac{\partial p_5}{\partial E} \geq 0$ and for M: $\frac{\partial p_3}{\partial M} < \frac{\partial p_2}{\partial M} \leq 0$ and $\frac{\partial p_5}{\partial M} < \frac{\partial p_4}{\partial M} \leq 0$.*

Proof: See Appendix.

The direct incentive effects are as expected. If the benefits of being a manager M increase, decentralizing subsidiary A becomes more attractive as an increase in M implies a higher incentive effect associated with the decentralization of the foreign managers own subsidiary A. A similar rationale holds with respect to the private benefits associated with empire-building E. In this case, decentralizing subsidiary B becomes more attractive when the associated benefits E are high. Coinsuring subsidiary B would weaken the incentives of the subsidiary manager A too much. However, there is a further indirect effect associated with an increase in the private benefits: Higher private benefits, i.e. higher values of E and M, both c.p. increase the probability of success q_A for subsidiary A. This in turn influences the attractiveness of the coinsurance effect. As q_A increases, coinsuring subsidiary B in the parental country becomes more attractive whereas the coinsurance of subsidiary A becomes less attractive. This indirect effect leads to the asymmetric results laid down in Proposition 2.8.

NATIONAL DIFFERENCES IN THE LEGAL ENVIRONMENT

So far, we focused on multinational corporations and/or business groups operating in countries with similar legal environments. Naturally, many multinationals have subsidiaries in countries with very different legal environments. In this final part of the section, we therefore introduce differences in the legal environment and investigate how these affect the optimal borrowing structure of multinational corporations. In our model, the legal environment is reflected by two parameters: First of all, creditor rights, captured by the parameter p, are core to the legal environment of a country (see introduction). Secondly, the legal environment comprehends also the design and the efficiency of the bankruptcy process. Thus, the associated dissipative costs $(1-\alpha)$ will be shaped by the prevailing legal environment.

In the following, we discuss the impact of both aspects on the optimal borrowing structure of a multinational corporation.

Consider the bankruptcy process first. Without differences in the bankruptcy process, i.e. identical values of α for the two countries, bankruptcy costs reflected by $(1-\alpha)$, influence the optimal borrowing structure in exactly the same way as future profits F. Both higher values for F or lower values of α increase expected losses from bankruptcy and therefore increase the attractiveness of avoiding bankruptcy and hence of a more centralized borrowing structure. The more interesting question however is, how differences in the efficiency of the bankruptcy process between the parental and the foreign country affect the optimal borrowing structure. To answer this question we introduce country specific parameters α_P and α_A for the (in-)efficiencies of the bankruptcy process in the parental and foreign country and investigate the effects on expected profits. Our results are summarized in the following Proposition:

Proposition 2.9 *If multinationals operate in countries with different bankruptcy systems, the CEO prefers to borrow in the country with a more efficient bankruptcy system.*

With $\frac{\partial E\pi(cc)}{\partial \alpha_A}\mid_{\alpha_A=\alpha_P=\alpha}=\frac{\partial E\pi(cd)}{\partial \alpha_A}\mid_{\alpha_A=\alpha_P=\alpha}=0\leq\frac{\partial E\pi(dd)}{\partial \alpha_A}\mid_{\alpha_A=\alpha_P=\alpha}\leq\frac{\partial E\pi(dc)}{\partial \alpha_A}\mid_{\alpha_A=\alpha_P=\alpha}$, a decrease in the bankruptcy costs $(1-\alpha_A)$ increases the attractiveness of decentralizing the borrowing for subsidiary A in the foreign country. This increase is especially pronounced for the mixed borrowing structure dc.

Proof: See Appendix.

The intuition is straightforward: A lower bankruptcy inefficiency in the foreign

country A, i.e. a higher value for α_A, is associated with a lower downside risk of decentralized borrowing in A. The loss in the future firm value in case of bankruptcy is lower, and so the CEO prefers to decentralize the borrowing for subsidiary A in order to better exploit the incentive effect. Since under dc subsidiary B is coinsured by subsidiary A, there are positive spillover effects of the better legal environment in country A. The intuition therefore is as follows: As coinsuring subsidiary B entails adverse incentive effects for the subsidiary A manager and hence lower probability of success for subsidiary A, the gains of a reduced cost of bankruptcy are larger. Note however, that the results are only driven by the reduced attractiveness of the coinsurance effect of centralized borrowing for subsidiary A. The (in-)efficiency of the bankruptcy system does not affect managerial incentives but only the loss in future value in case of bankruptcy.

Let us now turn to creditor rights. A priori, we would expect creditor rights to have a strong direct effect on expected profits. Surprisingly, though, this is not the case.

Proposition 2.10 *Differences in the creditor rights do not directly affect expected profits under any borrowing structure. However, due to the incentive effect, the attractiveness of borrowing structures with decentralized borrowing for subsidiary A increases with higher creditor rights in country A as compared to the parental country, i.e.* $\frac{\partial E\pi(cd)}{\partial p_A}\mid_{p_A=p_P=p}=\frac{\partial E\pi(cc)}{\partial p_A}\mid_{p_A=p_P=p}=0\le\frac{\partial E\pi(dd)}{\partial p_A}\mid_{p_A=p_P=p}\le\frac{\partial E\pi(dc)}{\partial p_A}\mid_{p_A=p_P=p}$.

Proof: See Appendix.

The intuition is as follows: Differences in the borrowing structure directly influence expected bankruptcy costs of the multinational corporation. However, they also affect the interest rates external investors require. From an ex-ante perspective, as investors are fully competitive, these two effects exactly cancel each other out. The only remaining impact of creditor rights is on the incentives of the subsidiary manager A. These of course only depend on the creditor rights prevailing in the country of origin of the debt. The overall effect under dc is stronger than under dd. This is due to the fact that the same increase in incentives has a stronger effect on expected bankruptcy costs if subsidiary B is coinsured.

2.6   Empirical Hypothesis

In this final section, we highlight the empirical implications of our model. We first set forth two general empirical hypotheses and then further hypotheses relating to the different aspects of the legal environment.

GENERAL IMPLICATIONS

Hypothesis 2.1 *The more decentralized the MNC's borrowing structure, the higher is a subsidiary's success rate.*

This hypothesis is based upon Proposition 2.1: Recall that both centralizing the debt for the subsidiary concerned as well as the other subsidiary entail adverse incentive effects. Hence, we expect lower probabilities of success for subsidiaries of multinationals with a higher degree of debt centralization.

From Propositions 2.6 and 2.7 we know that immediate profits and future profits have completely opposing effects. Therefore, we derive the following hypothesis with respect to the timing of investment pay-offs:

Hypothesis 2.2 *MNCs operating in industries with long life cycles (e.g. infrastructure and energy) prefer a centralized borrowing structure, whereas MNCs in industries with short life cycles (e.g. music industry and IT) prefer a decentralized borrowing structure.*

CREDITOR RIGHTS

As we have shown in our analysis, creditor rights are key in determining the optimal borrowing structure of a MNC.[70]

The first hypothesis we derive relates the strength of creditor rights to the performance of the MNC's foreign affiliates. As stronger creditor rights in the affiliate's country lead to stronger managerial incentives, the following hypothesis can be established:

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[70]Note, however, that with creditor rights we refer to effective creditor rights. As also Safavian and Sharma (2007) verify empirically, it is not only the creditor-friendliness of the laws that determines the effective strength of creditor rights in a country but also the enforcement of the laws. This is part of our model, as only an effective creditor-orientation constitutes a credible threat of liquidation.

Hypothesis 2.3 *MNC affiliates in countries with weaker creditor rights are riskier and less successful.*

The existing empirical literature provides indirect evidence for this hypothesis: Claessens et al. (2000) find that firms operating in common law countries – which are typically associated with more efficient legal enforcement and stronger investor protection – appear less risky. Levine (1999) finds that financial institutions are better developed with better legal protection and that the portion of the development of financial institutions related to better legal protection is associated with more economic growth. Our hypothesis also supports a positive relationship between the legal protection of creditors and growth as with weak creditor rights firms will be less successful.

We can derive a closely related second hypothesis:

Hypothesis 2.4 *Weaker creditor rights lead to less investment by MNCs' foreign affiliates and more bad loans.*

This hypothesis reflects that with a lower probability of success the investment project is more likely to fail and hence debt repayments cannot be met. In the extreme case an investment project might not even be NPV-positive and hence the investment project will not be undertaken.

Finally, when considering the overall borrowing structure of the MNC, we derive the following two hypotheses:

Hypothesis 2.5 *Subsidiaries of MNCs in countries with weaker creditor rights will face higher interest rates and substitute costly external borrowing with internal funds.*

Hypothesis 2.6 *MNCs adjust their debt allocation in order to optimally exploit differences in creditor rights. In particular, MNCs shift their borrowing to the country with better creditor protection.*

These hypotheses reflect the findings of Desai et al. (2004). The authors find evidence that foreign affiliates' borrowing costs for external finance are higher in countries with weak creditor rights. They furthermore show that foreign affiliates in countries with weak creditor rights use internal capital markets in order to substitute for external debt. As the authors reckon, weak creditor rights might give rise to an agency problem as they reduce the creditor's incentive to avoid bankruptcy. Internal capital markets

can thus be used "to fund subsidiaries in jurisdictions providing weak creditor rights, drawing on capital from operations located in countries offering strong creditor rights" (Desai et al. (2004), p. 2456). These are exactly the forces at work in our model. Also Aggarwal and Kyaw (2004) empirically confirm our findings with respect to interest rates. Furthermore, taking into account that financial institutions are better developed with better legal protection (Levine (1999)), it is also in line with the findings of Kang et al. (2004) of a positive relationship between the extent of foreign affiliates' local borrowing and financial market development.

DISSIPATIVE BANKRUPTCY COSTS

Consider the dissipative costs associated with the bankruptcy system next. In our model, bankruptcy costs are captured by the parameter $(1-\alpha)$. As higher bankruptcy costs increase expected losses from bankruptcy, we derive the following empirical hypothesis:

Hypothesis 2.7 *High bankruptcy costs lead to a more centralized borrowing structure.*

Even though in our analysis bankruptcy costs are modeled in a rather stylized way – as they simply consist of the costs associated with financial distress, and not of actual liquidation – the above relationship should even be reinforced if we included actual costs of liquidation.

Taking into account differences in the legal environment between the parent company and its foreign affiliates allows us to derive the second empirical hypothesis with respect to bankruptcy costs.

Hypothesis 2.8 *MNCs adjust their debt allocation in order to optimally exploit differences in bankruptcy systems. In particular, they borrow more in countries with more efficient bankruptcy procedures.*

PRIVATE BENEFITS AND THE LEGAL ENVIRONMENT

Finally, a more indirect relationship that can be established between the legal environment and the borrowing structure is related to the private benefits of control. As for example Dyck and Zingales (2004) empirically verify: strong "legal institutions are strongly associated with lower levels of private benefits" (Dyck and Zingales (2004),

p. 582).[71] This holds in particular for regulations regarding the transparency of firms. Thus, we expect the general level of private benefits of control to be relatively lower in countries with a more effective and transparent legal environment. Combining this relationship with our insights with respect to managerial private benefits, M and E, we can derive the following final hypothesis:

Hypothesis 2.9 *MNCs with foreign affiliates in countries with relatively low transparency requirements decentralize their affiliates' borrowing.*

2.7   Conclusion

In this paper we developed a framework for understanding the debt allocation process within multinational corporations. In our analysis we showed that the debt structure within multinationals matters beyond tax issues – a fact that had almost been completely neglected in the literature so far. In particular, we highlighted that the legal environment is key in determining the degree of debt centralization within a MNC. However, as our analysis suggests, different aspects of the legal environment have differing effects on the borrowing structure.

Although very stylized, our model and results do reflect the existing empirical findings related to multinational finance and creditor rights. While we provide a rationale for mixed borrowing structures, we demonstrate how the trade-off between incentive problems in internal capital markets and coinsurance determines the optimal borrowing structure. Our analysis highlights the relevance of creditor rights for a multi-entity firm's capital structure in general and for multinational corporations in particular. Differences in the legal environment induce a bias of the debt allocation towards the country with a better legal environment, i.e. stronger creditor rights and lower bankruptcy costs. A major contribution of our paper is to highlight the importance of a comprehensive view on multinationals' borrowing decision due to feedback effects on internal capital markets – an aspect that current research on MNC finance did not focus on yet.

A more comprehensive model would endogenize the incentive problems of the home subsidiary as well. The basic trade-off of our model would not be affected but there

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[71]Even though the focus of their analysis is on private benefits controlling shareholders enjoy, the general findings should at least be partially applicable to the private benefits a non-owner subsidiary manager enjoys.

may be room for reinforcing incentive effects between the subsidiaries. This must be left to future research. Further questions to be addressed in future research relate to the effect of creditor rights on several aspects of multinational finance. An extension of our work could incorporate the choice between equity and debt into a model of multinational finance. A particularly interesting question is how the legal environment affects the multinational's choice between internal debt, i.e. parental borrowing for the subsidiaries, and internal equity. Another interesting aspect which needs further empirical investigation is a differentiated analysis of the effect of creditor rights on the different aspects of the insolvency regime, for example also the actual liquidation of insolvent firms.

Chapter 3

Home Market Effects of Cross-Listing

3.1 Introduction

Several emerging economies have dismantled capital controls and liberalized their financial markets over the last decades. 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 American Depositary Receipts (ADRs) on an U.S. stock exchange, this number increased to 106 by 1995 and again doubled, reaching 214 cross-listed companies, by the beginning of 2008.[72] Interestingly, only about 60 percent of these companies used this issue to raise new capital, whereas the other 40 percent of the firms decided to cross-list but did not raise additional funds on the U.S. stock exchanges.

This observation seems surprising if firms are expected to cross-list in order to broaden their investor basis and generate new capital inflows. However, the observation supports the claim that firms use cross-listing as an informational device. Firms from

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[72]Source: Moel (1999) and Bank of New York Depository Receipts, http://www.adrbny.com/, data downloaded on August 7, 2008. Besides obtaining a direct listing on an US stock exchange, foreign firms can and typically prefer to 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 company's original shares are held in custody by the issuing bank in the company's home country. There are four types of ADR issues. Thereof, only Level II and III ADRs allow firms to be listed on an US stock exchange, and only a Level III issue allows firms to raise new capital. Accordingly, level II and level III issues have very high informational requirements, with firms having to register with the US Securities and Exchange Commission and comply with US GAAP disclosure requirements. For a detailed overview see Moel (1999).

informationally opaque countries with relatively weak corporate governance standards can borrow on the strict regulatory disclosure requirements of countries with better informational standards.

It is expected and empirically verified that cross-listing firms benefit from using this informational device. However, it is not clear up-front how this will affect the cross-listing firm's home market competitors and local welfare in the emerging country. The analysis of these home-market effects and in particular of the resulting welfare effects is the goal of my paper. In a model of adverse selection – taking into account the informational value of cross-listing as a signaling device – I first derive equilibria in closed and open economies and then investigate welfare effects of financial market liberalization. The model is designed in a way that excludes any effects of capital inflows and the changes of availability of funds. This allows me to focus on equilibrium and welfare effects which arise due to informational issues.

There are two major inefficiencies identified by the existing literature which might arise in emerging market finance due to problems of adverse selection. On the one hand, a problem of underinvestment can arise. Good firms might be credit-rationed, despite the existence of sufficient funds, simply because banks cannot distinguish between good and bad firms and want to avoid adverse selection (Stiglitz and Weiss (1981)). On the other hand, the adverse selection problem can lead to a problem of overinvestment, such that socially undesirable projects are financed (de Meza and Webb (1987)). The model I develop captures both of these inefficiencies in a stylized way and allows me to analyze welfare effects of financial market liberalization in a unified framework.

As derived in my analysis, the equilibrium in a closed economy exhibits either an overinvestment problem (de Meza and Webb-type economy), in which bad firms with NPV-negative investment projects are cross-subsidized by good firms with NPV-positive projects, or it exhibits an underinvestment problem, with bad firms driving good firms out of the market as well (Stiglitz and Weiss-type economy). The situation with underinvestment arises whenever the average project profitability on the local pool is very low. This can either be due to the fact that the market share of good firms is relatively small or due to the fact that the profitability of good investment projects is relatively low. The situation with overinvestment arises if the average project profitability on the home market pool is sufficiently high.

Liberalizing financial markets allows firms to cross-list. The decision of a firm to cross-list on an international stock exchange with very strong disclosure requirements

conveys information about the investment opportunities of the firm.[73] Only good firms have an interest in using this signaling device because being identified as a good firm allows them to obtain financing at a much lower interest rate than the prevailing average market interest rate.

However, cross-listing 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 more detailed and accurate financial information than required under local legislation. These costs depend on the legal environment of the home country as well as firm-specific characteristics, like its corporate governance practice and size. Doidge et al. (2008a) show how the incentives to cross-list are determined by the possibility of consuming private benefits and thus the corporate governance level of a particular company. They find that firms with bad corporate governance, which implies high benefits of control, are less likely to cross-list. This suggests that the (opportunity) cost of cross-listing is too high for these firms. Typically, profitable firms differ with respect to their corporate governance level and their size and as a consequence their costs of cross-listing. Therefore, only good firms with relatively low costs of cross-listing consider using this signaling device.

For both types of economies – economies characterized by an underinvestment or by an overinvestment problem – liberalizing financial markets entails negative cost of capital spillovers in form of higher interest rates on the local market and valuation spillovers for non-cross-listing firms. Despite these negative spillovers, welfare effects are not clear up-front. This is primarily due to the fact that negative spillovers on profitable domestic firms are indeed welfare reducing, whereas negative spillovers on unprofitable firms can be welfare increasing.

If the closed economy is characterized by an underinvestment problem (de Meza and Webb-type economy), financial market liberalization unambiguously enhances local welfare. In this case, financial market liberalization allows some of the good firms to cross-list and therefore obtain financing and invest. Therefore, the underinvestment problem is mitigated. If the closed economy is characterized by an overinvestment problem (Stiglitz and Weiss-type economy), welfare effects of financial market liberalization

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[73]One could also think about other signaling devices like engaging an auditor or certified accountant. The problem with employing these devices is, however, that they are subject to 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 issues will arise as to the reliability of the certificate provided by an auditor. In fact, for example, Rahman (1998) shows how auditors failed to act as effective external monitors in the East Asian crisis.

are ambiguous. In this case, it depends on whether the average project profitability in the home market pool is of intermediate level or high. If the average profitability is high, financial market liberalization reduces local welfare. However, if the average profitability is intermediate, financial market liberalization increases the local welfare. Intuitively, this is due to the fact that for high project profitability liberalizing financial markets primarily causes cross-listing costs, whereas for intermediate values it mitigates the overinvestment problem.

Overall, my analysis reveals that, despite negative cost-of-capital spillovers, financial market liberalization can only entail negative welfare effects for the emerging economy if it is characterized by overinvestment inefficiencies prior to liberalization.

The related literature on cross-listing is mainly empirical. Yet, there are 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, according to which cross-listing might be attractive due to informational issues since it gives firms the possibility to credibly bond themselves to stricter regulatory and disclosure practices. Based on this bonding hypothesis, several empirical studies investigate cost-of-capital and valuation effects of cross-listing. Stulz (1999) provides 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) confirms the hypothesis on the informational value of cross-listing. He finds positive share price reactions for the announcement dates of the initiation of ADR-programs. Interestingly, these reactions are significantly higher for firms from emerging countries with typically more severe informational problems than developed countries, and for exchange-listings, which typically have much higher disclosure requirements, and thus entail higher informational value. Also, more recent studies affirm the informational hypothesis. Hail and Leuz (2008) find positive cost-of-capital effects for cross-listing firms, which are also present after the passage of the Sarbanes and Oxley Act in 2002.[74] Consistent with the informational view, they find weaker cost-of-capital effects for firms that cross-list in the over-the-counter market and for exchange-listed firms from countries with stronger home-country institutions. Similarly, Claessens and Schmuckler (2007) find evidence that firms are more likely to

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[74]The Sarbanes-Oxley Act was passed after the accounting scandals at Enron and WorldCom in order to further strengthen the regulatory and disclosure requirements for US stock exchanges. There is a relatively large literature investigating the effects of this law, in particular as it increased the compliance costs for cross-listing firms. For a survey see for example Piotroski and Srinivasan (2008).

cross-list with worse institutional environments in their home country. And Doidge et al. (2004, 2008b) find a significant positive effect of cross-listing on the valuation of cross-listing companies if these firms cross-list in the U.S.. The higher valuation is indeed more pronounced for exchange-listed firms, and firms from countries with weaker investor protection, which confirms the informational hypothesis.

These empirical findings support the results of my model: As cross-listing firms are identified as good firms, they obtain financing at a lower interest rate and hence have lower costs of capital and a higher valuation. Furthermore, if the closed economy was characterized by an underinvestment problem, these firms can realize positive investment projects which they were not able to finance before. This enhances their firm value.

While the reasons for cross-listing and the resulting effects on the cross-listing firm – in particular on its valuation and cost-of-capital – have been widely investigated, only a few papers consider spillover effects on domestic firms. Melvin and Valero-Tonone (2008) find empirical evidence for a negative stock price impact of a firm's cross-listing decision on its home market rivals. They interpret their result as evidence for investors' valuation of the firms' future profitability. If investors observe cross-listing, they perceive it 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 on the home market rivals of a cross-listing firm. He shows that contrary to the evidence for the cross-listing firms themselves, the capitalization and turnover ratios of local non-cross-listing firms decline with the increase in cross-listings in twelve emerging markets. Levine and Schmuckler (2006) find negative spillovers on domestic firms' liquidity through the internationalization of other firms. Overall, there is significant evidence that cross-listing has adverse spillover effects for domestic firms on the local market. These empirical findings are consistent with the predictions of my model. However, as I show in my analysis, negative spillovers do not have to be detrimental for local welfare but can even be beneficial if they imply a better allocation of capital to profitable firms. Welfare effects have not been analyzed in the existing literature yet.

The remainder of this paper is organized as follows: Section 3.2 describes the model. In Sections 3.3 and 3.4 equilibria are analyzed for the closed and open economy, re-

spectively. The welfare analysis is presented in Section 3.5. Section 3.6 concludes.

3.2 The Model

Consider an economy with a continuum of risk-neutral firms, whereof a fraction α are good firms and a fraction $(1 - \alpha)$ are bad firms, with $0 < \alpha < 1$. Good firms have an investment opportunity which requires an initial investment normalized to one and yields a certain return of X. The investment opportunity of bad firms generates zero profits.

Firms have no funds of their own, so they have to borrow the required investment amount at a gross interest rate R from risk-neutral external investors.[75] In case of borrowing, investments are enforced and returns are verifiable. External investors are assumed to be risk-neutral and fully competitive. They have refinancing costs of R_0, which is the world risk-free gross interest rate. Given this interest rate R_0, it is assumed that $X - R_0 > 0$, i.e. the investment project of good firms exhibits a positive net present value (NPV). The bad firms' investment opportunity is NPV-negative, i.e. $-R_0 < 0$. The availability of funds is not limited. These assumptions hold for the closed as well as the open economy.[76]

The market is characterized by asymmetric information. While firms know their types, external investors only know the ex-ante distribution of good and bad firms. In a closed economy, investors have no means to distinguish whether a potential borrower is of a good or a bad type.

Opening up the economy gives firms the possibility to cross-list. As the availability of funds at R_0 is limited neither in the open nor in the closed economy, the decision to cross-list has only an informational value. I assume that cross-listing implies perfect disclosure of relevant project information and allows (local) investors to identify the type of a cross-listing firm. For the firms cross-listing is costly. The costs of cross-listing depend on different factors like the legal environment of the home-country and

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

[76] As stated in the introduction, these simplifying assumptions are made on purpose in order to focus on informational effects of financial market liberalization that go beyond international capital flows and the availability of additional funds. In fact, in an empirical study, King and Segal (2008) find that firms benefit from cross-listing even if they fail to broaden their investor base.

individual firm characteristics, such as the firm's size and the accounting standards already adopted. Firms are expected to differ with respect to their costs of cross-listing.[77] For simplification reasons I assume that the individual fixed costs of cross-listing for good firms F_i are uniformly distributed on the interval $\left[0; \overline{F}\right]$.[78] The same distribution function of cross-listing costs is assumed for bad firms as well. Besides the borrowers' types, all other information is common knowledge.

The timing of the model is as follows: At date 0, if the economy is open, firms decide whether to cross-list or not. The decision is observable to all market participants. If the economy is closed, this step is omitted. At date 1, investors decide whether and at which interest rate R to offer credit contracts to potential borrowers. At date 2, if offered a contract, firms decide if they want to borrow at the required interest rate, upon which investors provide the necessary funds. Finally, at date 3, investments are realized, and debt is repaid (if possible). The model is solved by backward induction.

3.3 Equilibrium in the Closed Economy

Consider the situation in a closed economy first. In a closed economy, firms cannot cross-list and convey information about their project quality.

At t=2, if offered a credit contract, a firm decides whether to borrow at the specified interest rate R_C. As bad firms never repay the debt, they always want to borrow regardless of the interest rate required. Hence, they accept any credit contract offered to them.[79] Good firms base their investment decision on the profits they can realize, which are given by

$$\pi_G = X - R_C. \tag{3.1}$$

Good firms only borrow and invest if doing so gives them positive profits, i.e. $\pi_G \geq 0$. If profits would be negative at a given interest rate R_C, i.e. $\pi_G < 0$, good firms do not have any incentive to borrow and invest.[80]

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[77]For example, Piotroski and Srinivasan (2008) identify size as a determinant of a firms cross-listing decision due to cost effects. Doidge et al (2008a) show that firms with bad corporate governance, thus high compliance costs, are less likely to cross-list.

[78]The main effects identified by this analysis do not depend on the specific distribution function. The aspect that drives the results is that good firms differ with respect to their costs of cross-listing.

[79]I implicitly assume that bad firms do borrow and invest if they are indifferent to do so.

[80]I assume that good firms have no incentive to invest if $R_C > X$. To be more precise, good firms would not be able to repay the debt in this case as they have no funds of their own. Hence, they would realize expected profits of zero and be indifferent whether to borrow or not. However, even if they wanted to borrow in this case, investors would anticipate that they will not be able to repay the

At t=1, risk-neutral investors decide on their credit offer. As investors have no means to distinguish between good and bad firms, they can only offer a single credit contract to all potential borrowers. If they expect good firms to be on the market, they offer a pooling credit contract to all potential borrowers at the pooling interest rate R_C. As investors are fully competitive, the equilibrium interest rate R_C leaves them with expected profits of zero. If they do not expect good firms to be on the market, they do not offer any credit contract at all.

The equilibrium in the closed economy is summarized by the following Proposition:

Proposition 3.1 *In the closed economy, if the average profitability on the local market is high enough, i.e. $\alpha X \geq R_0$, there exists a unique pooling equilibrium with all firms investing at the pooling interest rate*

$$R_C = \frac{R_0}{\alpha} > R_0.$$

If $\alpha X < R_0$, there exists a unique pooling equilibrium without borrowing and investment.

Proof: Straightforward by backward induction.

As a benchmark, consider the full information case: If investors had full information, they would offer a credit contract to good firms at R_0. Bad firms would not obtain any financing because their investment projects exhibit a negative NPV.

However, under asymmetric information, investors have no means to differentiate between good and bad firms. The best they can do is to offer a pooling contract based on the ex-ante market shares of good and bad firms. Good firms only borrow and invest whenever $X \geq R_C$. Potential investors anticipate the good firms' behavior and know that for interest rates $R_C > X$ only bad firms are willing to borrow. As bad firms never repay the debt, financing solely bad firms implies losses for potential investors. Hence, they are not willing to offer bad firms any credit contract in this case.

Which of the two possible situations arises depends on the market characteristics: The higher the market share of good firms α, the closer is the pooling interest rate R_C to the risk-free interest rate R_0. Therefore, the higher α and/or project returns X, the easier it becomes to sustain a pooling equilibrium with investment.

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full amount and thus would not offer any credit contract for $R_C > X$. This leads to the results of our modeling. Therefore we prefer the more intuitive formulation of our model.

This basic set-up allows me to capture both potential cases of inefficient investment levels stressed in the existing literature in a unified framework: The underinvestment problem focused on by Stiglitz and Weiss (1981) in their analysis of credit rationing as well as the overinvestment problem addressed by de Meza and Webb (1987).

In my model, the pooling equilibrium without borrowing, hence with market breakdown, which occurs if $\alpha X < R_0$, captures the underinvestment problem. In this case, the required pooling interest rate is too high for good firms to invest into their NPV-positive projects. Due to the adverse selection problem, the market breaks down and profitable investments are not realized. The overinvestment problem emerges in the pooling equilibrium with all firms investing at the pooling interest rate for $\alpha X \geq R_0$. In this case, bad firms are cross-subsidized by good firms via the relatively low pooling interest rate. Due to their limited liability they find it attractive to invest into their NPV-negative projects, and additional to the NPV-positive projects also these NPV-negative investments are realized.

3.4 Equilibrium in the Open Economy

Consider the situation in an open economy. Now, each good firm has the possibility to cross-list and convey full information about its type at an individual cost of cross-listing F_i, with $F_i \sim U(0, \overline{F})$. Being identified as a good firm allows borrowers to obtain financing at the risk-free interest rate R_0. In principle, bad firms could cross-list as well. However, they will never choose to cross-list – even if cross-listing is costless – as this would reveal their true type to investors and preclude them from borrowing.

Firms that do not cross-list are either offered a credit contract at an adjusted pooling interest rate of $\widetilde{R}$, or they are not offered any credit contract.

Good firms cross-list and invest at the risk-free interest rate if they can realize higher expected profits by doing so. As the costs of cross-listing are assumed to be uniformly distributed on the interval $[0; \overline{F}]$, each firm has to incur a different cost level. As a consequence, only some good firms – namely, the one with relatively low cross-listing costs – decide to cross-list.

The equilibrium in the open economy is summarized by the following Proposition:

Proposition 3.2 *Suppose that $\overline{F} > \max\left\{ \frac{4R_0(1-\alpha)}{\alpha}; X - R_0 \right\}$.[81] Then, the equilibrium*

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[81]This assumption ensures that the range for the fixed costs is sufficiently large, hence $\overline{F}$ sufficiently

in the open economy is characterized as follows:

1) For very high project returns, i.e. $X \geq X_2$, there exist two possible subgame perfect equilibria in pure strategies in which good firms with cross-listing costs $F_i \leq F_1^*$ or $F_i \leq F_2^*$, respectively, cross-list and invest at the risk-free interest rate R_0. All other firms invest at the pooling interest rate of $\widetilde{R}(F_1^*)$ or $\widetilde{R}(F_2^*)$, respectively.

2) For intermediate project returns, i.e. $X_1 \leq X < X_2$, there exists a unique subgame perfect equilibrium in pure strategies in which good firms with $F_i \leq F_1^*$ cross-list and invest at the risk-free interest rate R_0. All other firms invest at the pooling interest rate of $\widetilde{R}(F_1^*)$.

3) For relatively low project returns, i.e. $X < X_1$, there exists a unique subgame perfect equilibrium in pure strategies in which good firms with $F_i \leq F_0^*$ cross-list and invest at the risk-free interest rate R_0. All other firms do not borrow and invest at all.

With $F_1^* = \frac{\overline{F}}{2\alpha}\left[\alpha - \sqrt{\cdot}\right]$, $F_2^* = \frac{\overline{F}}{2\alpha}\left[\alpha + \sqrt{\cdot}\right]$, $F_0^* = X - R_0$, $\widetilde{R}(F_{1,2}^*) = \frac{R_0(1 - \alpha\frac{F_{1,2}^*}{\overline{F}})}{\alpha - \alpha\frac{F_{1,2}^*}{\overline{F}}}$, and $X_1 = \frac{R_0(2 - \alpha + \sqrt{\cdot})}{\alpha + \sqrt{\cdot}}$, $X_2 = \frac{R_0(2 - \alpha - \sqrt{\cdot})}{\alpha - \sqrt{\cdot}}$, $\sqrt{\cdot} = \sqrt{\alpha^2 - \frac{4\alpha R_0}{\overline{F}}(1 - \alpha)}$.

Proof: See Appendix.

The cross-listing decision of good firms is determined by the comparison between the expected profits they can realize by cross-listing and the expected profits they can realize in the local financing pool. The trade-off a good firm faces lies in the financing cost advantage of cross-listing (as it would have to pay R_0 instead of $\widetilde{R}$) as compared to its individual costs of cross-listing. Good firms with negligible costs of cross-listing definitely prefer to cross-list and leave the local pool. However, it is not clear up-front which total fraction $\frac{F_i^*}{\overline{F}}$ of good firms cross-lists and leaves the local pool in equilibrium. The cross-listing decision of a single good firm depends on the decision of the other good firms as well. The more good firms cross-list, the higher is the pooling interest rate $\widetilde{R}$ investors require as the remaining fraction of good firms in the pool decreases and the average pool quality deteriorates. As a consequence, expected profits on the local market are lowered and it becomes less attractive for good firms to stay in this market.

high and is needed to generate an inner solution. Note that I focus on pure strategies only.

Due to this negative feedback effect of cross-listing there are two possible equilibria for $X \geq X_2$. One possible outcome is that a relatively small fraction of good firms $\frac{F_1^*}{F}$ decides to leave the local financing pool. In this case, the average pool quality is quite high, the pooling interest rate $\widetilde{R}(F_1^*)$ is rather low and hence profits are relatively high on the local market. Thus, it is more attractive for a good firm with intermediate levels of cross-listing costs F_i, i.e. with $F_i \in (F_1^*; F_2^*]$, to stay in the local pool since many other good firms do so as well.

There also exists an equilibrium for $X > X_2$ in which a larger fraction $\frac{F_2^*}{F} > \frac{F_1^*}{F}$ of good firms leaves the local pool. In this case expected profits in the local pool are relatively low. Hence, it also pays for a good firm with $F_i \in (F_1^*; F_2^*]$ to incur the cross-listing costs. Given that also the other firms in this range cross-list, staying in the local pool is not an attractive option. Overall, the profits of good firms are higher in the first of the two equilibria. Intuitively, this is the case because firms can avoid the costs of cross-listing and anyhow obtain funding at a relatively low interest rate.

If project returns X are not too high, i.e. $X_1 \leq X < X_2$, the second equilibrium disappears. The intuition for this is as follows: If at intermediate values of X all firms with $F_i \leq F_2^*$ left the local pool, the pooling interest rate $\widetilde{R}(F_2^*)$ would be too high to sustain an equilibrium with positive expected profits and the local pool would break down. However, if only firms with $F_i \leq F_1^*$ leave the local pool, $\widetilde{R}(F_1^*)$ is sufficiently low to sustain positive expected profits. Enough good firms remain in the local pool to avoid market breakdown, and all firms invest. As shown in the Appendix, the pooling equilibrium with market breakdown cannot exist in this case: All firms with $F_i > F_1^*$ can attain higher profits by staying in the home market pool instead of cross-listing and prefer to do so. Hence, the local pool does not break down.

Finally, if project returns are low, i.e. $X < X_1$, both cross-listing and borrowing in the local pool becomes relatively unattractive. In equilibrium, good firms with relatively low costs of cross-listing, i.e. $F_i \leq F_0^*$, prefer to leave the local pool. The marginal firm to leave the local pool, with $F_0^* = X - R_0$, makes zero profits by cross-listing. All good firms with $F_i < F_0^*$ realize positive profits by cross-listing. All other good firms with $F_i > F_0^*$ would realize expected losses by cross-listing. They also prefer not to borrow at $\widetilde{R}(F_0^*)$ in the local pool. X is too low as compared to $\widetilde{R}(F_0^*)$ for realizing positive expected profits in the local pool. Hence, the home market collapses.

As discussed in the Appendix, the second equilibrium for $X \geq X_2$ with F_2^* is Pareto-dominated by the first and furthermore is not stable. I therefore exclude this second equilibrium from the rest of the analysis in this paper.

Note that the pooling interest rate $\widetilde{R}$ in the open economy is always higher than the pooling interest rate R_C in the closed economy. This is due to the smaller share of good firms in the local pool in an open economy and reflects the negative cost-of-capital effect on locally financed firms.

With respect to the problem of over- and underinvestment, the following can be said: For $X \geq X_1$ the situation in the open economy is characterized by overinvestment. All firms obtain financing and invest and all NPV-negative investment projects are also realized. For $X < X_1$ the situation in the open economy is characterized by an underinvestment problem; not all good firms with NPV-positive investment projects are able to realize their investment. However, as compared to the closed economy, the underinvestment problem is mitigated as at least some of the NPV-positive investment projects can be realized. In the following, I call the equilibrium outcome for $X \geq X_1$ the equilibrium without market breakdown and the equilibrium outcome for $X < X_1$ the equilibrium with market breakdown.

The next questions to be answered is which outcome is more likely to arise in what kind of an emerging country. In particular, how does the equilibrium outcome depend on the average project profitability, i.e. αX, of the market? And, how will the fixed costs of cross-listing affect the equilibrium outcome?

First note that a change in the average project profitability, determined by the project returns X and the market share α of good firms, influences the fraction of good firms that decides to cross-list in equilibrium.

Lemma 3.1 *The higher the market share of good firms α, the lower is the fraction $\frac{F_1^*}{F}$ of these good firms cross-listing in an equilibrium without market breakdown. The higher the project returns X, the larger is the fraction of good firms $\frac{F_0^*}{F}$ cross-listing in an equilibrium with market breakdown. An increase in α (in X) does not affect the fraction of good firms cross-listing in an equilibrium with (without) market breakdown. That is*

$$
\begin{aligned}
\frac{\partial(\frac{F_1^*}{F})}{\partial \alpha} &< 0 \; \wedge \; \frac{\partial(\frac{F_0^*}{F})}{\partial \alpha} = 0, \\
\frac{\partial(\frac{F_1^*}{F})}{\partial X} &= 0 \wedge \frac{\partial(\frac{F_0^*}{F})}{\partial X} > 0.
\end{aligned}
$$

Proof: See Appendix.

Consider the results with respect to α. First, assume that X is high enough to sustain an equilibrium without market breakdown. In this situation an increase in the market share of good firms α implies that a larger number of good firms is active in the local pool for a given marginal firm F_1^* to cross-list.[82] Ceteris paribus, this lowers the pooling interest rate $\widetilde{R}(F_1^*)$ and increases expected profits on the local market. Therefore, good firms with relatively high costs of cross-listing now prefer not to cross-list and the fraction of cross-listing good firms $\frac{F_1^*}{\overline{F}}$, decreases. In a situation with market breakdown the marginal firm is determined by its individual zero-profit condition for cross-listing, i.e. $X - R_0 - F_0^* = 0$. Therefore, the market share of good firms α does not affect $\frac{F_0^*}{\overline{F}}$.

Interestingly, an increase in X does not affect the fraction of good firms cross-listing in an equilibrium without market breakdown. Intuitively, this is due to the fact that the relative attractiveness of cross-listing as compared to the home market pool is not affected because neither $\widetilde{R}(F_1^*)$ nor the fixed costs of cross-listing change. However, X affects the zero profit-condition for cross-listing in case of market breakdown. In this case, more good firms decide to cross-list as their profits increase in X.

Based on these insights I derive the following Proposition:

Proposition 3.3 *The higher the average project profitability, i.e. αX, the easier is an equilibrium without market breakdown sustained. This is either driven by high project returns for good firms X, given that $\frac{\partial X_1}{\partial X} = 0$, or it is driven by a higher market share of good firms α, with $\frac{\partial X_1}{\partial \alpha} < 0$.*

Proof: See Appendix.

The result with respect to the project returns X is straightforward: The higher the value of X, the easier it becomes to sustain an equilibrium with positive profits in the home market pool and the easier $X > X_1$ is fulfilled.

The market share of good firms α increases the parameter range for which an equilibrium without market breakdown exists. This is due to two effects. First of all, there is a direct effect resulting from an increase in α: For a given marginal firm F_1^* there are ceteribus paribus more good firms on the home market. This increases the attractiveness of borrowing in the local pool. Secondly, as shown in Lemma 3.1,

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[82]This is due to the fact, that an increase in α does not change $\overline{F}$. Thus, the additional good firms have also fixed costs which are uniformly distributed on the interval $[0, \overline{F}]$.

an increase in α reduces the fraction $\frac{F_1^*}{\overline{F}}$ of cross-listing good firms. This reinforces the positive effect of α on the attractiveness of the home market pool. Overall, the threshold level for market breakdown X_1 decreases in α. Good firms prefer to stay in the local financing pool for lower project returns X, as $\widetilde{R}$ is relatively close to R_0.

To summarize, as in the case of a closed economy, I expect that strong open economies, i.e. economies with a relatively high average project profitability αX, are characterized by an overinvestment problem. Weak open economies, i.e. economies with a relatively low average profitability αX, are expected to exhibit an underinvestment problem. However, for weak economies the underinvestment problem is mitigated as some good firms do cross-list. Furthermore, I expect a larger fraction of good firms to cross-list if the home market economy is relatively weak.

Let us finally consider the effect of the overall level of cross-listing costs, i.e. of $\overline{F}$, on the equilibrium outcome.

Proposition 3.4 *With a larger range for cross-listing costs, i.e. higher values of $\overline{F}$, a smaller fraction of good firms cross-lists. In turn, the profit range for which an equilibrium without market breakdown is sustained, increases. That is*

$$\frac{\partial(\frac{F_1^*}{\overline{F}})}{\partial \overline{F}} < 0 \ \wedge \ \frac{\partial X_1}{\partial \overline{F}} < 0.$$

Proof: See Appendix.

An increase in $\overline{F}$ implies a dilation of the distribution of cross-listing costs, shifting the average costs of cross-listing towards higher levels. On average, it becomes more expensive for good firms to obtain a cross-listing. With higher costs of cross-listing, only a smaller number of good firms find it attractive to cross-list. Thus, the fraction $\frac{F_1^*}{\overline{F}}$ decreases. As a larger fraction of good firms stays on the home market pool, the average pool quality increases, the pooling interest rate $\widetilde{R}$ decreases and hence the range for which an equilibrium without market breakdown can be sustained increases.

One driver of the cross-listing costs is the necessary adjustment to the cross-listing firm's accounting practices. These, in turn, are influenced by the existing disclosure requirements in the home country of the cross-listing firm. In particular, the adjustment costs should be lower for all good firms if the local accounting standards are close to the standards of the target country for cross-listing and well enforced. In terms of the model, we expect countries with internationally more harmonized accounting standards

to exhibit a lower upper limit of the cross-listing costs $\overline{F}$. This allows me to derive a surprising result: Local governments of emerging countries can prevent good firms from leaving the local market and avoid market breakdown by opposing the harmonization of their accounting rules with international standards, i.e. by keeping a high value for $\overline{F}$.

3.5   Welfare Effects of Cross-Listing

In this section I investigate welfare effects. In particular, I determine under which circumstances financial market liberalization can be beneficial for an emerging market economy.

Welfare comprises expected profits of local investors and firms.[83] As a benchmark case, I derive welfare for the first best full information case. In a situation with full information, investors know the type of potential borrowers and offer all good firms a credit contract at the risk-free interest rate of R_0. Bad firms are not offered any credit contract. In this case welfare is given by

$$WF^{FB} = \alpha(X - R_0) > 0. \tag{3.2}$$

Welfare represents the total economic surplus generated by the good firms. Bad firms do not realize any profits, and investors realize expected profits of zero.

Now, turn to the situation in the closed economy with asymmetric information. First, consider the situation with underinvestment, i.e. market breakdown. In this case, welfare is given by

$$WF_C^{MBD} = 0. \tag{3.3}$$

In the closed economy, underinvestment implies that none of the firms – neither good nor bad – is able to invest. Underinvestment induces an inefficiency as the good firms' NPV-positive projects are not realized. Welfare is reduced as compared to the first best case by exactly $\alpha(X - R_0)$, which reflects the total surplus generated by the fraction α of all good firms.

Second, in the situation without market breakdown welfare is given by

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[83]It is assumed that cross-listing good firms obtain financing from local investors. This assumption is not crucial for the results, as availability of funds is not limited in the closed economy and investors realize expected profits of zero. For a detailed derivation of the welfare functions see Appendix.

$$WF_C^{NMBD} = \alpha X - R_0 > 0. \tag{3.4}$$

Without market breakdown, all firms obtain funding and invest into their projects at the pooling interest rate R_C. As compared to the first best case, welfare is lowered by the economic loss induced by the bad firms: A bad firm's investment requires an expense of R_0 but does not generate any profits. Welfare is reduced by exactly the resulting total loss of $(1 - \alpha)R_0$. However, as the average project profitability is relatively high, total welfare is positive and higher as compared to the underinvestment case.

Note that a higher average project profitability αX unambiguously increases welfare in the closed economy. First, it becomes easier to sustain an equilibrium without market breakdown. Secondly, welfare in the situation with market breakdown is unchanged whereas it is higher in the situation without market breakdown.

Next, consider the open economy. Welfare for the equilibrium with market breakdown is given by

$$WF_O^{MBD} = \frac{\alpha}{2\overline{F}}(X - R_0)^2 > 0. \tag{3.5}$$

In an equilibrium with market breakdown, a fraction $\frac{F_0^*}{\overline{F}}$ of the good firms α with relatively low costs of cross-listing can realize their NPV-positive investment projects. This has the positive welfare effect of $\alpha \frac{F_0^*}{\overline{F}}(X - R_0)$. However, each of these firms has to incur its individual cost of cross-listing. The total cross-listing costs are $\frac{\alpha F_0^{*2}}{2\overline{F}}$. With the marginal firm determined by $F_0^* = X - R_0$ and no other firm investing, I obtain the above welfare function. The welfare reducing effects as compared to the first best are twofold: First, the inefficiencies lie in the costs of cross-listing, which constitute pure waste for welfare. Secondly, only a fraction $\frac{F_i^*}{\overline{F}}$ of the α good investment projects are realized. However, total welfare is positive. Intuitively, this is due to the fact that all cross-listing firms voluntarily do so since they realize positive expected profits.

If there is no market breakdown in the open economy, welfare is given by

$$WF_O^{NMBD} = \alpha(X - R_0) - (1 - \alpha)R_0 - \frac{\alpha F_1^{*2}}{2\overline{F}} > 0. \tag{3.6}$$

In this case, good firms with relatively low cross-listing costs do cross-list and obtain financing at the risk-free interest rate R_0. The remaining good and bad firms all obtain financing at the pooling interest rate $\widetilde{R}(F_1^*)$ in the home market pool. As compared to the first best benchmark case, there are again two welfare reducing effects: First, welfare is reduced due to overinvestment, i.e. the financing of NPV-negative projects.

This effect is identical to the one in the closed economy and is given by $-(1-\alpha)R_0$. Secondly, welfare is reduced by the cross-listing costs $\frac{\alpha F_1^{*2}}{2\overline{F}}$, which the fraction $\frac{F_1^*}{\overline{F}}$ of good firms incur in order to be separated from bad firms. Note that there are two further effects of cross-listing: An interest rate advantage for cross-listing firms (R_0 vs. $\widetilde{R}(F_1^*)$) and an interest rate disadvantage for non-cross-listing good firms (higher interest rate $\widetilde{R}(F_1^*)$ as compared to R_C). However, these countervailing effects perfectly set each other off and have no net effect on total welfare. Again, it can be shown that total welfare is positive: The expected profits of good firms are so high that they compensate for the losses caused by the financing of bad firms and the fixed costs of cross-listing.

A better average project profitability, i.e. higher values for α and/or X, unambiguously increase welfare in the open economy, both with and without market breakdown. However, welfare effects of the overall cross-listing costs, more precisely of $\overline{F}$, depend on the market situation.

Proposition 3.5 *An increase in the range of cross-listing costs, i.e. an increase in $\overline{F}$, decreases welfare in an open economy with market breakdown. In an open economy without market breakdown it has the opposite effect. That is*

$$\frac{\partial WF_O^{MBD}}{\partial \overline{F}} < 0 \ \wedge \ \frac{\partial WF_O^{NMBD}}{\partial \overline{F}} > 0.$$

Proof: See Appendix.

An increase in $\overline{F}$ reduces the fraction of good firms that cross-list if there is market breakdown in the open economy. With market breakdown, cross-listing is the only possibility to obtain funds and invest into NPV-positive projects. As in this case less good firms can do so, this has an adverse effect on welfare. If there is no market breakdown in the economy, the decreased attractiveness of cross-listing has a welfare enhancing effect since it lowers the total (waste) costs of cross-listing.

Together with the result that an equilibrium without market breakdown becomes easier to sustain, i.e. $\frac{\partial X_1}{\partial \overline{F}} < 0$, this has an interesting implication: Governments of very weak economies, i.e. economies with a very low average pool quality, are expected to have an incentive to harmonize their legal accounting system with international standards, i.e. try to reduce $\overline{F}$. However, if the economy is relatively strong, i.e. it has a relatively high average pool quality, the government might have an interest in opposing the harmonization of their accounting rules with international standards.

The final question I address in this paper is how financial market liberalization affects local welfare. The results are given in the following Proposition:

Proposition 3.6 *If the closed economy is characterized by*
1) Underinvestment, i.e. $X < \frac{R_0}{\alpha}$*, financial market liberalization increases local welfare.*
2) Overinvestment, i.e. $X \geq \frac{R_0}{\alpha}$*, financial market liberalization increases local welfare for* $\frac{R_0}{\alpha} \leq X < X_{WF}$ *and decreases local welfare for* $X \geq X_{WF}$*.*

The threshold value X_{WF} *lies in the range* $\frac{R_0}{\alpha} \leq X_{WF} < X_1$ *and is given by* $X_{WF} = \overline{F} + R_0 - \sqrt{\overline{F}^2 - \frac{2\overline{F}R_0(1-\alpha)}{\alpha}}$*.*

Proof: See Appendix.

Consider the situation for $X < \frac{R_0}{\alpha}$ first.
In this case, there is market breakdown in the closed as well as the open economy. Hence, the only effect financial market liberalization entails is that good firms with relatively low cross-listing costs are able to cross-list and invest. As these firms voluntarily decide to do so, they make positive profits. Therefore, liberalizing the financial market mitigates the underinvestment problem and welfare increases.

Consider the situation for $X \geq \frac{R_0}{\alpha}$ next.
In this case, financial market liberalization might lead to market breakdown. This is due to the fact that the threshold for market breakdown in the closed economy (given by $\frac{R_0}{\alpha}$) is lower than the threshold in the open economy (given by X_1). If project returns are of an intermediate level, i.e. $\frac{R_0}{\alpha} \leq X < X_1$, the average project profitability of the remaining firms in the home market is not sufficient to sustain an equilibrium without market breakdown. However, if project returns are very high, i.e. $X \geq X_1$, financial market liberalization does not lead to market breakdown.

The welfare reducing effect of financial market liberalization for $X \geq X_1$ is clear: With $X \geq X_1$, there is no market breakdown neither in the closed nor in the open economy and all NPV-positive and NPV-negative investment projects are being realized. Therefore, the net effect of financial market liberalization is that cross-listing good firms incur costs in order to be identified as good firms. All other effects are purely redistributional: The profit increase due to the lower risk-free interest rate for cross-listing good firms is perfectly offset by the reduction in profits of the good firms

in the local pool due to the increase in the pooling interest rate from R_C to $\widetilde{R}(F_1^*)$. As a consequence, the welfare loss corresponds to the total costs of cross-listing good firms.

The welfare implications of financial market liberalization are not straightforward if it induces market breakdown, i.e. for $\frac{R_0}{\alpha} \leq X < X_1$. In this case, there are two negative effects of financial market liberalization: First, as in the cases before, there are the costs of cross-listing, amounting to $-\frac{\alpha F_0^{*2}}{2F}$. Secondly, as financial market liberalization leads to market breakdown, good firms with relatively high cross-listing costs are not able to obtain financing and invest into their NPV-positive projects anymore. This introduces a (partial) underinvestment problem and reduces welfare by $\alpha(1 - \frac{F_0^*}{F})(X - R_0)$. However, financial market liberalization entails also a positive effect now: Bad firms are also not able to obtain financing and invest into their NPV-negative investment projects anymore. Thus, the overinvestment problem is mitigated. This increases local welfare by $(1 - \alpha)R_0$.

The negative effects dominate the positive effect of financial market liberalization only for higher values of X, i.e. $X \geq X_{WF}$. This is due to the following: The positive effect of mitigating the overinvestment problem is independent of X in this range. However, the negative effects increase in X. With higher values of X, more good firms decide to cross-list (remember that $F_0^* = X - R_0$). This increases the overall cross-listing costs. Interestingly, despite the increased number of cross-listing good firms, also the welfare loss associated with the underinvestment problem increases in X. The intuition therefore is that the loss for the omitted NPV-positive investment opportunities also increases in X. For higher values of X, this dominates the positive effect of less omitted NPV-positive projects, i.e. more cross-listing good firms. As a consequence, the negative effects associated with the costs of cross-listing and the increased underinvestment problem dominate the positive effect related to the mitigation of the overinvestment problem for $X \geq X_{WF}$.

To summarize, for an economy characterized by an underinvestment problem (Stiglitz and Weiss-type of economy) financial market liberalization has a welfare enhancing effect even though negative interest rate spillovers on domestic firms take place. Even if the costs of cross-listing are welfare-reducing, these are more than offset by the positive effects of the mitigation of the underinvestment problem. Furthermore, for an economy characterized by an overinvestment problem (de Meza and Webb-type of economy) financial market liberalization can have a positive effect on national welfare as it allows to mitigate the overinvestment problem. However, this positive effect is

dominated by the the cross-listing costs and the introduction of a (partial) underinvestment problem whenever the NPV-positive investment projects that cannot be realized are relatively profitable. For a high project profitability in the emerging economy financial market liberalization is unambiguously welfare reducing since the overinvestment problem can not be mitigated but cross-listing costs are incurred.

3.6 Conclusion

This paper analyzed welfare effects of financial market liberalization within a model of adverse selection. In particular, I have shown that welfare effects can be positive or negative, depending on the average profitability of investment projects and the level of cross-listing costs in the emerging economy. As shown in the above analysis, and consistent with empirical evidence, financial market liberalization has a negative cost-of-capital spillover on the local financial market as the interest rate in the local pool increases. 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 emerging 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, the introduction of this signaling device can reduce the overinvestment problem and enhance welfare. However, this positive welfare effect can be overcompensated by the introduction of an underinvestment problem and the cross-listing costs if the good firms' investment projects are quite profitable. If the good firms' projects are highly profitable welfare is unambiguously reduced.

My analysis demonstrates that for assessing the effects of cross-listing on the domestic market it is not sufficient to consider the cost-of-capital or valuation spillover effects on local firms only. But in addition, the profitability and growth opportunities of these have to be taken into account.

Another contribution of the model is to derive under which circumstances emerging countries might be reluctant to harmonize their accounting system with international standards. As shown in the analysis, this is the case for strong emerging countries, i.e. economies with a high average profitability of local firms.

My findings are also consistent with empirical evidence on a positive relationship between financial market liberalization and the cross-listing firm's externally financed

growth (Khurana et al. (2008)) as well as local development on an aggregate level (e.g. Bekaert et al. (2005)). Whenever in my model welfare is enhanced by financial market liberalization, the average profitability of financed projects increases, which in turn leads to higher growth rates for the economy.

Thus, my model explains how cross-listing can have negative spillover effects on domestic rival firms, and at the same time can increase local welfare and contribute to an accelerated growth of the emerging economy.

Appendix to Chapter 1

A1.1 Proof of Proposition 1.2: Liquidation Strategies

Derivation of Threshold Values $\widetilde{\beta}_i$

Proportionate Sale (PS). By comparing $E\pi_{PS,L}^{t=2}$ and $E\pi_{PS,C}^{t=2}$ it follows that the originator liquidates the loan whenever $\beta \geq \widetilde{\beta}_{PS} = \widetilde{\beta}_{NS} = p + (1-p)\tau$. For $\beta < \widetilde{\beta}_{NS}$ the loan is continued.

First Loss Provision (FLP). $E\pi_{FLP,C}^{t=2} = [p(1-\gamma) + (1-p)0]\,D$ as $\gamma > \tau$. By comparing $E\pi_{FLP,L}^{t=2}$ and $E\pi_{FLP,C}^{t=2}$ it follows that the originator liquidates the loan whenever $\max\{(\beta - \gamma)D; 0\} \geq p(1-\gamma)D$. If $\beta < \gamma$, this condition reduces to $0 > \underbrace{p(1-\gamma)D}_{>0}$ and is never fulfilled. If $\beta \geq \gamma$, the condition reduces to $\beta - \gamma \geq p(1-\gamma) \Leftrightarrow \beta \geq p + (1-p)\gamma$. Overall, the originator liquidates the loan whenever $\beta \geq \widetilde{\beta}_{FLP} = p + (1-p)\gamma$[84]. He continuous the loan whenever $\beta < \widetilde{\beta}_{FLP}$.

Last Loss Provision (LLP). By comparing $E\pi_{LLP,L}^{t=2}$ and $E\pi_{FLP,C}^{t=2}$ it follows that the originator liquidates the loan, whenever $\min\{\beta; \gamma\} > p\gamma + (1-p)\tau$. If $\beta < \gamma$, this condition reduces to $\beta > p\gamma + (1-p)\tau$. If $\beta \geq \gamma$, the condition reduces to $\gamma \geq p\gamma + (1-p)\tau$. As with the assumption $\gamma > \tau$ it holds that $(1-p)\gamma > (1-p)\tau$, it follows that the condition is always fulfilled. Overall, the originator liquidates the loan whenever $\beta \geq \widetilde{\beta}_{LLP} = p\gamma + (1-p)\tau$[85]. He continues the loan whenever $\beta < \widetilde{\beta}_{LLP}$.

Comparison of Threshold Values $\widetilde{\beta}_i$

Proportionate Sale (PS) vs. No Sale (NS). With $\widetilde{\beta}_{PS} = \widetilde{\beta}_{NS}$, PS implies the same liquidation strategy as NS.

First Loss Provision (FLP) vs. No Sale (NS). With $\tau < \gamma$, there exists a range

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[84]This condition implies that liquidation only occurs if $\beta > \gamma$, as with $p + (1-p)\gamma = \gamma + (1-\gamma)p$ and $(1-\gamma)p > 0$, the condition $\beta > \gamma$ holds a fortiori.

[85]This condition implies also that continuation only occurs if $\beta > \gamma$, as with $\tau < \gamma$ it follows that $p\gamma + (1-p)\tau < \gamma$.

$[\widetilde{\beta}_{NS}; \widetilde{\beta}_{FLP})$, for which the originator chooses continuation under FLP but liquidation under NS. For $\beta \geq \widetilde{\beta}_{FLP}$ ($\beta < \widetilde{\beta}_{NS}$) the originator chooses liquidation (continuation) under both structures.

Last Loss Provision (LLP) vs. No Sale (NS). With $\gamma \leq 1$, there exists a range $[\widetilde{\beta}_{LLP}; \widetilde{\beta}_{NS})$, for which the originator chooses liquidation under LLP but continuation under NS. For $\beta \geq \widetilde{\beta}_{NS}$ ($\beta < \widetilde{\beta}_{LLP}$) the originator chooses liquidation (continuation) under both structures.

The originator's liquidation strategies are summarized in the following figure:
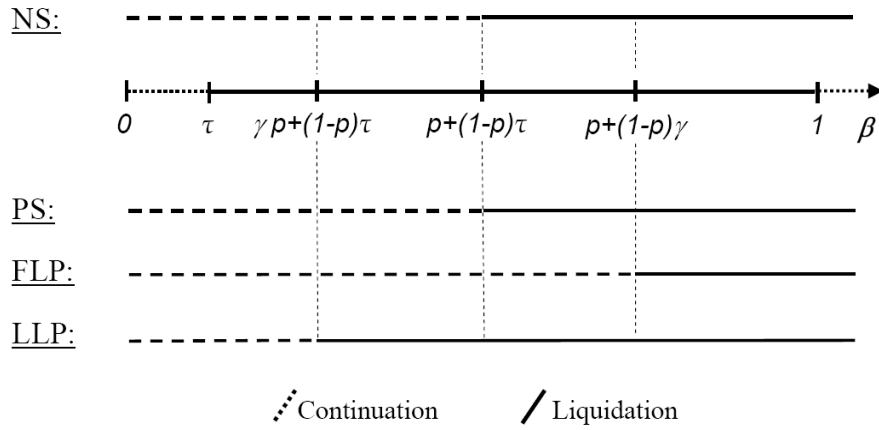
A1.2 Proof of Proposition 1.3: Optimal Monitoring Proportionate Sale (PS)

The date 1 optimization problem of the originator is given by

$$\max_{q} E\pi_{PS}^{t=1} = (1-\alpha)\left[qD + (1-q)D\max\{\beta; p + (1-p)\tau\}\right] - C(q),$$

yielding the following First Order Condition (FOC):[86]

$$\frac{\partial E\pi_{PS}^{t=1}}{\partial q} = \underbrace{[1 - \max\{\beta; p + (1-p)\tau\}](1-\alpha)D}_{MR_{PS}} - C'(q^{PS}) = 0.$$

---

[86]With $\frac{\partial^2 E\pi_{PS}^{t=1}}{\partial q^2} = -C''(q) < 0$, the second order condition (SOC) for a maximum is fulfilled.

Proportionate Sale (PS) vs. No Sale (NS). Comparing date 1 marginal revenues MR_{PS} with $MR_{NS} = [1 - \max\{\beta; p + (1-p)\tau\}] D$ yields

$$MR_{NS} - MR_{PS} = \underbrace{[1 - \max\{\beta; p + (1-p)\tau\}]}_{>0} \alpha D > 0.$$

As with $C'(q) > 0$ and $C''(q) > 0$, the cost function is monotonically increasing in q, it follows immediately that $q^{NS} > q^{PS}$.

A1.3 Proof of Proposition 1.4: Optimal Monitoring First Loss Provision (FLP)

The date 1 optimization problem of the originator is given by

$$\max_{q} E\pi_{FLP}^{t=1} = q(1-\gamma)D + (1-q)\max\left\{(\beta - \gamma); p(1-\gamma) + \underbrace{(1-p)0}_{\text{as } \tau < \gamma}\right\} D - C(q),$$

yielding the following FOC:[87]

$$\frac{\partial E\pi_{FLP}^{t=1}}{\partial q} = \underbrace{[(1-\gamma) - \max\{\beta - \gamma; p(1-\gamma)\}] D}_{MR_{FLP}} - C'(q^{FLP}) = 0,$$

which can be rearranged to the condition in Proposition 1.4.

First Loss Provision (FLP) vs. No Sale (NS). Comparing date 1 marginal revenues under NS and FLP yields

$$
\begin{aligned}
MR_{NS} - MR_{FLP} &= [1 - \max\{\beta; p + (1-p)\tau\}] D - [1 - \max\{\beta, p + (1-p)\gamma\}] D \\
&= \max\{0; \min\{\gamma(1-p) + p - \beta; (\gamma - \tau)(1-p)\}\} D,
\end{aligned}
$$

which is equivalent to

$$MR_{NS} - MR_{FLP} = \begin{cases} 0 & if \quad \beta \geq \widetilde{\beta}_{FLP}, \\ [p + (1-p)\gamma - \beta] D & if \quad \widetilde{\beta}_{NS} \leq \beta < \widetilde{\beta}_{FLP}, \\ (\gamma - \tau)(1-p)D & if \quad \beta < \widetilde{\beta}_{NS}, \end{cases}$$

with $\widetilde{\beta}_{NS} = p + (1-p)\tau$ and $\widetilde{\beta}_{FLP} = p + (1-p)\gamma$.

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[87]Again, with $\frac{\partial^2 E\pi_{FLP}^{t=1}}{\partial q^2} = -C''(q) < 0$, the SOC for a maximum is fulfilled.

For $\widetilde{\beta}_{NS} \leq \beta < \widetilde{\beta}_{FLP}$ it follows with $\beta < p + (1-p)\gamma$ that $D\left[p + (1-p)\gamma - \beta\right] > 0$.

Similarly, for $\beta < \widetilde{\beta}_{NS}$, with $\tau < \gamma$, it follows that $(\gamma - \tau)(1-p)D > 0$.

Hence, overall it follows that $MR_{NS} - MR_{FLP} \geq 0$ and, again, with $C'(q) > 0$ and $C''(q) > 0$, it follows that $q^{NS} \geq q^{FLP}$.

First Loss Provision (FLP) vs. Proportionate Sale (PS). Comparing date 1 marginal revenues under PS and FLP yields

$$MR_{PS} - MR_{FLP} = \begin{cases} -\alpha(1-\beta)D & if \quad \beta \geq \widetilde{\beta}_{FLP}, \\ \left[(1-\alpha)(1-\beta) - (1-\gamma)(1-p)\right]D & if \quad \widetilde{\beta}_{NS} \leq \beta < \widetilde{\beta}_{FLP}, \\ (1-p)\left[(1-\alpha)(1-\tau) - (1-\gamma)\right]D & if \quad \beta < \widetilde{\beta}_{NS}, \end{cases}$$

with $\widetilde{\beta}_{NS} = \widetilde{\beta}_{PS} = p + (1-p)\tau$ and $\widetilde{\beta}_{FLP} = p + (1-p)\gamma$.

For $\beta \geq \widetilde{\beta}_{FLP}$ it is straightforward that $MR_{PS} - MR_{FLP} < 0$.

For $\widetilde{\beta}_{NS} \leq \beta < \widetilde{\beta}_{FLP}$ we have to consider two different ranges: At the upper boundary, with $\beta = \widetilde{\beta}_{FLP}$, the difference in marginal revenues is given by $(MR_{PS} - MR_{FLP})\left. \right|_{\beta = \widetilde{\beta}_{FLP}} = \left\{(1-\alpha)\left[1-p-(1-p)\gamma\right] - (1-\gamma)(1-p)\right\}D = -\alpha(1-p)(1-\gamma)D < 0$.[88] At the lower boundary, with $\beta = \widetilde{\beta}_{NS}$, the difference in marginal revenues is given by $(MR_{PS} - MR_{FLP})\left. \right|_{\beta = \widetilde{\beta}_{NS}} = \left[(1-\alpha)(1-p)(1-\tau) - (1-\gamma)(1-p)\right]D$. The assumption $\tau < \min\left\{\alpha; \frac{\gamma-\alpha}{1-\alpha}; 2\gamma - 1\right\}$ implies that $\tau < \frac{\gamma-\alpha}{1-\alpha}$. With this condition it follows that $(1-\alpha)(1-p)(1-\tau) > (1-\gamma)(1-p)$ and hence $(MR_{PS} - MR_{FLP})\left. \right|_{\beta = \widetilde{\beta}_{NS}} > 0$. With $\frac{\partial(MR_{PS} - MR_{FLP})}{\partial\beta} = -(1-\alpha)D < 0$ for $\widetilde{\beta}_{NS} \leq \beta < \widetilde{\beta}_{FLP}$, it follows that there is a single interception point in this range, for which it holds that $MR_{PS} - MR_{FLP} = 0$. Solving this term for β gives the threshold value $\beta_{FLP/PS}$ in Proposition 1.4. It follows that $MR_{PS} - MR_{FLP} \leq 0$ for all β for which $\widetilde{\beta}_{NS} < \beta \leq \beta_{FLP/PS}$, and $MR_{PS} - MR_{FLP} > 0$ for all $\beta \in (\beta_{FLP/PS}; \widetilde{\beta}_{FLP}]$.

For $\beta < \widetilde{\beta}_{NS}$ with the assumption $\tau < \min\left\{\alpha; \frac{\gamma-\alpha}{1-\alpha}; 2\gamma - 1\right\}$, it follows that $(1-\alpha)(1-\tau)(1-p) > (1-\gamma)(1-p)$ and it unambiguously holds that $MR_{PS} - MR_{FLP} > 0$ for $\beta < \widetilde{\beta}_{NS}$.

Overall, with $C'(q) > 0$ and $C''(q) > 0$, it follows that $q^{PS} > q^{FLP}$ for $\beta < \beta_{FLP/PS}$, $q^{PS} = q^{FLP}$ for $\beta = \beta_{FLP/PS}$, and $q^{PS} < q^{FLP}$ for $\beta > \beta_{FLP/PS}$.

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[88] As there is no jump discontinuity, it suffices to consider the value at $\beta = \widetilde{\beta}_{FLP}$ without forming the limit.

A1.4 Proof of Proposition 1.5: Optimal Monitoring Last Loss Provision (LLP)

The date 1 optimization problem of the originator is given by

$$\max E\pi_{LLP}^{t=1} = q\gamma D + (1-q)D \max\left\{\min\left\{\beta;\gamma\right\}; p\gamma + (1-p)\tau\right\} - C(q),$$

yielding the following FOC:[89]

$$\frac{\partial E\pi_{LLP}^{t=1}}{\partial q} = \underbrace{\left[\gamma - \max\left\{\min\left\{\beta;\gamma\right\}; p\gamma + (1-p)\tau\right\}\right]D}_{MR_{LLP}} - C'(q^{LLP}) = 0.$$

The FOC can be rearranged to

$$\frac{\partial E\pi_{LLP}^{t=1}}{\partial q} = \begin{cases} 0 & if & \beta \geq \gamma, \\ (\gamma - \beta)D - C'(m^{LLP}) & if & \widetilde{\beta}_{LLP} \leq \beta < \gamma, \\ (\gamma - \tau)(1-p)D - C'(m^{LLP}) & if & \beta < \widetilde{\beta}_{LLP}, \end{cases}$$

with $\widetilde{\beta}_{LLP} = \gamma p + (1-p)\tau$.[90]

Last Loss Provision (LLP) vs. No Sale (NS). Comparing marginal revenues under LLP with NS yields

$MR_{NS} - MR_{LLP} =$
$= \left\langle \left[1 - \max\left\{\beta; p + (1-p)\tau\right\}\right] - \left[\gamma - \max\left\{\min\left\{\beta;\gamma\right\}; p\gamma + (1-p)\tau\right\}\right]\right\rangle D$

$$= \begin{cases} (1-\beta)D & if & \beta \geq \gamma \wedge \beta \geq \widetilde{\beta}_{NS}, \\ \left[1 - p - (1-p)\tau\right]D & if & \beta \geq \gamma \wedge \beta < \widetilde{\beta}_{NS}, \\ (1-\gamma)D & if & \widetilde{\beta}_{LLP} \leq \beta < \gamma \wedge \beta \geq \widetilde{\beta}_{NS}, \\ \left[1 - \gamma + \beta - p - (1-p)\tau\right]D & if & \widetilde{\beta}_{LLP} \leq \beta < \gamma \wedge \beta < \widetilde{\beta}_{NS}, \\ (1-\gamma)(1-p)D & if & \beta < \widetilde{\beta}_{LLP}, \end{cases}$$

with $\widetilde{\beta}_{NS} = p + (1-p)\tau$ and $\widetilde{\beta}_{LLP} = \gamma p + (1-p)\tau$.[91]

For $\beta \geq \gamma \wedge \beta \geq \widetilde{\beta}_{NS}$, and $\widetilde{\beta}_{LLP} \leq \beta < \gamma \wedge \beta \geq \widetilde{\beta}_{NS}$, and $\beta < \widetilde{\beta}_{LLP}$ it is straightforward that $MR_{NS} - MR_{LLP} > 0$.

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[89] Again, with $\frac{\partial^2 E\pi_{LLP}^{t=1}}{\partial q^2} = -C''(q) < 0$ the SOC for a maximum is fulfilled.

[90] Note that with $\tau < \gamma$ it follows that $\widetilde{\beta}_{LLP} = p\gamma + (1-p)\tau < \gamma$.

[91] Note that we have to differentiate five cases because $\gamma \leq p + (1-p)\tau$ or $\gamma > p + (1-p)\tau$ are both possible.

For $\beta > \gamma \wedge \beta < \widetilde{\beta}_{NS}$ it follows from the assumptions $\tau < 1$ and $p < 1$ that $(p + (1 - p)\tau) < 1$. Hence, it holds that $MR_{NS} - MR_{LLP} > 0$.

For $\widetilde{\beta}_{LLP} \leq \beta < \gamma \wedge \beta < \widetilde{\beta}_{NS}$ it follows from $\beta \geq \gamma p + (1 - p)\tau$ that $[1 - \gamma + \beta - p - (1 - p)\tau] \geq [1 - \gamma + \gamma p + (1 - p)\tau - p - (1 - p)\tau]$. The right-hand side can be simplified to $(1 - \gamma)(1 - p) > 0$. Hence, we can derive that $MR_{NS} - MR_{LLP} > 0$ also for this case.

Overall, $MR_{NS} - MR_{LLP} \geq 0$ holds $\forall \beta \in (\tau, 1)$ and with $C'(q) > 0$ and $C''(q) > 0$, it follows that $q^{NS} \geq q^{LLP} \; \forall \beta \in (\tau, 1)$.

Last Loss Provision (LLP) vs. Proportionate Sale (PS). Comparing marginal revenues under PS and LLP yields

$$MR_{PS} - MR_{LLP} = \begin{cases} [(1 - \alpha)(1 - \beta) - \max\{0, \gamma - \beta\}]\, D & if & \beta \geq \widetilde{\beta}_{NS}, \\ [(1 - \alpha)(1 - p)(1 - \tau) - \max\{0, \gamma - \beta\}]\, D & if & \widetilde{\beta}_{LLP} \leq \beta < \widetilde{\beta}_{NS}, \\ (1 - p)[(1 - \alpha)(1 - \tau) - (\gamma - \tau)]\, D & if & \beta < \widetilde{\beta}_{LLP}, \end{cases}$$

with $\widetilde{\beta}_{NS} = p + (1 - p)\tau$ and $\widetilde{\beta}_{LLP} = \gamma p + (1 - p)\tau$.

For $\beta \geq \widetilde{\beta}_{LLP}$ it is straightforward that whenever $\beta \leq \gamma$, it holds that $MR_{PS} - MR_{LLP} > 0$.

Consider $\alpha < 0.5$ first.

For $\alpha < 0.5$ it holds that $(1 - \gamma)(2\alpha - 1) < 0$ and hence $\frac{\gamma - (1 - \alpha)}{\alpha} < 2\gamma - 1 < \frac{\gamma - \alpha}{1 - \alpha}$.[92]

In this case, there are two possible ranges for τ. First, $\frac{\gamma - (1 - \alpha)}{\alpha} \leq \tau < 2\gamma - 1$. Secondly, $\tau < \frac{\gamma - (1 - \alpha)}{\alpha}$.

For $\frac{\gamma - (1 - \alpha)}{\alpha} \leq \tau < 2\gamma - 1$ the condition $\frac{\gamma - (1 - \alpha)}{\alpha} \leq \tau$ implies that $(1 - \alpha)(1 - \tau) - (\gamma - \tau) \geq 0$ and therefore $MR_{PS} - MR_{LLP} \geq 0$ for $\beta \leq \widetilde{\beta}_{LLP}$.[93] With $\frac{\partial MR_{PS}}{\partial \beta} =$

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[92]Note that, if $\tau < \frac{\gamma - (1 - \alpha)}{\alpha}$, marginal revenues are higher under LLP as compared to PS for $\beta < \widetilde{\beta}_{LLP}$. Similarly, if $\tau < 2\gamma - 1$, marginal revenues under LLP are higher than under FLP for $\beta < \widetilde{\beta}_{LLP}$. Finally, if $\tau < \frac{\gamma - \alpha}{1 - \alpha}$, marginal revenues under PS are higher than under FLP for $\beta < \widetilde{\beta}_{PS}$. Comparing these thresholds yields the above described ordering whenever $(1 - \gamma)(2\alpha - 1) < 0$.

[93]Note that with $\frac{\gamma - (1 - \alpha)}{\alpha} \leq \tau$ this is the only case in which the constraints on the parameter range for τ and β could be binding. However, comparing all conditions on τ shows that there exist parameter ranges for which a solution exists.

$$\begin{cases} -(1-\alpha)D & if \quad \beta \geq \widetilde{\beta}_{NS} \\ 0 & if \quad \beta < \widetilde{\beta}_{NS} \end{cases} \text{ and } \frac{\partial MR_{LLP}}{\partial \beta} = \begin{cases} 0 & if \quad \beta \geq \gamma \\ -D & if \quad \widetilde{\beta}_{LLP} \leq \beta < \gamma \\ 0 & if \quad \beta < \widetilde{\beta}_{LLP} \end{cases} \text{, it follows}$$

that for $\widetilde{\beta}_{LLP} < \beta < \gamma$ marginal revenues decrease in β for both structures (or are constant for PS if $\beta \leq \widetilde{\beta}_{NS}$) and with $\frac{\partial MR_{PS}}{\partial \beta} > \frac{\partial MR_{LLP}}{\partial \beta}$ the decrease is stronger for LLP. Hence, it follows that $MR_{PS} - MR_{LLP} > 0$ also for $\widetilde{\beta}_{LLP} < \beta < \gamma$. And finally, with $MR_{PS} - MR_{LLP} > 0$ for $\gamma \geq \beta$ it follows that LLP is dominated by PS, i.e. $MR_{PS} - MR_{LLP} \geq 0, \forall \beta \in (\tau, 1)$.

For $\tau < \frac{\gamma-(1-\alpha)}{\alpha}$ it follows that $MR_{PS} - MR_{LLP} < 0$ for $\beta \leq \widetilde{\beta}_{LLP}$. As at $\beta \geq \gamma$ it holds that $MR_{PS} - MR_{LLP} \geq 0$ and at $\beta = \widetilde{\beta}_{LLP}$ it holds that $MR_{PS} - MR_{LLP} \mid_{\beta=\widetilde{\beta}_{LLP}} < 0$ it follows with $\frac{\partial MR_{PS}}{\partial \beta} > \frac{\partial MR_{LLP}}{\partial \beta}$ for $\widetilde{\beta}_{LLP} < \beta < \gamma$ that there is one interception point in the range $(\widetilde{\beta}_{LLP}; \gamma)$. This threshold level is characterized by the condition $MR_{PS} - MR_{LLP} = 0$, which solving for β yields $\beta_{LLP/PS} = \max\left\{\frac{\gamma-(1-\alpha)}{\alpha}; \gamma - (1-\alpha)(1-p)(1-\tau)\right\}$. For $\beta < \beta_{LLP/PS}$ it follows that $MR_{PS} - MR_{LLP} < 0$ and for $\beta > \beta_{LLP/PS}$ it follows that $MR_{PS} - MR_{LLP} > 0$. Note that $\frac{\gamma-(1-\alpha)}{\alpha}$ is the threshold value if the intercept lies in the range $(\widetilde{\beta}_{LLP}; \widetilde{\beta}_{NS})$ and $\gamma - (1-\alpha)(1-p)(1-\tau)$ the threshold value if the intercept lies in the range $\beta > \widetilde{\beta}_{NS}$.

Consider $\alpha \geq 0.5$ next.

For $\alpha \geq 0.5$ it holds that $(1-\gamma)(2\alpha - 1) \geq 0$ and hence $\frac{\gamma-\alpha}{1-\alpha} \leq 2\gamma - 1 \leq \frac{\gamma-(1-\alpha)}{\alpha}$. As with $\tau < \frac{\gamma-\alpha}{1-\alpha}$ it always holds that $\tau < \frac{\gamma-(1-\alpha)}{\alpha}$, the same rationing as above applies and it follows that $MR_{PS} - MR_{LLP} < 0$ for $\beta < \widetilde{\beta}_{LLP/PS}$ and $MR_{PS} - MR_{LLP} = 0$ for $\beta = \widetilde{\beta}_{LLP/PS}$ and $MR_{PS} - MR_{LLP} > 0$ for $\beta > \widetilde{\beta}_{LLP/PS}$.

Overall, with $C'(q) > 0$ and $C''(q) > 0$, it follows that if $\alpha \geq 0.5$ or $\alpha < 0.5 \wedge \tau < \frac{\gamma-(1-\alpha)}{\alpha}$ the monitoring effort under LLP is higher (lower) than under PS, i.e. $q^{LLP} > (\leq) q^{PS}$, whenever $\beta < (\geq)\widetilde{\beta}_{LLP/PS}$. If however $\alpha < 0.5 \wedge \tau \geq \frac{\gamma-(1-\alpha)}{\alpha}$, the monitoring effort under LLP is always lower than under PS, i.e. $q^{LLP} < q^{PS} \forall \beta \in (\tau, 1)$.

Last Loss Provision (LLP) vs. First Loss Provision (FLP). Comparing marginal revenues under LLP with FLP yields

$$MR_{FLP} - MR_{LLP} = \begin{cases} (1-\beta)D & if \quad \beta \geq \widetilde{\beta}_{FLP}, \\ [(1-p)(1-\gamma) - \max\{0; \gamma - \beta\}]D & if \quad \widetilde{\beta}_{LLP} \leq \beta < \widetilde{\beta}_{FLP}, \\ (1-p)[(1-\gamma) - (\gamma - \tau)]D & if \quad \beta < \widetilde{\beta}_{LLP}, \end{cases}$$

with $\widetilde{\beta}_{FLP} = p + (1-p)\gamma$ and $\widetilde{\beta}_{LLP} = \gamma p + (1-p)\tau$.

For $\beta \geq \widetilde{\beta}_{FLP}$ it is straightforward that $MR_{FLP} - MR_{LLP} \geq 0$.

For $\widetilde{\beta}_{LLP} \leq \beta < \widetilde{\beta}_{FLP}$ we have to consider two possible ranges: At the upper boundary, with $\beta = \widetilde{\beta}_{FLP}$, it holds with $p + (1-p)\gamma = \gamma + (1-\gamma)p$ that $\gamma < \beta$ and hence the difference in marginal revenues is given by $(MR_{FLP} - MR_{LLP}) \mid_{\beta=\widetilde{\beta}_{FLP}} = (1-p)(1-\gamma)D > 0.$[94] At the lower boundary, with $\beta = \widetilde{\beta}_{LLP}$, the difference in marginal revenues is given by $(MR_{FLP} - MR_{LLP}) \mid_{\beta=\widetilde{\beta}_{LLP}} = [(1-p)(1-\gamma) - (1-p)(\gamma-\tau)]D$. With the assumption $\tau < \min\left\{\alpha; \frac{\gamma-\alpha}{1-\alpha}; 2\gamma-1\right\}$, it holds that $\tau < 2\gamma - 1$ and it follows immediately that $(MR_{FLP} - MR_{LLP}) \mid_{\beta=\widetilde{\beta}_{LLP}} < 0$. With $\frac{\partial(MR_{FLP}-MR_{LLP})}{\partial\beta} \geq 0$, it follows that there is a single interception point in this range for which it holds that $MR_{FLP} - MR_{LLP} = 0$. Solving the equation $(1-p)(1-\gamma) - \max\{0; \gamma-\beta\} = 0$ yields the threshold level $\widetilde{\beta}_{FLP/LLP} = \gamma - (1-p)(1-\gamma) = 2\gamma - 1 + p(1-\gamma)$, at which $MR_{FLP} - MR_{LLP} = 0.$[95] With the monotonicity of the marginal revenues it follows that $MR_{FLP} - MR_{LLP} \leq 0$ for all β, for which $\widetilde{\beta}_{LLP} < \beta \leq \beta_{FLP/LLP}$ and $MR_{FLP} - MR_{LLP} > 0$ for all β, for which $\beta_{FLP/LLP} < \beta \leq \widetilde{\beta}_{FLP}$.

Also for $\beta < \widetilde{\beta}_{LLP}$, with $\tau < 2\gamma - 1$, it follows immediately that $MR_{FLP} - MR_{LLP} < 0$.

Overall, with $C'(q) > 0$ and $C''(q) > 0$, it holds that $q^{LLP} > q^{FLP}$ for $\beta < \beta_{FLP/LLP}$, $q^{LLP} = q^{FLP}$ for $\beta = \beta_{FLP/LLP}$ and $q^{LLP} < q^{FLP}$ for $\beta > \beta_{FLP/LLP}$.

A1.5 Proof of Proposition 1.6: The Originator's Choice of the Resale Structure

Date Zero Expected Profits under PS

The originator's ex-ante expected profits are given by

$$E\pi_{PS}^{t=0} = \left[q^{PS} + (1-q^{PS})\max\{\beta; p+(1-p)\tau\}\right](1-\alpha)D - C(q^{PS}) +$$
$$+\underbrace{\frac{\left[q^{PS} + (1-q^{PS})\max\{\beta; p+(1-p)\tau\}\right]\alpha D}{(1+r_H)}}_{=I_{PS}}.$$

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[94] As there is no jump discontinuity for marginal revenues, it suffices to consider the value at $\beta = \widetilde{\beta}_{FLP} = p + (1-p)\gamma$ without forming the limit.

[95] Note that the intersection point between FLP and LLP will lie in a parameter range with $\gamma > \beta$, as the marginal revenue under LLP is equal to zero $\forall\beta$ with $\beta > \gamma$ but for FLP equals to zero only for $\beta = 1$.

This can be rearranged to

$$E\pi_{PS}^{t=0} = (\tfrac{1+(1-\alpha)r_H}{1+r_H}) \left[q^{PS} + (1-q^{PS})\max\{\beta; p + (1-p)\tau\}\right] D - C(q^{PS})$$

$$= \widetilde{D}^{PS} - C(q^{PS}) - \tfrac{\alpha r_H}{1+r_H}\widetilde{D}^{PS},$$

with $\widetilde{D}^{PS} = \left[q^{PS} + (1-q^{PS})\max\{\beta; p + (1-p)\tau\}\right] D$.

Date Zero Expected Profits under FLP

In the following we consider the two parameter ranges $\beta \geq \widetilde{\beta}_{FLP} = (1-p)\gamma + p$ and $\beta < \widetilde{\beta}_{FLP}$ separately.

1) $\beta \geq \widetilde{\beta}_{FLP}$

If $\beta \geq \widetilde{\beta}_{FLP}$, the originator liquidates a non-performing loan in t=2. Expected profits for the investor are given by

$$E\pi_{FLP}^{I} = q^{FLP}\gamma D + (1-q^{FLP})\gamma D - I_{FLP}$$

As the originator makes a 'take it or leave it offer' it holds that $\gamma D - I_{FLP} \overset{!}{=} (1 + r_L)I_{FLP} - I_{FLP}$. Solving for I_{FLP} yields

$$I_{FLP} = \tfrac{\gamma D}{(1+r_L)}.$$

Therefore, ex-ante expected profits for the originator are given by

$$E\pi_{FLP}^{t=0} = (1-\gamma)q^{FLP}D + (1-q^{FLP})(\beta-\gamma)D - C(q^{FLP}) + \tfrac{\gamma D}{(1+r_L)} =$$

$$= \left[q^{FLP} + (1-q^{FLP})\beta\right] D - C(q^{FLP}) - \tfrac{r_L\gamma D}{(1+r_L)}.$$

2) $\beta < \widetilde{\beta}_{FLP}$

If $\beta < \widetilde{\beta}_{FLP}$, the originator continues a non-performing loan. Expected profits for the investor are given by

$$E\pi_{FLP}^{I} = q^{FLP}\gamma D + (1-q^{FLP})\left[p\gamma + (1-p)\tau\right] D - I_{FLP}.$$

Again, as the originator makes a "take it or leave it" offer, resulting in

$$I_{FLP} = \tfrac{\left\{\left[q^{FLP}+p(1-q^{FLP})\right]\gamma+(1-q^{FLP})(1-p)\tau\right\}D}{(1+r_L)}.$$

Therefore, ex-ante expected profits for the originator are given by

$$E\pi_{FLP}^{t=0} = q^{FLP}(1-\gamma)D + (1-q^{FLP})p(1-\gamma)D - C(q^{FLP}) + \tfrac{\gamma D\left[q^{FLP}+p(1-q^{FLP})\right]+\tau D(1-p)(1-q^{FLP})}{(1+r_L)}$$

$$= (\tfrac{1+r_L(1-\gamma)}{(1+r_L)}) \left[q^{FLP} + p(1-q^{FLP})\right] D + \tfrac{(1-q^{FLP})(1-p)\tau D}{(1+r_L)} - C(q^{FLP}) =$$

$$= \left[q^{FLP} + (1 - q^{FLP})(p + (1-p)\tau)\right] D - C(q^{FLP}) - \frac{r_L\left\{\left[q^{FLP} + p(1-q^{FLP})\right]\gamma + (1-q^{FLP})(1-p)\tau\right\}D}{(1+r_L)}.$$

Comparison of Expected Profits

By setting $r_L = 0$, I obtain the following term for the originator's ex-ante profits under FLP:

$$E\pi_{FLP}^{t=0} = \begin{cases} \left[q^{FLP} + (1 - q^{FLP})\beta\right] D - C(q^{FLP}) & if \quad \beta \geq \widetilde{\beta}_{FLP}, \\ \left[q^{FLP} + (1 - q^{FLP})(p + (1-p)\tau)\right] D - C(q^{FLP}) & if \quad \beta < \widetilde{\beta}_{FLP}, \end{cases}$$

with $\widetilde{\beta}_{FLP} = p + (1-p)\gamma$.

The originator chooses the resale structure that gives him higher expected profits. The difference in expected profits under PS and FLP is given by

$$E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} = \begin{cases} \left[\frac{1+(1-\alpha)r_H}{1+r_H}\right] \widetilde{D}_L^{PS} - C(q^{PS}) - \widetilde{D}_L^{FLP} + C(q^{FLP}) & if \quad \beta \geq \widetilde{\beta}_{FLP}, \\ \left[\frac{1+(1-\alpha)r_H}{1+r_H}\right] \widetilde{D}_L^{PS} - C(q^{PS}) - \widetilde{D}_C^{FLP} + C(q^{FLP}) & if \quad \widetilde{\beta}_{NS} \leq \beta < \widetilde{\beta}_{FLP}, \\ \left[\frac{1+(1-\alpha)r_H}{1+r_H}\right] \widetilde{D}_C^{PS} - C(q^{PS}) - \widetilde{D}_C^{FLP} + C(q^{FLP}) & if \quad \beta < \widetilde{\beta}_{NS}, \end{cases}$$

with $\widetilde{\beta}_{FLP} = p + (1-p)\gamma$ and $\widetilde{\beta}_{NS} = p + (1-p)\tau$,

$\widetilde{D}_L^{PS} = \left[q^{PS} + (1 - q^{PS})\beta\right] D$ and $\widetilde{D}_C^{PS} = \left[q^{PS} + (1 - q^{PS})(p + (1-p)\tau)\right] D$,

$\widetilde{D}_L^{FLP} = \left[q^{FLP} + (1 - q^{FLP})\beta\right] D$, and $\widetilde{D}_C^{FLP} = \left[q^{FLP} + (1 - q^{FLP})(p + (1-p)\tau)\right] D$.

First, consider $\beta \geq \widetilde{\beta}_{FLP}$.

For this range I want to show that $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} < 0$, irrespectively of r_H.

Since with $1 - \alpha < 1$ it holds that $\frac{1+(1-\alpha)r_H}{1+r_H} < 1$, it follows that $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} < 0$ whenever $\widetilde{D}_L^{PS} - C(q^{PS}) - \widetilde{D}_L^{FLP} + C(q^{FLP}) < 0$.[96]

From the analysis of the optimal monitoring level in t=1 we know that for this range $q^{FLP} > q^{PS}$. Even though it is straightforward with $q^{FLP} > q^{PS}$ that $\widetilde{D}_L^{FLP} > \widetilde{D}_L^{PS}$, we still have to show that this effect is not overcompensated by the higher costs of monitoring under FLP: For a given β, we obtain the following derivatives $\frac{\partial\left[\widetilde{D}_C^{FLP} - C(q^{FLP})\right]}{\partial q} = (1-\beta)D - C'(q^{FLP})$ and $\frac{\partial\left[\widetilde{D}_C^{PS} - C(q^{PS})\right]}{\partial q} = (1-\beta)D - C'(q^{PS})$.

As $(1-\beta)D - C'(q^{FLP})$ is exactly the originator's FOC under FLP at date 1, it follows that $(1-\beta)D - C'(q^{FLP}) = 0$ and date zero expected profits cannot be further increased at the monitoring level q^{FLP}. With a convex cost function, i.e. $C''(q) > 0$,

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[96]Note that $\widetilde{D}_L^{FLP} - C(q^{FLP}) = E\pi_{FLP}^{t=0}$ for $r_L = 0$ and $\widetilde{D}_L^{PS} - C(q^{PS}) = E\pi_{PS}^{t=0}$ for $r_H = 0$.

and $q^{FLP} > q^{PS}$ it follows that $C'(q^{FLP}) > C'(q^{PS})$ and therefore $\frac{\partial\left[\widetilde{D}_C^{PS} - C(q^{PS})\right]}{\partial q} > 0$. As $\widetilde{D}_L^{PS} - C(q^{PS})$ and $\widetilde{D}_L^{FLP} - C(q^{FLP})$ have the same cost function and are structurally identical, $\frac{\partial\left[\widetilde{D}_C^{PS} - C(q^{PS})\right]}{\partial q} > 0$ implies that $\widetilde{D}_L^{PS} - C(q^{PS}) < \widetilde{D}_L^{FLP} - C(q^{FLP})$ and a fortiori $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} < 0$ for $\beta \geq \widetilde{\beta}_{FLP}$.

Next, consider the parameter range $\beta < \widetilde{\beta}_{NS}$.
For this range I want to show that $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} > 0$ whenever $r_H < \overline{r}$ and $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} \leq 0$ whenever $r_H \geq \overline{r}$.

We know from the analysis of the optimal monitoring intensity that $q^{NS} > q^{PS} > q^{FLP}$. Given the derivatives $\frac{\partial\left[\widetilde{D}_C^{FLP} - C(q^{FLP})\right]}{\partial q} = \{1 - [p + (1-p)\tau]\} D - C'(q^{FLP})$ and $\frac{\partial\left[\widetilde{D}_C^{PS} - C(q^{PS})\right]}{\partial q} = \{1 - [p + (1-p)\tau]\} D - C'(q^{PS})$ and a convex cost function with $C''(q) > 0$, it follows with $\{1 - [p + (1-p)\tau]\} D - C'(q) = 0$ at q^{NS} that $\frac{\partial\left[\widetilde{D}_C^{FLP} - C(q^{FLP})\right]}{\partial q} > \frac{\partial\left[\widetilde{D}_C^{PS} - C(q^{PS})\right]}{\partial q} > 0$. As $\widetilde{D}_L^{PS} - C(q^{PS})$ and $\widetilde{D}_L^{FLP} - C(q^{FLP})$ have the same cost function and are structurally identical, this implies $\widetilde{D}_L^{PS} - C(q^{PS}) - \widetilde{D}_L^{FLP} + C(q^{FLP}) > 0$. Hence, if $r_H = 0$, it would follow that $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} > 0$. However, for $r_H > 0$ as $E\pi_{PS}^{t=0} = \left[\frac{1+(1-\alpha)r_H}{1+r_H}\right] \widetilde{D}_C^{PS} - C(q^{PS})$ with $\left[\frac{1+(1-\alpha)r_H}{1+r_H}\right] < 1$, it can still be that $E\pi_{PS}^{t=0} < E\pi_{FLP}^{t=0}$. More specifically, this is the case whenever $\left[\frac{1+(1-\alpha)r_H}{1+r_H}\right] \widetilde{D}_C^{PS} - C(q^{PS}) - \widetilde{D}_C^{FLP} + C(q^{FLP}) < 0$. Solving for r_H yields the threshold value $\overline{r}$.

Hence, with $\frac{\partial\left[\frac{1+(1-\alpha)r}{1+r}\right]}{\partial r} = -\frac{\alpha}{(1+r)^2} < 0$, it holds that $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} \leq 0$ for $r_H \geq \overline{r}$ and for $r_H < \overline{r}$ it holds that $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} > 0$ in the range $\beta < \widetilde{\beta}_{NS}$.

Finally, I consider the parameter range $\widetilde{\beta}_{NS} \leq \beta < \widetilde{\beta}_{FLP}$.
For this range I want to show that for $r_H \geq \overline{\overline{r}}$ it follows that $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} \leq 0$. Furthermore, I want to show that for $\overline{r} \leq r_H < \overline{\overline{r}}$ it follows that $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} < 0$ for $\beta < \overline{\beta}$ and $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} \geq 0$ for $\overline{\beta} \leq \beta < \widetilde{\beta}_{FLP}$.[97]
For this parameter range the originator chooses liquidation under PS and continuation under FLP. With continuation under FLP, it follows immediately $\frac{\partial E\pi_{FLP}^{t=0}}{\partial \beta} = 0$. Let us first assume that $\frac{\partial E\pi_{PS}^{t=0}}{\partial \beta} > 0$ for this range. The threshold value $\overline{\overline{r}}$ is derived by setting the difference in expected profits equal to zero at the upper limit $\widetilde{\beta}_{FLP}$, i.e. $\left[\frac{1+(1-\alpha)\overline{\overline{r}}}{1+\overline{\overline{r}}}\right]\left[q^{PS} + (1-q^{PS})\widetilde{\beta}_{FLP}\right] D - C(q^{PS}) - \widetilde{D}_C^{FLP} + C(q^{FLP}) = 0$, and solving for $\overline{\overline{r}}$. With $\frac{\partial E\pi_{PS}^{t=0}}{\partial \beta} > 0$ and $\frac{\partial E\pi_{FLP}^{t=0}}{\partial \beta} = 0$ and $\frac{\partial\left[\frac{1+(1-\alpha)r}{1+r}\right]}{\partial r} = -\frac{\alpha}{(1+r)^2} < 0$ it follows immediately

---

[97]Note that with $D\left[q^{PS} + (1-q^{PS})(p + (1-p)\gamma)\right] > D\left[q^{PS} + (1-q^{PS})(p + (1-p)\tau)\right]$ and $(1-\alpha) < 1$ it follows immediately that $\overline{\overline{r}} > \overline{r}$.

that if $r_H > \overline{\overline{r}}$, it can never hold that $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} \geq 0$ in the range $\widetilde{\beta}_{NS} \leq \beta < \widetilde{\beta}_{FLP}$. However, if $\overline{r} \leq r_H < \overline{\overline{r}}$ it follows from $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} < 0$ for $\beta = \widetilde{\beta}_{NS}$ and $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} \geq 0$ if β approaches $\widetilde{\beta}_{FLP}$, with $\frac{\partial(E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0})}{\partial\beta} > 0$ that there is one interception point at which $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} = 0$. This interception point $\overline{\beta}$ is characterized by the following equation: $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} = \left[\frac{1+(1-\alpha)r_H}{1+r_H}\right]\left[q^{PS} + (1 - q^{PS})\overline{\beta}\right]D - C(q^{PS}) - \left\{q^{FLP} + (1 - q^{FLP})\left[p + (1-p)\tau\right]\right\}D + C(q^{FLP}) = 0$.

With $\frac{\partial(E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0})}{\partial\beta} > 0$, it follows immediately that $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} \geq 0$ for $\overline{\beta} \leq \beta < \widetilde{\beta}_{FLP}$ and $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} < 0$ for $\beta < \overline{\beta}$.

I still have to show that $\frac{\partial E\pi_{PS}^{t=0}}{\partial\beta} > 0$ for $\beta < \widetilde{\beta}_{FLP}$.

The derivative of $E\pi_{PS}^{t=0} = \left[\frac{1+(1-\alpha)r_H}{1+r_H}\right]\widetilde{D}_L^{PS} - C(q^{PS})$ with respect to β is given by:

$\frac{\partial E\pi_{PS}^{t=0}}{\partial\beta} = \left[\frac{1+(1-\alpha)r_H}{1+r_H}\right](1 - q^{PS})D + \frac{\partial q^{PS}}{\partial\beta}\left\{\left[\frac{1+(1-\alpha)r_H}{1+r_H}\right](1-\beta)D - C'(q^{PS})\right\}.$

$\frac{\partial q^{PS}}{\partial\beta}$ can be derived from the monitoring FOC for PS by using the implicit function theorem and is given by $\frac{\partial q^{PS}}{\partial\beta} = -\frac{(1-\alpha)D}{C''(q^{PS})}$. Plugging the expression into the derivative of the expected profit function yields

$\frac{\partial E\pi_{PS}^{t=0}}{\partial\beta} = \left[\frac{1+(1-\alpha)r_H}{1+r_H}\right]\left[(1 - q^{PS})D - \frac{(1-\alpha)D}{C''(q^{PS})}(1-\beta)D\right] + \frac{(1-\alpha)D}{C''(q^{PS})}C'(q^{PS}).$

With $\left[\frac{1+(1-\alpha)r_H}{1+r_H}\right] < 1$ it holds that

$\left[\frac{1+(1-\alpha)r_H}{1+r_H}\right]\left[(1 - q^{PS})D - \frac{(1-\alpha)D}{C''(q^{PS})}(1-\beta)D\right] + \frac{(1-\alpha)D}{C''(q^{PS})}C'(q^{PS}) >$

$\left[\frac{1+(1-\alpha)r_H}{1+r_H}\right]\left\{(1 - q^{PS})D - \frac{(1-\alpha)D}{C''(q^{PS})}\left[(1-\beta)D - C'(q^{PS})\right]\right\}.$

With the assumption $\frac{C''(q^{PS})}{C'(q^{PS})} > \frac{\alpha}{(1-q^{PS})}$ for $\beta \geq p + (1-p)\tau$ it follows that

$(1 - q^{PS})D - \frac{D}{C''(q^{PS})}\underbrace{\left[(1-\alpha)(1-\beta)D - C'(q^{PS})\right]}_{=0,\text{ as is FOC of PS}} - \frac{\alpha D}{C''(q^{PS})}C'(q^{PS}) > 0.$

Note that the LHS of the equation can be rearranged to

$(1 - q^{PS})D - \frac{(1-\alpha)D}{C''(q^{PS})}\left[(1-\beta)D - C'(q^{PS})\right].$

As $(1 - q^{PS})D - \frac{(1-\alpha)D}{C''(q^{PS})}\left[(1-\beta)D - C'(q^{PS})\right] > 0$, it follows a fortiori

$\left[\frac{1+(1-\alpha)r_H}{1+r_H}\right]\left[(1 - q^{PS})D - \frac{(1-\alpha)D}{C''(q^{PS})}(1-\beta)D\right] + \frac{(1-\alpha)D}{C''(q^{PS})}C'(q^{PS}) > 0.$

Considering Explicit Cost Functions

Note that the assumption $\frac{C''(q^{PS})}{C'(q^{PS})} > \frac{\alpha}{(1-q^{PS})}$ is only made, because I could not show with an implicit cost function that $\frac{\partial E\pi_{PS}^{t=0}}{\partial \beta} > 0$. In the following, I illustrate for two different explicit cost functions that the assumption is not needed.

1) Cost function $C(q) = \frac{q}{1-q}$

With $C'(q) = \frac{1}{(1-q)^2} > 0$ and $C''(q) = \frac{2}{(1-q)^3} > 0$.

Even though $C'(0) = 0$ does not hold for this cost function, I ensure the existence of an inner solution by setting $(1-\alpha)(1-\beta)D > 1$.

The FOC for the optimal monitoring effort under PS for liquidation, i.e. $\beta \geq \widetilde{\beta}_{NS}$, is given by

$$\frac{\partial E\pi_{PS}^{t=1}}{\partial q} = (1-\alpha)(1-\beta)D - \frac{1}{(1-q^{PS})^2} = 0.$$

Solving for q^{PS} yields, with $q^{PS} \leq 1$,

$$q^{PS} = 1 - \sqrt{\frac{1}{(1-\alpha)(1-\beta)D}}.$$

As shown above, $\frac{\partial E\pi_{PS}^{t=0}}{\partial \beta} > 0$, whenever $(1-q^{PS})D - \frac{(1-\alpha)D}{C''(q^{PS})}\left[(1-\beta)D - C'(q^{PS})\right] > 0$.

Hence, I have to show that $(1-q^{PS})D - \frac{(1-\alpha)D}{\frac{2}{(1-q^{PS})^3}}\left[(1-\beta)D - \frac{1}{(1-q^{PS})^2}\right] > 0$,

which is fulfilled, if $\left[1 - \frac{(1-\alpha)}{2}\left((1-q^{PS})^2(1-\beta)D - 1\right)\right] > 0$.

Plugging in $q^{PS} = 1 - \sqrt{\frac{1}{(1-\alpha)(1-\beta)D}}$ and simplifying yields $1 + \frac{(1-\alpha)}{2} - \frac{1}{2} > 0$,

which with $\alpha < 1$ is always satisfied.

2) Quadratic cost function $C(q) = \frac{q^2}{2}$

With $C'(q) = q > 0$ and $C''(q) = 1 > 0$.

Even though $\lim_{q \longrightarrow 1} C(q) = \infty$ does not hold, I ensure the existence of an inner solution by setting $D = 1$.

The optimal monitoring effort q^{PS} under liquidation is given by

$$q^{PS} = (1-\alpha)(1-\beta).$$

As shown above, $\frac{\partial E\pi_{PS}^{t=0}}{\partial \beta} > 0$, whenever $(1-q^{PS})D - \frac{(1-\alpha)D}{C''(q^{PS})}\left[(1-\beta)D - C'(q^{PS})\right] > 0$.

Hence, it has to hold that $[1 - (1-\alpha)(1-\beta)] - (1-\alpha)\left[(1-\beta) - (1-\alpha)(1-\beta)\right] > 0$.

After some simplifications, I obtain $\beta + \alpha^2(1-\beta) > 0$, which with β, $\alpha < 1$ is always satisfied.

A1.6 Proof of Proposition 1.7: The Efficient Resale Structure

The difference in ex-ante total project values under FLP and PS is given by

$$
EV_{PS}^{t=0} - EV_{FLP}^{t=0} = \begin{cases} \widetilde{D}_L^{PS} - C(q^{PS}) - \widetilde{D}_L^{FLP} + C(q^{FLP}) & if & \beta \geq \widetilde{\beta}_{FLP}, \\ \widetilde{D}_L^{PS} - C(q^{PS}) - \widetilde{D}_C^{FLP} + C(q^{FLP}) & if & \widetilde{\beta}_{NS} \leq \beta < \widetilde{\beta}_{FLP}, \\ \widetilde{D}_C^{PS} - C(q^{PS}) - \widetilde{D}_C^{FLP} + C(q^{FLP}) & if & \beta < \widetilde{\beta}_{NS}, \end{cases}
$$

with $\widetilde{\beta}_{FLP} = p + (1-p)\gamma$ and $\widetilde{\beta}_{PS} = p + (1-p)\tau$

$\widetilde{D}_L^{PS} = \left[q^{PS} + (1-q^{PS})\beta \right] D$ and $\widetilde{D}_C^{PS} = \left[q^{PS} + (1-q^{PS})(p + (1-p)\tau) \right] D$,

$\widetilde{D}_L^{FLP} = \left[q^{FLP} + (1-q^{FLP})\beta \right] D$, and $\widetilde{D}_C^{FLP} = \left[q^{FLP} + (1-q^{FLP})(p + (1-p)\tau) \right] D$

For $\beta \geq \widetilde{\beta}_{FLP}$ it holds that $EV_{PS}^{t=0} - EV_{FLP}^{t=0} < 0$. The proof goes as in the proof of Proposition 1.6 on page 102.

For $\beta < \widetilde{\beta}_{NS}$ it holds that $EV_{PS}^{t=0} - EV_{FLP}^{t=0} > 0$. Again, the proof goes as in the proof of Proposition 1.6 on page 103.

For $\widetilde{\beta}_{NS} \leq \beta < \widetilde{\beta}_{FLP}$ it holds that $EV_{PS}^{t=0} - EV_{FLP}^{t=0} \mid_{\widetilde{\beta}_{NS}} > 0$ (argumentation as for the case $\beta < \widetilde{\beta}_{NS}$). With $\frac{\partial EV_{PS}^{t=0}}{\partial \beta} = (1-q^{PS})D - \frac{(1-\alpha)D}{C''(q^{PS})} \left[(1-\beta)D + C'(q^{PS}) \right]$, it follows immediately with the assumption $\frac{C''(q^{PS})}{C'(q^{PS})} > \frac{\alpha}{(1-q^{PS})}$ that $\frac{\partial EV_{PS}^{t=0}}{\partial \beta} > 0$.[98]

Together with $\frac{\partial EV_{FLP}^{t=0}}{\partial \beta} = 0$ this implies that $EV_{PS}^{t=0} - EV_{FLP}^{t=0} > 0$ also for the whole range $\widetilde{\beta}_{NS} \leq \beta < \widetilde{\beta}_{FLP}$.

A1.7 Proof of Proposition 1.8: Comparative Statics w.r.t. γ for Incentives

Consider the liquidation decision first.

With $\frac{\partial \widetilde{\beta}_{NS}}{\partial \gamma} = 0$ and $\frac{\partial \widetilde{\beta}_{FLP}}{\partial \gamma} = 1 - p > 0$, it follows immediately that the threshold value for efficient liquidation $\widetilde{\beta}_{NS}$ is not affected, however the threshold value for liquidation under FLP $\widetilde{\beta}_{FLP}$ increases. Therefore, the range $\left[\widetilde{\beta}_{NS}; \widetilde{\beta}_{FLP} \right)$ for inefficient continuation under FLP increases.

---

[98]Again, this assumption is only needed for keeping the implicit form of the cost function. For explicit cost functions I have shown above that $D(1-q^{PS}) - \frac{(1-\alpha)D}{C''(q^{PS})}(D(1-\beta) + C'(q^{PS})) > 0$, which is $\frac{\partial EV_{PS}^{t=0}}{\partial \beta} > 0$.

Consider the monitoring decision next.

With the implicit function theorem, I obtain the following derivatives: $\frac{\partial q^{FLP}}{\partial \gamma} = 0$ for the range $\beta \geq \widetilde{\beta}_{FLP} = p + (1-p)\gamma$; and $\frac{\partial q^{FLP}}{\partial \gamma} = -\frac{(1-p)D}{C''(q^{FLP})} < 0$ for the range $\beta < \widetilde{\beta}_{FLP} = p + (1-p)\gamma$. Hence, the monitoring effort equals the efficient monitoring level and is not affected under FLP as long as $\beta \geq \widetilde{\beta}_{FLP}$. For $\beta < \widetilde{\beta}_{FLP}$ the inefficiently low monitoring effort is further reduced by an increase in γ. Furthermore, with $\frac{\partial \widetilde{\beta}_{FLP}}{\partial \gamma} > 0$, also the range for inefficient monitoring under FLP is increased.

A1.8 Proof of Proposition 1.9: Comparative Statics w.r.t. γ for Efficience of Resale Choice

Note that in the following all parameters and thresholds with a dash indicate the values after an increase in γ to γ'. E.g. $\widetilde{\beta}_{FLP}$ is the initial threshold level for liquidation under FLP and $\widetilde{\beta}'_{FLP}$ the threshold after the increase in γ.

First, consider the derivative of the expected profits function $E\pi_{FLP}^{t=0}$ (which equals $EV_{FLP}^{t=0}$) under FLP with respect to γ :

For $\beta \geq \widetilde{\beta}_{FLP}$ it is given by $\frac{\partial E\pi_{FLP}^{t=0}}{\partial \gamma} = \underbrace{\left[(1-\beta)D - C'(q^{FLP}) \right]}_{=0} \underbrace{\frac{\partial q^{FLP}}{\partial \gamma}}_{=0} = 0.$

For $\beta < \widetilde{\beta}_{FLP}$ it is given by
$$\frac{\partial E\pi_{FLP}^{t=0}}{\partial \gamma} = \underbrace{\left\{ [1 - (p + (1-p)\tau)] D - C'(q^{FLP}) \right\}}_{>0,\ \text{as}\ (1-p)(1-\tau)D > (1-p)(1-\gamma)D = C'(q^{FLP})} \underbrace{\frac{\partial q^{FLP}}{\partial \gamma}}_{<0} < 0.$$

With respect to the efficient (second best) choice of the resale structure for $\beta \geq \widetilde{\beta}'_{FLP}$ it follows that $EV_{PS}^{t=0} - EV_{FLP}^{t=0} \leq 0$ and for $\beta < \widetilde{\beta}'_{FLP}$ it follows that $EV_{PS}^{t=0} - EV_{FLP}^{t=0} > 0$.

Consider the originator's choice of the resale structure as compared to the efficient structure next.

Independent of r_H it still holds for $\beta \geq \widetilde{\beta}'_{FLP}$ with $\frac{\partial E\pi_{FLP}^{t=0}}{\partial \gamma} = 0$ and $\frac{\partial E\pi_{PS}^{t=0}}{\partial \gamma} = 0$ that $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} < 0$ is fulfilled (and the choice of FLP over PS is still efficient).

<u>1) $r_H \leq \bar{r}$</u>

For $\beta < \widetilde{\beta}_{FLP}$, with $\frac{\partial E\pi_{FLP}^{t=0}}{\partial \gamma} < 0$ and $\frac{\partial E\pi_{PS}^{t=0}}{\partial \gamma} = 0$, it follows immediately that $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} > 0$ is a fortiori fulfilled (and the choice of PS over FLP still efficient).

For $\widetilde{\beta}_{FLP} \le \beta < \widetilde{\beta}'_{FLP}$ the originator efficiently chose FLP before the increase in γ and efficiently chooses PS after the increase in γ.

2) $\overline{r} < r_H \le \overline{\overline{r}}$

For $\beta < \widetilde{\beta}_{FLP}$ with $\frac{\partial E\pi_{FLP}^{t=0}}{\partial \gamma} < 0$ and $\frac{\partial E\pi_{PS}^{t=0}}{\partial \gamma} = 0$, it follows immediately that $\frac{\partial \overline{\beta}}{\partial \gamma} < 0$ (and the choice of PS over FLP is still efficient for this whole range). Hence, the range for which FLP is inefficiently chosen is reduced. Note that if $\overline{\beta}$ is reduced so much that $\overline{\beta}' < \widetilde{\beta}_{NS}$ it follows that $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} > 0$ for the whole range, as the domain for $\overline{\beta}$ is given by $\left[\widetilde{\beta}_{NS}; \widetilde{\beta}_{FLP}\right)$ and we switch to the case $r_H < \overline{r}'$.

For $\widetilde{\beta}_{FLP} \le \beta < \widetilde{\beta}'_{FLP}$ the originator efficiently chose FLP before the increase in γ and efficiently chooses PS after the increase in γ. Therefore the shift in $\widetilde{\beta}_{FLP}$ does not have any effect on the efficiency of the originator's resale choice.

3) $r_H > \overline{\overline{r}}$

With $r_H > \overline{\overline{r}}$, it follows that $E\pi_{PS}^{t=0} - E\pi_{FLP}^{t=0} > 0$ for the whole range and the potential interception point $\overline{\beta}$ lies outside the domain $\left[\widetilde{\beta}_{NS}; \widetilde{\beta}_{FLP}\right)$ at $\overline{\beta} \ge \widetilde{\beta}_{FLP}$. With $\frac{\partial \widetilde{\beta}_{FLP}}{\partial \gamma} > 0$, and $\overline{\beta} \ge \widetilde{\beta}_{FLP}$ an increase in γ initially leads to an increase of the range for which FLP is inefficiently chosen. Then, with $\frac{\partial \overline{\beta}}{\partial \gamma} < 0$, as soon as $\overline{\beta}' < \widetilde{\beta}'_{FLP}$ a further increase in γ begins to reduce the range for which FLP is inefficiently chosen.[99] Only if the increase in γ is so strong that $\overline{\beta}' < \widetilde{\beta}_{FLP}$, it will reduce the range for which FLP is inefficiently chosen as compared to the situation before the change. Note further that we switch to the case $r_H < \overline{\overline{r}}'$. If the increase in γ is even larger, it follows that we switch to the case $r_H < \overline{r}'$ and with $\overline{\beta}' < \widetilde{\beta}_{NS}$ the originator never inefficiently chooses FLP over PS.

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[99] As for $\overline{\beta}' \le \beta < \widetilde{\beta}_{FLP}$ the originator efficiently chooses PS a further increase in $\widetilde{\beta}_{FLP}$ does not affect the efficiency of the originator's choice.

Appendix to Chapter 2

A2.1 Derivation of Expected Profits

First, expected profits of the MNC depending on the interest rate required by external investors for the different borrowing structures are given by

$$
\begin{aligned}
E\pi(dd) &= q_A^{dd}(X - R_A^{dd}D + F) + q_B(X - R_B^{dd}D + F) + (1 - q_A^{dd})(1 - p)\alpha F \\
&\quad + (1 - q_B)(1 - p)\alpha F, \\
E\pi(dc) &= q_A^{dc}q_B(2X - R_A^{dc}D - R_B^{dc}D + 2F) + q_A^{dc}(1 - q_B)(X - R_A^{dc}D - R_B^{dc}D + 2F) \\
&\quad + (1 - q_A^{dc})q_B(X - R_B^{dc}D + F + (1 - p)\alpha F) \\
&\quad + (1 - q_A^{dc})(1 - q_B)\left[(1 - p)\alpha F + (1 - p)\alpha F\right], \\
E\pi(cd) &= q_A^{cd}q_B(2X - R_A^{cd}D - R_B^{cd}D + 2F) + q_B(1 - q_A^{cd})(X - R_A^{cd}D - R_B^{cd}D + 2F) \\
&\quad + (1 - q_B)q_A^{cd}\left[X - R_A^{cd}D + F + (1 - p)\alpha F\right] \\
&\quad + (1 - q_A^{cd})(1 - q_B)\left[(1 - p)\alpha F + (1 - p)\alpha F\right], \\
E\pi(cc) &= q_A^{cc}q_B(2X - 2R^{cc}D + 2F) + \left[(1 - q_A^{cc})q_B + q_A^{cc}(1 - q_B)\right](X - 2R^{cc}D + 2F) \\
&\quad + 2(1 - q_A^{cc})(1 - q_B)(1 - p)\alpha F.
\end{aligned}
$$

Secondly, interest rates are determined by the zero profit condition for investors and are summarized for the different borrowing structures in the following table. The interest rates in the left column indicate the borrowing for the foreign subsidiary A and in the right column for subsidiary B.

	A	**B**
dd	$R_A^{dd} = \dfrac{D - (1 - q_A^{dd})p\alpha F}{q_A^{dd}D}$	$R_B^{dd} = \dfrac{D - (1 - q_B)p\alpha F}{q_B D}$
dc	$R_A^{dc} = \dfrac{D - (1 - q_A^{dc})p\alpha F}{q_A^{dc}D}$	$R_B^{dc} = \dfrac{D - (1 - q_A^{dc})(1 - q_B)p\alpha F}{\left[q_B + (1 - q_B)q_A^{dc}\right]D}$
cd	$R_A^{cd} = \dfrac{D - (1 - q_A^{cd})(1 - q_B)p\alpha F}{\left[q_A^{cd} + (1 - q_A^{cd})q_B\right]D}$	$R_B^{cd} = \dfrac{D - (1 - q_B)p\alpha F}{q_B D}(= R_B^{dd})$
cc	$R_A^{cc} = R_B^{cc} = R^{cc} = \dfrac{D - (1 - q_A^{cc})(1 - q_B)p\alpha F}{\left[q_A^{cc} + (1 - q_A^{cc})q_B\right]D}$	

Finally, plugging in the corresponding interest rates into the expected profit functions

above yields – after some algebraic simplification – the expressions in section 2.3 on page 54.

A2.2 Proof of Proposition 2.2: Optimal Borrowing Structure with $E = 0$

First, we derive the conditions for the optimal borrowing structure:

With $E = 0$, it follows that $q_A^{dc} = q_A^{dd} = pM$ and $q_A^{cd} = q_A^{cc} = (1 - q_B)pM$.

As $pM(1 - q_B) \geq 0$ holds $\forall\ q_B \epsilon\, [0, 1]$, the comparison of expected profits under dd and dc yields: $E\pi(dc) \geq E\pi(dd)\ \forall\ q_B \epsilon\, [0, 1]$.

Similarly, we also obtain: $E\pi(cc) \geq E\pi(cd)\ \forall\ q_B \epsilon\, [0, 1]$.

Comparing expected profits for cc and dc yields the optimality conditions specified in Proposition 2.2.

Secondly, we illustrate the existence of the full-set result with a numerical example:

For a full set of optimal borrowing structures to exist, i.e. that there are parameter ranges for which for lower values of p up to p_1 cc is optimal and starting from p_1 dc is optimal, the following constraints have to be fulfilled:[100]

1a) $NPV_B \geq 0:\ q_B X - D + F \geq 0$,

1b) $NPV_A(dc) \geq 0:\ pMX - D + F \geq 0$,

1c) $NPV_A(cc) \geq 0:\ (1 - q_B)pMX - D + F \geq 0$,

2a) $0 \leq q_A^{dc} \leq 1:\ 0 \leq pM \leq 1$,

2b) $0 \leq q_A^{cc} \leq 1:\ 0 \leq (1 - q_B)pM \leq 1$,

3) $DR_A^{dc} \geq F\left[1 - (1 - p)\alpha\right]$ (no incentive to bailout A under dc),[101]

4a) For $p \leq p_1$: $X \geq 2DR^{cc}$ (coinsurance of both subsidiaries possible),

4b) For $p > p_1$: $X \geq D(R_B^{dc} + R_A^{dc})$ (debt repayment for A and coinsurance of B possible).

Now consider the following parameter set: $X = 2000$, $\alpha = 0.1$, $M = 0.5$, $q_B = 0.8$, $D = 160$, $F = 220$ and naturally $E = 0$. In this example, $p_1 = 0,1739$. Thus, for

---

[100]The conditions $R_A^{ij} \geq 1$ and $R_B^{ij} \geq 1$ with $i, j = c, d$ do not have to be fulfilled with $E = 0$. It is only relevant for the cases with small and large empire-building tendencies.

[101]This is the only condition with respect to the incentives to bailout, as with $E = 0$ decentralized borrowing for subsidiary A occurs only if $p \geq p_1$. The borrowing for subsidiary B is always centralized and if $p_1 < p$ for subsidiary A as well.

$p < p_1 = 0,1739$, it follows that $E\pi(cc) > E\pi(cd)$ whereas for $p \geq p_1 = 0,1739$ it follows that $E\pi(cd) \geq E\pi(cc)$. Consider the above listed constraints next: With $F > D$ the constraints 1a)-1c) are slack $\forall p \in [0,1]$. With $M, p \geq 0$ and $q_B \leq 1$ the left hand side of both conditions 2a) and 2b) are never binding. The right hand side of condition 2b) holds as long as the right hand side of condition 2a) is fulfilled. With $\frac{\partial q_A^{dc}}{\partial p} > 0$ and $q_A^{dc}(p = 1) = 0.5$ both conditions are fulfilled on the whole range of $p \in [0,1]$. As condition 3) becomes more binding with higher values of p (and hence c.p. lower interest rates), it is again sufficient to check the condition for $p = 1$: At $p = 1$, $DR_A^{dc} = 298 > F[1 - (1 - p)\alpha] = 220$. And finally, we have to check the coinsurance condition: With the constraints 4a) and 4b) becoming more binding for lower values of p, it suffices to check them at the lowest relevant value of p.[102] Under cc this value is $p = 0$. For $p = 0$, $2DR^{cc} = 400 < 2000 = X$. The lowest relevant value for p under dc is $p_1 = 0,1739$. For p_1, $D(R_B^{dc} + R_A^{dc}) = 1994.8777 < 2000 = X$. Both of the conditions are hence fulfilled.

A2.3 Proof of Proposition 2.3: Optimal Borrowing Structure with $0 < E < \overline{E}$

Expected profits as a function of creditor rights p are given by

$$E\pi(dd) = \underbrace{q_B X - 2D + [2 - (2 - q_B)(1 - \alpha)]F + E[X + (1 - \alpha)F]}_{I_{dd}}$$
$$+ \underbrace{[X + (1 - \alpha)F]M}_{S_{dd}}p,$$
$$E\pi(dc) = \underbrace{q_B X - 2D + [2 - (2 - q_B)(1 - \alpha)]F + q_B E[X + (2 - q_B)(1 - \alpha)F]}_{I_{dc}}$$
$$+ \underbrace{[X + (2 - q_B)(1 - \alpha)F]M}_{S_{dc}}p,$$

---

[102]Strictly speaking the coinsurance condition only has to be fulfilled under the respectively optimal borrowing structure. With the condition becoming more binding with lower p and cc optimal for $0 \leq p \leq p_1$, 4a) has to hold on the whole range, whereas 4b) only has to hold for $p \geq p_1$. If condition 4b) is binding for $p < p_1$ no coinsurance can be realized for this range. Without the possibility of coinsuring subsidiary A, the borrowing structure turns de facto into dd. If furthermore X is even too low to meet required debt repayments in case of success, investors will not be willing to lend to the unit and it will make zero profits. In both cases however, expected profits are a fortiori less than under cc and therefore do not interfere with the optimality of cc.

Note further that the issue of a binding constraint with decentralized borrowing for subsidiary A arises for very low values of p only due to our specific model set-up with a base-line probability of success of zero for subsidiary A in the absence of managerial efforts. Allowing for a more complex model set-up with a fixed base-line probability of success for subsidiary A larger than zero releases the constraints. However, introducing the base-line probability of success unnecessarily complicates the modeling without adding to the main insights of our simpler model.

$$
\begin{aligned}
E\pi(cd) \;=\; & \underbrace{q_B X - 2D + 2\left[1 - (1 - q_B)(1 - \alpha)\right]F + E\left[X + (1 - q_B)(1 - \alpha)F\right]}_{I_{cd}} \\
& + \underbrace{\left[X + (1 - q_B)(1 - \alpha)F\right](1 - q_B)Mp}_{S_{cd}}, \\
E\pi(cc) \;=\; & \underbrace{q_B X - 2D + 2[1 - (1 - q_B)(1 - \alpha)]F + q_B E[X + 2(1 - q_B)(1 - \alpha)F]}_{I_{cc}} \\
& + \underbrace{[X + 2(1 - q_B)(1 - \alpha)F](1 - q_B)Mp}_{S_{cc}}.
\end{aligned}
$$

First, we show that for $p = 0$ (thus the intercept) the following ordering:

A) $I_{cd} \geq I_{cc} \geq I_{dd} \geq I_{dc}$ if $\frac{X}{(1-\alpha)F} \leq \frac{q_B - (1 - 2q_B + 2q_B^2)E}{(1 - q_B)E}$,

B) $I_{cd} \geq I_{dd} \geq I_{cc} \geq I_{dc}$ if $\frac{X}{(1-\alpha)F} > \frac{q_B - (1 - 2q_B + 2q_B^2)E}{(1 - q_B)E}$.

This ordering can be derived by comparing the intercepts:

$I_{dc} \leq I_{dd}$ if

$q_B\left[X + (2 - q_B)(1 - \alpha)F\right] \leq X + (1 - \alpha)F$ and can be rearranged to

$-(1 - q_B)^2(1 - \alpha)F \leq (1 - q_B)X$ and thus

$\underbrace{-(1 - q_B)(1 - \alpha)F}_{\leq 0} \leq \underbrace{X}_{\geq 0}$, which is fulfilled.

$I_{dc} \leq I_{cc}$ if

$-(2 - q_B)(1 - \alpha)F + q_B E(2 - q_B)(1 - \alpha)F \leq -2(1 - q_B)(1 - \alpha)F + q_B E 2(1 - q_B)(1 - \alpha)F$

$(1 - \alpha)F(2 - 2q_B - 2 + q_B) \leq q_B E(1 - \alpha)F(2 - 2q_B - 2 + q_B)$

$-q_B(1 - \alpha)F \leq q_B E(1 - \alpha)F(2 - 2q_B - 2 + q_B)$ and thus

$q_B E \leq 1$, which has to hold for an internal solution.

$I_{dd} \leq I_{cd}$ if

$-(2 - q_B)(1 - \alpha)F + E(1 - \alpha)F \leq -2(1 - q_B)(1 - \alpha)F + E(1 - q_B)(1 - \alpha)F$

$E(1 - 1 + q_B) \leq 2 - q_B - 2 + 2q_B$

$Eq_B \leq q_B$.

As with the condition for an internal solution $pM + E \leq 1$ it holds that $E \leq 1$, it follows that $Eq_B \leq q_B$ is satisfied.

$I_{cc} \leq I_{cd}$ if

$$q_B[X + 2(1 - q_B)(1 - \alpha)F]E \leq [X + (1 - q_B)(1 - \alpha)F]\, E$$

$$(1 - \alpha)F\underbrace{(2q_B - 1)}_{\leq 1} \leq X.$$

Thus, if we can show that $(1 - \alpha)F \leq X$ this condition will be satisfied.

$X \geq (1 - \alpha)F$ is always true as long as net interest rates are positive, i.e. $R_A^{ij} \geq 1$ and $R_B^{ij} \geq 1$ with $i, j = c, d$: As is shown further down, the borrowing structure dc can only be optimal for the highest values of p.[103] Under dc, the condition "no incentive to bailout subsidiary A", $DR_A^{dc} \geq F[1 - (1 - p)\alpha]$ has to hold. Secondly, with $\frac{\partial R_A^{dc}}{\partial p} < 0$ (proof see section A2.6), this relationship holds a fortiori for all lower values of p. With $R_A^{dc} \geq 1$ and $(1 - p) \leq 1$, we conclude that $D \geq F(1 - \alpha)$ for all relevant values of p. As returns have to be high enough to repay the debt under all optimal borrowing structures, it follows with $R_A^{ij} \geq 1$ and $R_B^{ij} \geq 1$ that $X \geq D$ holds for all relevant values of p. Combining these two conditions yields $X \geq (1 - \alpha)F$ for all relevant values of p.

$I_{dd} \leq I_{cc}$ if

$$-(2 - q_B)(1 - \alpha)F + E[X + (1 - \alpha)F] \leq -2(1 - q_B)(1 - \alpha)F + q_B E[X + 2(1 - q_B)(1 - \alpha)F].$$
This can be rearranged to the above condition

$$\frac{X}{(1 - \alpha)F} \leq \frac{q_B - (1 - 2q_B + 2q_B^2)E}{(1 - q_B)E}.$$

Secondly, we show that the following ordering holds for the slope of the expected profit functions:

1) $S_{dc} \geq S_{dd} \geq S_{cc} \geq S_{cd}$ if $\frac{X}{(1 - \alpha)F} \geq \frac{2(1 - q_B)^2 - 1}{q_B}$,

2) $S_{dc} \geq S_{cc} \geq S_{dd} \geq S_{cd}$ if $\frac{X}{(1 - \alpha)F} < \frac{2(1 - q_B)^2 - 1}{q_B}$.

$S_{dc} \geq S_{dd}$ if

$$X + (2 - q_B)(1 - \alpha)F \geq X + (1 - \alpha)F.$$

Rearranging yields the condition $(2 - q_B) \geq 1$, which is always fulfilled.

$S_{dc} \geq S_{cc}$ if

$$X + (2 - q_B)(1 - \alpha)F \geq (1 - q_B)X + 2(1 - q_B)^2(1 - \alpha)F.$$

---

[103]This is due to the fact that it has the lowest interception point at $p = 0$ and the steepest slope S_{dc}.

Rearranging yields

$$q_B X \geq (1-\alpha)F(2q_B^2 - 3q_B)$$

$$\underbrace{X}_{>0} \geq \underbrace{(1-\alpha)F}_{>0}\underbrace{(2q_B - 3)}_{<0}, \text{ which is always fulfilled.}$$

$S_{dd} \geq S_{cd}$ if

$$X + (1-\alpha)F \geq (1-q_B)X + (1-q_B)^2(1-\alpha)F.$$

Rearranging yields

$$q_B X \geq (1-\alpha)F[(1-q_B)^2 - 1]$$

$$\underbrace{X}_{>0} \geq \underbrace{(1-\alpha)F}_{>0}\underbrace{(q_B - 2)}_{<0}, \text{ which is always fulfilled.}$$

$S_{cc} \geq S_{cd}$ if

$$[X + 2(1-q_B)(1-\alpha)F](1-q_B) \geq [X + (1-q_B)(1-\alpha)F](1-q_B).$$

Rearranging yields $2 \geq 1$, which is always fulfilled.

$S_{dd} \geq S_{cc}$ if

$$X + (1-\alpha)F \geq [X + 2(1-q_B)(1-\alpha)F](1-q_B).$$

Rearranging yields the above condition

$$\frac{X}{F(1-\alpha)} \geq \frac{2(1-q_B)^2 - 1}{q_B}$$

Next, by comparing expected profits under the different borrowing structures, we obtain the following interception points. As expected profits are linear in p, there is only one interception point between two expected profit functions.

$$E\pi(cc) \geq E\pi(cd): \ \ p \geq p_2 = \frac{[X+(1-2q_B)(1-\alpha)F]E}{(1-q_B)(1-\alpha)FM},$$

$$E\pi(dc) \geq E\pi(cc): \ \ p \geq p_3 = \frac{(1-\alpha)F(1-Eq_B)}{[X+(3-2q_B)(1-\alpha)F]M},$$

$$E\pi(dd) \geq E\pi(cd): \ \ p \geq p_4 = \frac{(1-\alpha)F(1-E)}{[X+(2-q_B)(1-\alpha)F]M},$$

$$E\pi(dc) \geq E\pi(dd): \ \ p \geq p_5 = \frac{[X+(1-q_B)(1-\alpha)F]E}{(1-\alpha)FM},$$

$$E\pi(dd) \geq E\pi(cc):$$

$$p \geq (<)p_6 = \frac{(1-\alpha)F\{q_B - E[1-2(1-q_B)q_B]\} - X(1-q_B)E}{\{q_B X + (1-\alpha)F[1-2(1-q_B)^2]\}M}, \text{ if } q_B X + (1-\alpha)F[1-2(1-q_B)^2] \geq (<)0.$$

Based on these interception points and by applying the relationship $X \geq (1-\alpha)F$, we derive that $p_2 \geq p_5$.

Now consider the condition $E < \overline{E} = \frac{(1-q_B)(1-\alpha)^2 F^2}{X^2 + 4(1-q_B)(1-\alpha)FX + (3+3q_B^2 - 7q_B)(1-\alpha)^2 F^2}$. This condition only holds if $p_2 < p_3$ and ensures that there is a range $[p_2; p_3]$ for which the borrowing structure cc dominates cd but is not dominated by dc (yet) and hence can be optimal. We finally have to show that for this parameter range cc is not dominated by dd either. First note that with $p_2 \geq p_5$ and $p_2 < p_3$ holding contemporaneously, it follows immediately that cc cannot be "fully dominated" by dd; i.e. that together with $p_2 \geq p_5$ and $p_2 < p_3$, $S_{cc} \leq S_{dd}$ and $I_{cc} \leq I_{dd}$ cannot hold contemporaneously: $S_{cc} \leq S_{dd}$ with $I_{cc} \leq I_{dd}$ implies that $p_4 < p_2$. This together with $p_2 \geq p_5$ would necessitate $p_3 < p_2$, which is a contradiction.

Thus, with $p_2 \geq p_5$ and $p_2 < p_3$ the possible cases to be investigated reduce to three: 1) $S_{dd} < S_{cc} \wedge I_{dd} < I_{cc}$, 2) $S_{dd} < S_{cc} \wedge I_{dd} \geq I_{cc}$ and 3) $S_{dd} \geq S_{cc} \wedge I_{dd} < I_{cc}$. Under 1) cc can never be dominated by dd as in this case the expected profits function for cc runs above the expected profits function for $dd \; \forall \; p \geq 0$. For 2) it follows with $S_{dd} < S_{cc}$, $I_{dd} \geq I_{cc}$ and $p_2 \geq p_5$ that $p_6 < p_2$ and thus for $p_2 < p < p_3 \; dd$ will be dominated by cc. And finally for 3) it follows with $p_2 \geq p_5$ and $p_2 < p_3$ that dd is dominated by dc from p_5 on while cc dominates dc until p_3. Hence with $p_2 < p_3 \; dd$ cannot dominate cc on the relevant interval.

Having derived the optimality condition for the sequencing $cd \rightarrow cc \rightarrow dc$ we illustrate existence of the full solution set $cd \rightarrow cc \rightarrow dc$ with a numerical example: Consider the parameter values $\alpha = 0.1$, $M = 1.2$, $E = 0.001$, $q_B = 0.8$, $X = 2200$, $D = 160$ and $F = 220$. As long as the necessary constraints – positive NPVs and net interest rates, the possibility of debt repayments and coinsurance, no incentive to bailout and probabilities $\in [0, 1]$ – hold, expected profits are given by the following profit functions:

$$
\begin{aligned}
E\pi(dd) &= 1644.7980 + 2877.6000p, \\
E\pi(dc) &= 1644.3501 + 2925.1200p, \\
E\pi(cd) &= 1803.0396 + 537.5040p, \\
E\pi(cc) &= 1802.6234 + 547.0080p.
\end{aligned}
$$

As for the given parameter set: $E = 0.001 < \overline{E} = 0.0015$, the sequencing range is $cd \rightarrow cc \rightarrow dc$, with the interception point between cd and cc given by $p_2 = 0.0438$ and the interception point between cc and dc given by $p_3 = 0.06655$. Thus, cd is the

optimal borrowing structure for $p < p_2$, cc the optimal structure for $p_2 \leq p \leq p_3$ and dc the optimal borrowing structure for $p > p_3$, if the above mentioned constraints hold. We check the conditions in the following:[104]

First of all, the NPV of both projects is positive under all borrowing structures: As the NPV of project A and B are given by $NPV_A = q_A(p)X - D + F$ and $NPV_B = q_B X - D + F$ respectively, this follows from $D < F$ for the numerical example. Consider the constraint with respect to the effort level next. For having an internal solution of the optimization problem $q_A(p) \leq 1$ has to hold for the optimal borrowing structures. With $q_A^{dd} = pM + E \leq 1$ as the tightest constraint in the full solution-range p is bounded above by $\overline{p} = 0.8325$.[105] Next we consider the constraint "no incentive to bailout" subsidiary A and B, which in general terms is given by $DR(p) \geq F[1 - \alpha(1-p)]$. This constraint can be rearranged to $p \leq \overline{p}^{cd} = \frac{D - q_B(1-\alpha)F}{\alpha F} = 0.0727$ for subsidiary B under cd and $p \leq \overline{\overline{p}}^{dc} = \frac{D - q_B(1-\alpha)FE}{\alpha F + (1-\alpha)FM} = 0.6157$ for subsidiary A under dc.[106] While with $p_2 = 0.0438$ the condition is easily fulfilled under the optimal borrowing structure cd, with $p \leq \overline{\overline{p}}^{dc} = 0.6157$ it imposes an upper boundary on the feasible range for p. As $R_k^{ij} > 1$ at $\overline{\overline{p}}^{dc} = 0.6157$ and $\frac{\partial R_k^{ij}}{\partial p} < 0 \ \forall i, j \in \{c, d\} \wedge k = A, B$ for this example, the constraint becomes less binding the higher p. And hence the condition for positive net interest rates is fulfilled on the relevant range as well.

Finally, consider the coinsurance constraint.[107] With $\frac{\partial R_A^{dc}}{\partial p} \leq 0$ (proof see section A2.6) and $\frac{\partial R_B^{cd}}{\partial p} \leq 0$ (which is generally true as with $R_B^{cd} \geq 1$, $p\alpha F \leq D$ holds and hence $\frac{\partial R_B^{cd}}{\partial p} \leq 0$) the constraints become less binding the higher p. Hence, if it is fulfilled for the lowest relevant value of p, it will be fulfilled in the whole relevant range. For cd, the lowest possible value of p is $p = 0$. At $p = 0$, $D(R_A^{cd} + R_B^{cd}) = 399.9600 < X = 2200$. The lowest relevant value of p for cc is $p_2 = 0.0438$. At p_2, $D(R_A^{cc} + R_B^{cc}) = 399.9200 < X = 2200$. And finally, the lowest relevant value of p under dc is $p_3 = 0.06655$. At

---

[104]Note that we only check that the constraints hold for the optimal borrowing structure at a given p. However, this does not constitute a major problem. Even if the constraints for non-optimal borrowing structures might be binding for some values of p, expected profits in this case never exceed expected profits under the then optimal borrowing structure. Note furthermore that potential complications with respect to binding constraints would easily disappear in a setting with a certain baseline probability of success (independent of managerial effort) for subsidiary A as the constraints typically become very slack. However, as complicating the analysis does not ad any major additional insights to our analysis, we stick to the simpler and analytically clearer version of this paper.

[105]Note that relaxing this boundary would not change the results obtained in our model. Even with a corner solution, the borrowing structure dc would still be optimal.

[106]In this case with weak empire-building tendencies, cd and dc are the only two borrowing structures for which this condition has to be fulfilled.

[107]Note that the coinsurance condition, which has to hold for all three optimal borrowing structures, ensures that the return X is high enough to meet debt repayments as well.

p_1, $D(R_A^{dc} + R_B^{dc}) = 2162.6645 < X = 2200$. Hence, all of the relevant conditions are fulfilled.

A2.4 Proof of Proposition 2.4: Optimal Borrowing Structure with $\mathbf{E} > \overline{\overline{\mathbf{E}}}$

The first part of the proof for Proposition 2.3 also applies for Proposition 2.4. Therefore, we can directly turn to the proof of the sequencing $cd \rightarrow dd \rightarrow dc$. Consider the condition $E > \overline{\overline{E}} = \frac{(1-\alpha)^2 F^2}{X^2 + (3 - 2q_B)(1-\alpha)FX + (3 - 3q_B + q_B^2)(1-\alpha)^2 F^2}$. This condition only holds if $p_4 < p_5$ and ensures that there is a range $[p_4; p_5]$ for which the borrowing structure dd dominates cd but is not dominated by dc (yet). In this case, we have to show that for this parameter range dd cannot be dominated by cc. Along the lines of our argumentation for case 2, it follows that with $p_2 \geq p_5$ and $p_4 < p_5$, dd cannot be fully dominated by cc, i.e. $S_{cc} \geq S_{dd}$ and $I_{cc} \geq I_{dd}$ cannot hold contemporaneously. For $E > \overline{\overline{E}}$, the possible cases reduce to the following: 1) $S_{dd} \geq S_{cc} \wedge I_{dd} \geq I_{cc}$, 2) $S_{dd} \geq S_{cc} \wedge I_{dd} < I_{cc}$ and 3) $S_{dd} < S_{cc} \wedge I_{dd} \geq I_{cc}$. Under 1) dd can never be dominated by cc as in this case the expected profits function for dd runs above the expected profits function for cc $\forall\, p \geq 0$. Under 2) as $p_2 \geq p_5$ and with condition $E > \overline{\overline{E}}$, $p_4 < p_5$ hold, $S_{dd} \geq S_{cc} \wedge I_{dd} < I_{cc}$ imply that $p_6 < p_4$. Hence, for $p_4 \leq p \leq p_5$ cc will be dominated by dd. And finally, under 3) with $p_2 \geq p_5$ and $p_4 < p_5$ it follows with $I_{cc} \leq I_{dd}$ that cc cannot dominate dd on the relevant range $[p_4; p_5]$.

Having proven the optimality condition for the sequencing $cd \rightarrow dd \rightarrow dc$, we again illustrate existence of the full solution set with a numerical example:

Consider the parameter values $\alpha = 0.1$, $M = 1.2$, $E = 0.13$, $q_B = 0.7$, $X = 2200$, $D = 400$ and $F = 410$. For the internal solution expected profits are given by

$$
\begin{aligned}
E\pi(dd) &= 1414.2700 + 3082.8000p, \\
E\pi(dc) &= 1324.1527 + 3215.6400p, \\
E\pi(cd) &= 1638.9910 + 831.8520p, \\
E\pi(cc) &= 1558.9474 + 871.7040p.
\end{aligned}
$$

With $\overline{\overline{E}} = 0.0215 < E = 0.13$ the condition for the optimal sequencing of $cd \rightarrow dd \rightarrow dc$ is fulfilled. The interception points between cd/dd and dd/dc are given by $p_4 = 0.0998$ and $p_5 = 0.6784$ respectively. Again, with $F > D$, the NPV of both investment projects is positive. The upper boundary due to the internal solution requirement for the optimal effort level under dd is given by $\bar{p} = 0.725$. In this case, with $\frac{\partial R_A^{dc}}{\partial p} <$

$0, \frac{\partial R_A^{dd}}{\partial p} < 0, \frac{\partial R_B^{dd}}{\partial p} < 0$ and $\frac{\partial R_B^{cd}}{\partial p} < 0$ all of the "no incentive to bailout" conditions are slack: While the condition for subsidiary B is always satisfied for $p \leq \frac{D - q_B(1-\alpha)F}{\alpha F} =$ $3,456$, it is satisfied for A under dc for $p \leq \frac{D - q_B E(1-\alpha)F}{\alpha F + (1-\alpha)FM} = 0.7574$ and under dd for $p \leq \frac{D - E(1-\alpha)F}{\alpha F + (1-\alpha)FM} = 0.7276$. Again it can be shown that also the condition of positive net interest rates, hence $R > 1$ is fulfilled on the whole relevant range of $p \leq 0.725$. And finally, the coinsurance conditions and hence the condition for sufficient returns to meet debt repayments hold for cd at $p = 0$, which is the lowest possible value for p in the optimality range of cd, as $X - D(R_B^{cd} + R_A^{cd}) = 1087.2994 > 0$. And for dd at p_4, as $X - D(R_B^{dd} + R_A^{dd}) = 41.3424 > 0$.[108] And finally for dc at p_5, as $X - D(R_B^{dc} + R_A^{dc}) = 1350.0512 > 0$. Hence, all of the relevant conditions are fulfilled.

A2.5 Proof of Corollary 2.1: Corner Solutions of Managerial Incentive Problem

Consider the optimization constraint $0 \leq q_A \leq 1$.

1) With $E, M \geq 0$, the lower boundary is never violated. The probability of success for subsidiary A is at most equal to zero. With $q_A = 0$ expected profits reduce to

$$
\begin{aligned}
E\pi(dd) &= q_B X - 2D + [2 - (2 - q_B)(1 - \alpha)]F, \\
E\pi(dc) &= q_B X - 2D + [2 - (2 - q_B)(1 - \alpha)]F, \\
E\pi(cd) &= q_B X - 2D + [2 - 2(1 - q_B)(1 - \alpha)]F, \\
E\pi(cc) &= q_B X - 2D + [2 - 2(1 - q_B)(1 - \alpha)]F,
\end{aligned}
$$

yielding $E\pi(dd) = E\pi(dc) \leq E\pi(cd) = E\pi(cc) \; \forall p \in [0, 1]$.

2) The upper boundary can be binding if E and/or M are relatively large. If for a borrowing structure the upper boundary is binding, i.e. $q_A = 1$, project A is certainly successful. A further increase in the effort level would reduce the expected utility of the subsidiary manager, as it causes additional effort costs without increasing the probability of success. Thus, as soon as $q_A = 1$ is reached, the manager does not further increase his effort level. Consider the "strongest" corner solution, i.e. $q_A^{cc} = (1 - q_B)pM + q_B E = 1$. As the incentives under cc are weakest, this implies that the upper boundary is bind a fortiori for the other borrowing structures.[109] In this case

---

[108]Note, that we do not need this condition under dd as no coinsurance takes place. However, if even the coinsurance condition is fulfilled, than X is by far high enough to meet debt repayments in both subsidiaries.

[109]If E and M are not as large the upper limit might not be binding for cc but only for dc. In this

expected profits reduce to

$$
\begin{aligned}
E\pi(dd) &= (1+q_B)X - 2D + [2 - (1-q_B)(1-\alpha)]F, \\
E\pi(dc) &= (1+q_B)X - 2D + 2F, \\
E\pi(cd) &= (1+q_B)X - 2D + [2 - (1-q_B)(1-\alpha)]F, \\
E\pi(cc) &= (1+q_B)X - 2D + 2F,
\end{aligned}
$$

yielding $E\pi(dd) = E\pi(cd) \leq E\pi(dc) = E\pi(cc) \; \forall p \in [0,1]$.

Thus, both with $q_A = 0$ and $q_A^{cc} = 1$ the borrowing structure cc yields at least as much expected profits as any other borrowing structure and hence is optimal.

A2.6 Proof of Proposition 2.5: Creditor Rights and Interest Rates

For $R_A^{dc} = \frac{D - [1-(pM+q_BE)]p\alpha F}{(pM+q_BE)D}$:

$$
\frac{\partial R_A^{dc}}{\partial p} = \frac{\overbrace{-\alpha F(1-q_BE)(pM+q_BE)}^{\leq 0} \overbrace{-M\{D - [1-(pM+q_BE)]p\alpha F\}}^{\leq 0}}{\underbrace{D(Eq_B + Mp)^2}_{\geq 0}} \leq 0.
$$

For $R_A^{dd} = \frac{D - [1-(pM+E)]p\alpha F}{(pM+E)D}$:

$$
\frac{\partial R_A^{dd}}{\partial p} = \frac{\overbrace{-\overbrace{(1-E)}^{\geq 0}\alpha F(pM+E)}^{\leq 0} \overbrace{-M\overbrace{\{D - [1-(pM+E)]p\alpha F\}}^{\geq 0,\ \text{as } R_A^{dd} \geq 1}}^{\leq 0}}{\underbrace{D(E+Mp)^2}_{\geq 0}} \leq 0.
$$

A2.7 Proof of Proposition 2.6: Comparative Statics X

$$
p_1 : \frac{\partial\left\{\frac{(1-\alpha)F}{M[X+(3-2q_B)(1-\alpha)F]}\right\}}{\partial X} = -\frac{(1-\alpha)F}{[X+(3-2q_B)(1-\alpha)F]^2 M} \leq 0.
$$

---

case, independent of whether $q_A^{dc} \lessgtr q_A^{cd}$ the optimal borrowing structure is dc. With dc, the CEO can realize highest possible profits as subsidiary A is successful with certainty: By coinsuring subsidiary B, the CEO can eliminate bankruptcy costs, without affecting the effort level, as $q_A^{dc} = 1$.

Similarly, there might be a situation, in which the upper limit binds for cd. Now, two cases have to be distinguished: Either it holds that $\frac{pM}{E} \geq \frac{(1-q_B)}{q_B}$, than we are back to the situation in the case above. Or $\frac{pM}{E} < \frac{(1-q_B)}{q_B}$. In this case, we have the trade-offs discussed in the main part of the paper. Note however, that a fully decentralized debt structure will entail no advantages as compared to cd anymore.

And finally, with the same argumentation, if the upper limit only binds for dd, we again face the trade-offs discussed in the main part of the paper.

With p_2 : $\dfrac{\partial\left\{\frac{[X+(1-\alpha)F(1-2q_B)]E}{M[(1-\alpha)F(1-q_B)]}\right\}}{\partial X} = \dfrac{E}{(1-q_B)(1-\alpha)FM} \geq 0$

and p_3 : $\dfrac{\partial\left\{\frac{(1-\alpha)F(1-Eq_B)}{[X+(1-\alpha)F(3-2q_B)]M}\right\}}{\partial X} = -\dfrac{(1-\alpha)F}{M}\dfrac{\overbrace{(1-Eq_B)}^{\geq 0 \text{ for } q_A \leq 1}}{\underbrace{[X+F(1-\alpha)(3-2q_B)]^2}_{\geq 0}} \leq 0$

$\Rightarrow \dfrac{\partial(p_3-p_2)}{\partial X} \leq 0.$

With p_4 : $\dfrac{\partial\left\{\frac{(1-\alpha)F(1-E)}{[X+(2-q_B)(1-\alpha)F]M}\right\}}{\partial X} = -\dfrac{(1-\alpha)F}{M}\dfrac{\overbrace{(1-E)}^{\geq 0 \text{ for } q_A \leq 1}}{[X+(2-q_B)(1-\alpha)F]^2} \leq 0$

and p_5 : $\dfrac{\partial\left\{\frac{E[X+F(1-\alpha)(1-q_B)]}{MF(1-\alpha)}\right\}}{\partial X} = \dfrac{1}{M}\dfrac{E}{(1-\alpha)F} \geq 0$

$\Rightarrow \dfrac{\partial(p_5-p_4)}{\partial X} \geq 0.$

$\overline{E}$: $\dfrac{\partial\overline{E}}{\partial X} = \dfrac{\partial\left[\frac{(1-q_B)(1-\alpha)^2F^2}{X^2+4(1-q_B)(1-\alpha)FX+(3+3q_B^2-7q_B)(1-\alpha)^2F^2}\right]}{\partial X} = -(1-\alpha)^2 F^2 (1-q_B) \cdot$

$\dfrac{4(1-q_B)(1-\alpha)F+2X}{\left[X^2+4(1-q_B)(1-\alpha)FX+(3+3q_B^2-7q_B)(1-\alpha)^2F^2\right]^2} \leq 0.$

$\overline{\overline{E}}$: $\dfrac{\partial\overline{\overline{E}}}{\partial X} = \dfrac{\partial\left[\frac{(1-\alpha)^2F^2}{X^2+(3-2q_B)(1-\alpha)FX+(3-3q_B+q_B^2)(1-\alpha)^2F^2}\right]}{\partial X} = -(1-\alpha)^2 F^2 \cdot$

$\dfrac{\overbrace{(1-\alpha)F\overbrace{(3-2q_B)}^{>0}+2X}^{\geq 0}}{\left[X^2+(3-2q_B)(1-\alpha)FX+(3-3q_B+q_B^2)(1-\alpha)^2F^2\right]^2} \leq 0.$

A2.8 Proof of Proposition 2.7: Comparative Statics F

p_1 : $\dfrac{\partial\left\{\frac{(1-\alpha)F}{M[X+(3-2q_B)(1-\alpha)F]}\right\}}{\partial F} = \dfrac{1}{M}X\dfrac{(1-\alpha)}{[X+(3-2q_B)(1-\alpha)F]^2} \geq 0.$

With p_2 : $\dfrac{\partial\left\{\frac{[X+(1-2q_B)(1-\alpha)F]E}{(1-q_B)(1-\alpha)FM}\right\}}{\partial F} = -\dfrac{1}{F^2M}X\dfrac{E}{(1-\alpha)(1-q_B)} \leq 0$

and p_3 : $\dfrac{\partial\left\{\frac{(1-\alpha)F(1-Eq_B)}{[X+(3-2q_B)(1-\alpha)F]M}\right\}}{\partial F} = \dfrac{1}{M}X(1-\alpha)\dfrac{\overbrace{(1-Eq_B)}^{\geq 0 \text{ for } q_A \leq 1}}{[X+F(1-\alpha)(3-2q_B)]^2} \geq 0$

$\Rightarrow \dfrac{\partial(p_3-p_2)}{\partial F} \geq 0.$

With p_4 : $\dfrac{\partial\left(\frac{(1-\alpha)F(1-E)}{M[X+(2-q_B)(1-\alpha)F]}\right)}{\partial F} = \dfrac{1}{M}X(1-\alpha)\dfrac{\overbrace{(1-E)}^{\geq 0 \text{ for } q_A \leq 1}}{[X+F(1-\alpha)(2-q_B)]^2} \geq 0$

and p_5 : $\dfrac{\partial\left(\frac{E[X+(1-q_B)(1-\alpha)F]}{(1-\alpha)FM}\right)}{\partial F} = -\dfrac{1}{F^2M}\dfrac{EX}{(1-\alpha)} \leq 0$

$$\Rightarrow \frac{\partial (p_5 - p_4)}{\partial F} \leq 0.$$

$$\overline{E} : \frac{\partial \overline{E}}{\partial F} = \frac{\partial \left(\frac{(1-q_B)(1-\alpha)^2 F^2}{X^2 + 4(1-q_B)(1-\alpha)FX + (3+3q_B^2 - 7q_B)(1-\alpha)^2 F^2} \right)}{\partial F} = 2FX(1-\alpha)^2(1-q_B) \cdot$$

$$\frac{2(1-q_B)(1-\alpha)F + X}{\left[X^2 + 4(1-q_B)(1-\alpha)FX + (3+3q_B^2 - 7q_B)(1-\alpha)^2 F^2 \right]^2} \geq 0.$$

$$\overline{\overline{E}} : \frac{\partial \overline{\overline{E}}}{\partial F} = \underbrace{\frac{\partial \left(\frac{(1-\alpha)^2 F^2}{X^2 + (3-2q_B)(1-\alpha)FX + (3-3q_B+q_B^2)(1-\alpha)^2 F^2} \right)}{\partial F}}_{\geq 0} = FX(1-\alpha)^2 \cdot$$

$$\frac{(1-\alpha)F \overbrace{(3-2q_B)}^{>0} + 2X}{\left[X^2 + (3-2q_B)(1-\alpha)FX + (3-3q_B+q_B^2)(1-\alpha)^2 F^2 \right]^2} \geq 0.$$

A2.9 Proof of Proposition 2.8: Comparative Statics E and M

The derivatives of the optimality threshold values with respect to E are given by

$p_2 : \frac{\partial p_2}{\partial E} = \frac{1}{(1-q_B)(1-\alpha)FM} \left[X + (1-2q_B)(1-\alpha)F \right].$

With $\frac{\partial [X + F(1-\alpha)(1-2q_B)]}{\partial q_B} = -2(1-\alpha)F \leq 0$ the most negative value for $(1-2q_B)(1-\alpha)F$ is $-(1-\alpha)F$. With $X \geq (1-\alpha)F$ it follows that $[X + (1-2q_B)(1-\alpha)F] \geq 0$ $\forall q_B \in [0;1]$ and hence $\frac{\partial p_2}{\partial E} \geq 0$.

$p_3 : \frac{\partial p_3}{\partial E} = -\frac{q_B}{M} \underbrace{\frac{(1-\alpha)F}{[X + (3-2q_B)(1-\alpha)F]}}_{\geq 0} \leq 0.$

$p_4 : \frac{\partial p_4}{\partial E} = -\frac{(1-\alpha)F}{[X + (2-q_B)(1-\alpha)F]M} \leq 0.$

$p_5 : \frac{\partial p_5}{\partial E} = \frac{1}{(1-\alpha)FM} \left[X + (1-q_B)(1-\alpha)F \right] \geq 0.$

$\Rightarrow$ With $\frac{\partial p_2}{\partial E} \geq 0$ and $\frac{\partial p_3}{\partial E} \leq 0$ the optimality ranges for:

    cd increases,

    cc decreases,

    dc increases.

$\Rightarrow$ With $\frac{\partial p_5}{\partial E} \geq 0$, $\frac{\partial p_4}{\partial E} \leq 0$ the optimality ranges for:

    cd decreases,

    dd increases,

    dc decreases.

And finally, with higher values of E it is more likely that the MNC is in a situation with strong empire-building tendencies as the condition $E < \overline{E}$ becomes more binding and the condition $E > \overline{\overline{E}}$ easier to be fulfilled.

The derivatives of the optimality threshold values with respect to M are given by

$p_2 : \frac{\partial p_2}{\partial M} = -\frac{1}{(1-\alpha)FM^2} \frac{E}{(1-q_B)} \left[X + (1-2q_B)(1-\alpha)F \right].$

With the same rationing as above for E it follows that

$\frac{\partial p_2}{\partial M} \leq 0.$

$p_3 : \frac{\partial p_3}{\partial M} = -\frac{(1-\alpha)F}{M^2} \frac{(1-Eq_B)}{[X+(3-2q_B)(1-\alpha)F]} \leq 0.$

$p_4 : \frac{\partial p_4}{\partial M} = -\frac{(1-\alpha)F}{M^2} \frac{(1-E)}{[X+(2-q_B)(1-\alpha)F]} \leq 0.$

$p_5 : \frac{\partial p_5}{\partial M} = -\frac{E}{(1-\alpha)FM^2} \left[X + (1-q_B)(1-\alpha)F \right] \leq 0.$

$\Rightarrow$ With $\frac{\partial p_2}{\partial M} \leq 0$ and $\frac{\partial p_3}{\partial M} \leq 0$, the size of the effects has to be compared:

$\frac{\partial p_3}{\partial M} > \frac{\partial p_2}{\partial M}$ if

$\frac{(1-\alpha)F}{M^2} \frac{1-Eq_B}{[X+(3-2q_B)(1-\alpha)F]} < \frac{1}{(1-\alpha)FM^2} \frac{E}{(1-q_B)} \left[X + (1-2q_B)(1-\alpha)F \right].$

Solving for E yields $E > \frac{(1-q_B)(1-\alpha)^2F^2}{[X^2+4(1-q_B)(1-\alpha)FX+(3-7q_B+3q^2)(1-\alpha)^2F^2]}.$

However, this is a contradiction to the condition for being in case 2 with weak empire-building tendencies $E < \overline{E} = \frac{(1-q_B)(1-\alpha)^2F^2}{X^2+4(1-q_B)(1-\alpha)FX+(3-7q_B+3q^2)(1-\alpha)^2F^2}$. It follows that $\frac{\partial p_3}{\partial M} < \frac{\partial p_2}{\partial M}$ and the optimality range for

  dc increases,

  cc decreases,

  cd decreases.

$\Rightarrow$ Similarly, we have to compare $\frac{\partial p_5}{\partial M} \leq 0$ und $\frac{\partial p_4}{\partial M} \leq 0$.

$\frac{\partial p_5}{\partial M} < \frac{\partial p_4}{\partial M}$ if $\frac{E}{(1-\alpha)FM^2} \left[X + (1-q_B)(1-\alpha)F \right] > \frac{(1-\alpha)F}{M^2} \frac{1-E}{[X+(2-q_B)(1-\alpha)F]}.$

Solving for E yields: $E > \frac{(1-\alpha)^2F^2}{\left[X^2+(3-2q_B)(1-\alpha)FX+(3-3q_B+q_B^2)(1-\alpha)^2F^2 \right]}$ which is exactly the condition $E > \overline{\overline{E}}$ for case 3. It follows that $\frac{\partial p_5}{\partial M} < \frac{\partial p_4}{\partial M}$ and the optimality range for

  dc increases,

  dd decreases,

  cd decreases.

A2.10 Proof of Proposition 2.9: Differences in α

With α_P for the parental country and α_A for the foreign country of subsidiary A, interest rates are given by the following table:

$$
\begin{array}{cll}
 & \text{A} & \text{B} \\
\text{dd} & R_A^{dd} = \frac{D-(1-q_A^{dd})p\alpha_A F}{q_A^{dd}D} & R_B^{dd} = \frac{D-(1-q_B)p\alpha_P F}{q_B D} \\
\text{dc} & R_A^{dc} = \frac{D-(1-q_A^{dc})p\alpha_A F}{q_A^{dc}D} & R_B^{dc} = \frac{D-(1-q_A^{dc})(1-q_B)p\alpha_P F}{\left[q_B+(1-q_B)q_A^{dc}\right]D} \\
\text{cd} & R_A^{cd} = \frac{D-(1-q_A^{cd})(1-q_B)p\alpha_P F}{[q_A^{cd}+(1-q_A^{cd})q_B]D} & R_B^{cd} = \frac{D-(1-q_B)p\alpha_P F}{q_B D}(= R_B^{dd}) \\
\text{cc} & R^{cc} = \frac{D-\left(1-q_A^{cc}\right)(1-q_B)p\alpha_P F}{\left[q_A^{cc}+(1-q_A^{cc})q_B\right]D} &
\end{array}
$$

Plugging these into the new expected profits functions gives after some algebraic simplifications the following expected profit functions

$$
\begin{aligned}
E\pi(dd) &= (q_A^{dd}+q_B)X - 2D + \left[q_A^{dd}(1-\alpha_A)+\alpha_A+\alpha_P+q_B(1-\alpha_P)\right]F, \\
E\pi(dc) &= (q_A^{dc}+q_B)X - 2D + \left\{2q_A^{dc}+(1-q_A^{dc})\left[\alpha_A+\alpha_P(1-q_B)+q_B\right]\right\}F, \\
E\pi(cd) &= (q_A^{cd}+q_B)X - 2D + \left[2-(1-q_B)(2-q_A^{cd})(1-\alpha_P)\right]F, \\
E\pi(cc) &= (q_A^{cc}+q_B)X - 2D + \left[2-2(1-q_A^{cc})(1-q_B)(1-\alpha_P)\right]F.
\end{aligned}
$$

Note that the optimal effort levels q_A^{ij} with $i,j \in \{d,c\}$ are independent of α.

As we want to investigate the effect of $\alpha_A \uparrow$ starting from a situation with $\alpha = \alpha_A = \alpha_P$ we consider how expected profits react to an increase in α_A :

$$
\frac{\partial E\pi(dd)}{\partial \alpha_A}\Big|_{\alpha_A=\alpha_P=\alpha} = (1-q_A^{dd})F \geq 0,
$$

$$
\frac{\partial E\pi(dc)}{\partial \alpha_A}\Big|_{\alpha_A=\alpha_P=\alpha} = (1-q_A^{dc})F \geq 0,
$$

$$
\frac{\partial E\pi(cd)}{\partial \alpha_A}\Big|_{\alpha_A=\alpha_P=\alpha} = 0,
$$

$$
\frac{\partial E\pi(cc)}{\partial \alpha_A}\Big|_{\alpha_A=\alpha_P=\alpha} = 0.
$$

With $q_A^{dc} < q_A^{dd}$ it follows that $\frac{\partial E\pi(cc)}{\partial \alpha_A} = \frac{\partial E\pi(cd)}{\partial \alpha_A} = 0 \leq \frac{\partial E\pi(dd)}{\partial \alpha_A} \leq \frac{\partial E\pi(dc)}{\partial \alpha_A}$.

A2.11 Proof of Proposition 2.10: Differences in p

With p_P for creditor rights in the parental country and p_A for creditor rights in the

foreign country, the internal solutions for the optimal effort levels are given by

$$
\begin{aligned}
q_A^{dd} &= p_A M + E, \\
q_A^{dc} &= p_A M + q_B E, \\
q_A^{cd} &= (1 - q_B) p_B M + E, \\
q_A^{cc} &= (1 - q_B) p_B M + q_B E.
\end{aligned}
$$

Thus, expected profits under the different borrowing structures are given by

$$
\begin{aligned}
E\pi(dd) &= q_B X - 2D + [2 - (2 - q_B)(1 - \alpha)] F + E [X + (1 - \alpha)F] \\
&\quad + [X + (1 - \alpha)F] M p_A, \\
E\pi(dc) &= q_B X - 2D + [2 - (2 - q_B)(1 - \alpha)] F + q_B E [X + (2 - q_B)(1 - \alpha)F] \\
&\quad + [X + (2 - q_B)(1 - \alpha)F] M p_A, \\
E\pi(cd) &= q_B X - 2D + 2 [1 - (1 - q_B)(1 - \alpha)] F + E [X + (1 - q_B)(1 - \alpha)F] \\
&\quad + [X + (1 - q_B)(1 - \alpha)F] (1 - q_B) M p_B, \\
E\pi(cc) &= q_B X - 2D + 2 [1 - (1 - q_B)(1 - \alpha)] F + q_B E [X + 2(1 - q_B)(1 - \alpha)F] \\
&\quad + [X + 2(1 - q_B)(1 - \alpha)F] (1 - q_B) M p_B.
\end{aligned}
$$

Starting from a situation with $p = p_A = p_P$ we consider the effect of $p_A \uparrow$ on expected profits:

$$
\frac{\partial E\pi(dd)}{\partial p_A} \Big|_{p_A = p_P = p} = [X + (1 - \alpha)F] M,
$$

$$
\frac{\partial E\pi(dc)}{\partial p_A} \Big|_{p_A = p_P = p} = [X + (2 - q_B)(1 - \alpha)F] M,
$$

$$
\frac{\partial E\pi(cd)}{\partial p_A} \Big|_{p_A = p_P = p} = 0,
$$

$$
\frac{\partial E\pi(cc)}{\partial p_A} \Big|_{p_A = p_P = p} = 0.
$$

With $(2 - q_B) \geq 1$ it follows that

$$
\frac{\partial E\pi(cd)}{\partial p_A} \Big|_{p_A = p_P = p} = \frac{\partial E\pi(cc)}{\partial p_A} \Big|_{p_A = p_P = p} = 0 \leq \frac{\partial E\pi(dd)}{\partial p_A} \Big|_{p_A = p_P = p} \leq \frac{\partial E\pi(dc)}{\partial p_A} \Big|_{p_A = p_P = p}.
$$

Appendix to Chapter 3

A3.1 Proof of Proposition 3.2: Equilibrium in the Open Economy

In a first step assume that all potential constraints are non-binding and that all firms with costs of cross-listing $F_i \leq F^*$ decide to cross-list in t=0.[110] This corresponds to a cross-listing fraction $\frac{F^*}{\overline{F}}$ of good firms and of $\alpha \frac{F^*}{\overline{F}}$ of total firms. The share of good firms remaining on the home market pool is $\frac{\alpha - \alpha \frac{F^*}{\overline{F}}}{1 - \alpha \frac{F^*}{\overline{F}}}$.

If all remaining firms in the local pool borrow in t=2, investors require a pooling interest rate which satisfies: $E\pi_I = \frac{\alpha - \alpha \frac{F^*}{\overline{F}}}{1 - \alpha \frac{F^*}{\overline{F}}} \widetilde{R} - R_0 = 0$. Thus, in t=1, investors offer a pooling contract with $\widetilde{R}(F^*) = \frac{R_0 \left(1 - \alpha \frac{F^*}{\overline{F}}\right)}{\alpha - \alpha \frac{F^*}{\overline{F}}}$, if $X \geq \widetilde{R}(F^*)$. They do not offer any pooling credit contract if $X < \widetilde{R}(F^*)$. Investors furthermore offer a credit contract at R_0 to all cross-listing firms, as these are correctly identified as good firms.

Next, consider the decision of a good firm to cross-list in t=0. Let us first assume that enough good firms remain in the local market, such that $X - \widetilde{R}(F^*) \geq 0$. In this case good firms cross-list whenever expected profits of cross-listing are higher than on the home market pool. A good firm's expected profits with cross-listing is given by $E\pi_{CL}(F_i) = X - R_0 - F_i$. F_i is its individual costs of cross-listing drawn from the uniform distribution on $\left[0, \overline{F}\right]$. With the fraction of $\frac{F^*}{\overline{F}}$ of all good firms cross-listing, an individual good firm's expected profits on the home market is given by $E\pi_H(F^*) = X - \widetilde{R}(F^*)$. Note that with a continuum of firms, a single firm does not affect the interest rate at the home market $\widetilde{R}(F^*)$. Hence, given the marginal firm F^* that cross-lists, profits on the home market can be seen as constant.

For the marginal firm to cross-list it has to hold that $E\pi_{CL}(F^*) = E\pi_H(F^*)$. Note that with $\frac{\partial E\pi_{CL}(F_i)}{\partial F_i} < 0$ and $\frac{\partial E\pi_H(F^*)}{\partial F_i} = 0$, given that the marginal firm to cross-list is

---

[110]In the following analysis, F_i always refers to an arbitrary firm i, whereas F^* and F_i^* indicate the marginal firm to cross-list.

F^*, firms with $F_i < F^*$ indeed prefer cross-listing, as for them $E\pi_{CL}(F_i) > E\pi_H(F^*)$. Firms with $F_i > F^*$ indeed prefer the home market pool, as for them $E\pi_{CL}(F_i) < E\pi_H(F^*)$. The indifference condition for the marginal firm $E\pi_{CL}(F^*) = X - R_0 - F^* = X - \frac{R_0\left(1-\alpha\frac{F^*}{\overline{F}}\right)}{\alpha-\alpha\frac{F^*}{\overline{F}}} = E\pi_H(F^*)$ can be rearranged to $F^{*2} - \overline{F}F^* + \frac{\overline{F}}{\alpha}R_0(1-\alpha) \geq 0$, which solving for F^* yields the following two possible solutions:

$$F_1^* = \frac{\overline{F}}{2\alpha}\left[\alpha - \sqrt{\alpha^2 - \frac{4\alpha R_0}{\overline{F}}(1-\alpha)}\right],$$

$$F_2^* = \frac{\overline{F}}{2\alpha}\left[\alpha + \sqrt{\alpha^2 - \frac{4\alpha R_0}{\overline{F}}(1-\alpha)}\right].$$

Given the two equilibrium candidates, we first control for possibly binding constraints:

A) Existence of an Internal Solution

For an internal solution to exist, it has to hold that $0 \leq F_i^* \leq \overline{F}$ and $\alpha^2 - \frac{4\alpha R_0}{\overline{F}}(1-\alpha) > 0$.

First, consider $0 \leq F_i^* \leq \overline{F}$:

With $\alpha^2 - \frac{4\alpha R_0}{\overline{F}}(1-\alpha) < \alpha^2$ and hence $\alpha > \sqrt{\alpha^2 - \frac{4\alpha R_0}{\overline{F}}(1-\alpha)}$ neither the LHS nor the RHS of the condition is binding.

Second, consider $\alpha^2 - \frac{4\alpha R_0}{\overline{F}}(1-\alpha) > 0$:

With the assumption $\overline{F} > \max\left\{\frac{4R_0(1-\alpha)}{\alpha}; X - R_0\right\}$, the condition $\alpha^2 - \frac{4\alpha R_0}{\overline{F}}(1-\alpha) > 0$ holds throughout the paper.[111]

B) Non-Negativity Condition

The local pool breaks down as soon as the marginal firm with costs of cross listing F^{MBD} leaves the local market. F^{MBD} is characterized by

$$X - \frac{R_0(1-\alpha\frac{F^{MBD}}{\overline{F}})}{\alpha(1-\frac{F^{MBD}}{\overline{F}})} = 0.$$

Solving for the threshold marginal firm F^{MBD} yields $F^{MBD} = \frac{\overline{F}}{\alpha}\frac{\alpha X - R_0}{(X-R_0)}$.

With $\sqrt{\cdot} \equiv \sqrt{\alpha^2 - \frac{4\alpha R_0}{\overline{F}}(1-\alpha)}$, it follows that $F_1^* \leq F^{MBD}$ if

$$R_0(1 - \underbrace{\tfrac{1}{2}(\alpha - \underbrace{\sqrt[2]{\cdot}}_{<\alpha})}_{>0,<1}) \leq \tfrac{1}{2}X(\underbrace{\alpha + \sqrt{\cdot}}_{>0}),$$

---

[111]Note that if $\alpha^2 - \frac{4\alpha R_0}{\overline{F}}(1-\alpha) = 0$, we would have a unique solution and if $\alpha^2 - \frac{4\alpha R_0}{\overline{F}}(1-\alpha) < 0$, cross-listing would dominate borrowing on the home market pool. In equilibrium all good firms that could realize positive expected profits by cross-listing would do so and the home market pool would break down.

which solving for X yields the condition

$$X \geq X_1 = \frac{R_0(2-\alpha+\sqrt{\cdot})}{\alpha+\sqrt{\cdot}}.$$

Similarly, $F_2^* \leq F^{MBD}$ holds whenever

$$X \geq X_2 = \frac{R_0(2-\alpha-\sqrt{\cdot})}{\alpha-\sqrt{\cdot}}.$$

Comparing X_1 to X_2 shows that $X_2 > X_1$ for all parameter ranges.

Note that with $\frac{\partial E\pi_{CL}}{\partial F_i^*} = -1 < 0$ and $\frac{\partial E\pi_H}{\partial F_i^*} = -\frac{R_0(1-\alpha)}{\overline{F}(1-\frac{F_i^*}{\overline{F}})} < 0$, expected profits for the marginal firm are both decreasing in F_i^*. While with $\frac{\partial^2 E\pi_{CL}}{\partial F_i^{*2}} = 0$, $E\pi_{CL}(F_i^*)$ linearly falls in F_i^*, $E\pi_H(F_i^*)$ is a concave function in F_i^*, i.e. $\frac{\partial^2 E\pi_H}{\partial F_i^{*2}} = -\frac{R_0(1-\alpha)}{(\overline{F}-F_i^*)^2} < 0$.

This implies, with $F_1^* < F_2^*$, that $E\pi_{CL}(F_i^*) > E\pi_H(F_i^*)$ if the marginal firm to cross-list is given by $F_i^* < F_1^*$, $E\pi_{CL}(F_i^*) \leq E\pi_H(F_i^*)$ if the marginal firm to cross-list is given by $F_1^* \leq F_i^* \leq F_2^*$ and again $E\pi_{CL}(F_i^*) > E\pi_H(F_i^*)$ if $F_i^* > F_2^*$.

Consider the different parameter ranges for X next:

1) $X \geq X_2$:

For this parameter range the zero profit condition is neither binding for F_1^* nor for F_2^*.

Consider the equilibrium candidate F_1^* first: In t=2, all firms in the local pool invest at the interest rate $\widetilde{R}(F_1^*)$ and cross-listing firms invest at R_0. None of the firms has an incentive to deviate. In t=1, an investor observes the fraction of cross-listing good firms and offers credit at R_0 for cross-listing firms and at $\widetilde{R}(F_1^*)$ for non-cross-listing firms. The investor makes expected profits of zero and does not have any incentive to deviate. Consider the good firms' incentives to deviate in t=0 for F_1^*: The marginal firm to cross-list F_1^* is indifferent between cross-listing and not cross-listing and does not have any incentive to deviate from its cross-listing strategy. As with the fraction $\frac{F_1^*}{\overline{F}}$ of all good firms cross-listing, all other firms with costs of cross-listing $F_i < F_1^*$ realize higher profits by cross-listing and prefer cross-listing (remember that, as there is a continuum of good firms, a single firm cannot influence expected profits on the home market). All other firms with $F_i > F_1^*$ realize higher profits by staying in the home market pool and they do not have any incentives to deviate either. Hence, in this case F_1^* characterizes a subgame-perfect Nash equilibrium.

Similarly it can be shown, that F_2^* characterizes a subgame-perfect Nash equilibrium.

<u>2) $X_1 \leq X < X_2$:</u>

For this parameter range the zero profit condition is binding only for F_2^*.

With the same argumentation as for $X > X_2$, we know that F_1^* characterizes a subgame-perfect Nash equilibrium. However, as for F_2^* the zero profit condition is binding, F_2^* cannot characterize a Nash equilibrium. The alternative equilibrium candidate for F_2^* is the situation in which all firms with $F_i < F_0^*$ cross-list and the market breaks down in the local pool. However this cannot be an equilibrium either: Assume for a moment, that indeed a fraction $\frac{F_0^*}{F}$ of good firms did cross-list. With $F_0^* > F_1^*$, $\frac{\partial^2 E\pi_{CL}}{\partial F_i^{*2}} = 0$ and $\frac{\partial^2 E\pi_H}{\partial F_i^{*2}} < 0$, it follows that $F_0^* < F^{MBD}$ and hence $X > \widetilde{R}(F_0^*)$. Thus, for the cross-listing firm F_0^* it holds that $E\pi_{CL}(F_0^*) = 0 < E\pi_H(F_0^*)$ and it has an incentive not to cross-list (and all other firms with $F_i > F_1^*$ as well). For this parameter range, the only equilibrium is given by F_1^*.

<u>3) $X < X_1$:</u>

For this parameter range the zero profit condition is binding for F_1^* as well as F_2^*.

Both for F_1^* and F_2^* the marginal firm's profits under cross-listing as well as on the home market would be negative. Thus, only good firms with cross-listing costs $F_i \leq F_0^* \equiv X - R_0(< F_1^* < F_2^*)$ cross-list and invest.[112] As with $F_0^* < F_1^*$, $\frac{\partial^2 E\pi_{CL}}{\partial F_i^{*2}} = 0$ and $\frac{\partial^2 E\pi_H}{\partial F_i^{*2}} < 0$, it follows that $F_0^* > F^{MBD}$, investors anticipate that $\widetilde{R}(F_0^*) > X$ and do not offer any pooling credit contract. This is a subgame perfect Nash equilibrium, as neither the firms nor the investors have an incentive to deviate from their strategies.

A3.2 Elimination of the equilibrium $\mathbf{F_2^*}$ (for $\mathbf{X \geq X_2}$)

Recall that $E\pi_{CL}(F_i^*) < E\pi_H(F_i^*)$ if the marginal firm to cross-list was given by $F_1^* < F_i^* < F_2^*$ and $E\pi_{CL}(F_i^*) > E\pi_H(F_i^*)$ if $F_i^* > F_2^*$.

<u>*1) Instability of the Equilibrium:*</u>

Consider the equilibrium at F_2^*. Now, assume that for some reason only a smaller fraction of good firms $\frac{F_2^{*\prime}}{F} < \frac{F_2^*}{F}$ decides to cross-list. As investors observe the cross-listing decisions and are fully competitive, they offer an interest rate for the home market pool of $\widetilde{R}(F_2^{*\prime}) = \frac{R_0\left(1 - \alpha\frac{F_2^{*\prime}}{F}\right)}{\alpha - \alpha\frac{F_2^{*\prime}}{F}}$. At this interest rate, $E\pi_{CL}(F_2^{*\prime}) < E\pi_H(F_2^{*\prime})$

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[112]The assumption $\overline{F} > \max\left\{\frac{4R_0(1-\alpha)}{\alpha}; X - R_0\right\}$ assures the existence of an inner solution with $F_0^* < \overline{F}$.

for the marginal cross-listing firm $F_2^{*\prime}$. Thus it has an incentive to deviate and stay on the home market pool. This rationing holds for all potential marginal firms with $F_1^* < F_i^* < F_2^*$. A stable equilibrium is only reached when the marginal firm to cross-list is F_1^*. Similarly, it can be shown that if the marginal firm to cross-list was for some reason given by $F_2^{*\prime\prime} > F_2^*$, more and more firms would like to cross-list and a corner solution would arise. Thus, even though with F_2^* we have a subgame-perfect Nash equilibrium, it is not stable vis-à-vis small perturbations. The equilibrium with F_1^* is stable vis-à-vis small perturbations.

<u>*2) Pareto-Dominance:*</u>

As investors and bad firms make zero profits in both equilibria, it suffices to compare expected profits for good firms only. All good firms with $F_i < F_1^*$ realize the same expected profits in both equilibria, as in both cases they do cross-list and realize $E\pi_{CL}(F_i)$. However, with $\frac{\partial E\pi_{CL}}{\partial F_i^*} = -1 < 0$, $\frac{\partial E\pi_H}{\partial F_i^*} = -\frac{R_0\alpha(1-\alpha)}{\overline{F}\alpha\left(1-\frac{F_i^*}{\overline{F}}\right)} < 0$ and $F_1^* < F_2^*$, it immediately follows that the marginal firms expected profits are higher for F_1^* as compared to F_2^*. As a consequence, also all other firms with $F_i > F_1^*$ realize higher expected profits on the home market pool. Hence, the equilibrium with F_1^* Pareto-dominates the one with F_2^*.

A3.3 Proof of Lemma 3.1: Comparative Statics Fraction w.r.t. α and X

- $\frac{\partial\left(\frac{F_1^*}{\overline{F}}\right)}{\partial\alpha} = -\frac{1}{\alpha^2}\frac{R_0}{\left[\overline{F}\alpha-4R_0(1-\alpha)\right]}\sqrt{\alpha^2 - \frac{4\alpha R_0}{\overline{F}}(1-\alpha)}.$

  With the assumption $\overline{F} > \frac{4R_0(1-\alpha)}{\alpha}$ it follows that $\frac{\partial\left(\frac{F_1^*}{\overline{F}}\right)}{\partial\alpha} < 0.$

- As $\frac{F_1^*}{\overline{F}}$ is independent of X, it follows immediately that $\frac{\partial\left(\frac{F_1^*}{\overline{F}}\right)}{\partial X} = 0.$

- As $\frac{F_0^*}{\overline{F}}$ is independent of α it follows immediately that $\frac{\partial\left(\frac{F_0^*}{\overline{F}}\right)}{\partial\alpha} = 0.$

- $\frac{\partial\left(\frac{X-R_0}{\overline{F}}\right)}{\partial X} = \frac{1}{\overline{F}} > 0.$

A3.4 Proof of Proposition 3.3: Comparative Statics X_1 w.r.t. α and X.

- $\frac{\partial X_1}{\partial\alpha} = -\frac{R_0}{\alpha}\frac{\overline{F}(\alpha+\sqrt{\cdot})-2R_0(1-\alpha)}{\alpha\overline{F}(\alpha+\sqrt{\cdot})-(1-\alpha)2R_0(2\alpha+\sqrt{\cdot})},$

with $\sqrt{\cdot} = \sqrt{\alpha^2 - \frac{4\alpha R_0}{\overline{F}}(1-\alpha)}$.

The derivate $\frac{\partial X_1}{\partial \alpha}$ is negative if $\frac{\overline{F}(\alpha+\sqrt{\cdot})-2R_0(1-\alpha)}{\alpha\overline{F}(\alpha+\sqrt{\cdot})-(1-\alpha)2R_0(2\alpha+\sqrt{\cdot})} > 0$.

With the assumption $\overline{F} > \frac{4R_0(1-\alpha)}{\alpha}$ it follows for the numerator that

$\overline{F}(\alpha + \sqrt{\cdot}) - 2R_0(1-\alpha) > 0$, as $\overline{F}(\alpha + \sqrt{\cdot}) > \overline{F}\alpha$ and $2R(1-\alpha) < 4R_0(1-\alpha)$.

The denominator is larger than zero if $\alpha^2\overline{F} - (1-\alpha)\alpha 4R_0 > \sqrt{\cdot}\underbrace{[(1-\alpha)2R_0 - \alpha\overline{F}]}_{<0,\ \text{as}\ \overline{F}\alpha-4R_0(1-\alpha)>0}$,

thus if $\alpha\underbrace{(\overline{F}\alpha - (1-\alpha)4R_0)}_{>0} > 0$, which is fulfilled.

Hence, it follows that $\frac{\partial X_1}{\partial \alpha} < 0$.

- As X_1 is independent of X, it follows immediately that $\frac{\partial X_1}{\partial X} = 0$.

A3.5 Proof of Proposition 3.4: Comparative Statics w.r.t. $\overline{F}$

- $\frac{\partial\left(\frac{F_1^*}{\overline{F}}\right)}{\partial \overline{F}} = -\frac{1}{\overline{F}^2}R_0\frac{(1-\alpha)}{\sqrt{\alpha^2 - \frac{4\alpha R_0}{\overline{F}}(1-\alpha)}} < 0.$

- $\frac{\partial X_1}{\partial \overline{F}} = -\frac{2}{\overline{F}}R_0^2\frac{(1-\alpha)^2}{\alpha\overline{F}(\alpha+\sqrt{\cdot})-2R_0(1-\alpha)(2\alpha+\sqrt{\cdot})}$,   with $\sqrt{\cdot} = \sqrt{\alpha^2 - \frac{4\alpha R_0}{\overline{F}}(1-\alpha)}$.

As $-\frac{2}{\overline{F}}R_0^2(1-\alpha)^2 < 0$, it holds that $\frac{\partial X_1}{\partial \overline{F}} < 0$ if $\alpha\overline{F}(\alpha+\sqrt{\cdot})-2R_0(1-\alpha)(2\alpha+\sqrt{\cdot}) > 0$

By subtracting and adding $2R_0(1-\alpha)\sqrt{\cdot}$ on the LHS, we obtain the condition

$\underbrace{[\alpha\overline{F} - 4R_0(1-\alpha)]}_{>0}(\alpha + \sqrt{\cdot}) + 2R_0(1-\alpha)\sqrt{\cdot} > 0,$

which is always fulfilled. Hence, it follows that $\frac{\partial X_1}{\partial \overline{F}} < 0$.

A3.6 Derivation of Welfare Functions

1) Welfare for the First Best Case

$$WF^{FB} = \underbrace{\alpha(X - R_0)}_{\sum E\pi_G} + \underbrace{(1-\alpha)0}_{\sum E\pi_B} + \underbrace{\alpha R_0 - \alpha R_0}_{\sum E\pi_I} = \alpha(X - R_0) > 0.$$

2) Welfare in the Closed Economy with Market Breakdown

$WF_C^{MBD} = 0$ (none of the firms invests)

3) Welfare in the Closed Economy without Market Breakdown

$$WF_C^{NMBD} = \alpha \underbrace{(X - R_C)}_{\sum E\pi_G} + \underbrace{(1-\alpha)0}_{\sum E\pi_B} + \underbrace{\alpha R_C - R_0}_{\sum E\pi_I}$$

$$= \alpha X - R_0.$$

With $X - \frac{R_0}{\alpha} \geq 0$ it follows that $WF_C^{NMBD} > 0$, .

4) Welfare in the Open Economy with Market Breakdown

$$WF_O^{MBD} = \alpha \frac{F_0^*}{\overline{F}}(X - R_0) - \alpha \underbrace{\int_0^{F_0^*} F_i \frac{1}{\overline{F}} dF_i + \alpha \frac{F_0^*}{\overline{F}} R_0 - \alpha \frac{F_0^*}{\overline{F}} R_0}_{\text{Investors}}$$

$$\underbrace{\qquad\qquad\qquad\qquad}_{\text{Cross-listing good firms}}$$

$$= \alpha \frac{F_0^*}{\overline{F}}(X - R_0) - \frac{1}{2}\frac{\alpha}{\overline{F}}F_0^{*2}.$$

with $F_0^* = X - R_0$ it follows that

$$WF_O^{MBD} = \frac{\alpha}{2\overline{F}}(X - R_0)^2 > 0.$$

5) Welfare in the open economy without market breakdown

$$WF_O^{NMBD} = \underbrace{(1-\alpha)0}_{\text{Bad firms}} + \underbrace{(\alpha - \alpha \frac{F_1^*}{\overline{F}})(X - \widetilde{R}(F_1^*))}_{\text{Non-cross-listing good firms}} +$$

$$\underbrace{\alpha \frac{F_1^*}{\overline{F}}(X - R_0) - \alpha \int_0^{F_1^*} F_i \frac{1}{\overline{F}} dF_i}_{\text{Cross-listing good firms}} + \underbrace{\alpha \frac{F_1^*}{\overline{F}} R_0 + (\alpha - \alpha \frac{F_1^*}{\overline{F}})\widetilde{R}(F_1^*) - R_0}_{\text{Investors}}$$

$$= \alpha X - R_0 - \frac{1}{2}\frac{\alpha}{\overline{F}}F_1^{*2}.$$

With the condition $X \geq \frac{R_0(1 - \alpha \frac{F_1^*}{\overline{F}})}{\alpha(1 - \frac{F_1^*}{\overline{F}})}$ for no market breakdown in the open economy,

it follows that $\alpha X \geq R_0 + \underbrace{(X - R_0)}_{\hat{=}F_0^* > F_1^*}\alpha \frac{F_1^*}{\overline{F}} > R_0 + F_1^*\alpha \frac{F_1^*}{\overline{F}} > R_0 + \frac{1}{2}F_1^*\alpha \frac{F_1^*}{\overline{F}}.$

Hence, it holds that $WF_O^{NMBD} > 0$.

A3.7 Comparative Statics Welfare w.r.t. α and X

- The derivatives of the welfare functions with respect to α are given by

$$\frac{\partial WF_C^{MBD}}{\partial \alpha} = 0$$

$$\frac{\partial WF_C^{NMBD}}{\partial \alpha} = X > 0,$$

$$\frac{\partial WF_O^{MBD}}{\partial \alpha} = \frac{1}{2\overline{F}}(X - R_0)^2 > 0,$$

$$\frac{\partial WF_O^{NMBD}}{\partial \alpha} = X - \left[\frac{F_1^{*2}}{2\overline{F}} + \frac{\alpha}{\overline{F}}F_1^* \frac{\partial F_1^*}{\partial \alpha}\right].$$

With $\frac{\partial F_1^*}{\partial \alpha} = -\frac{\overline{F}}{2\alpha^2}\frac{R_0}{\sqrt{\frac{\overline{F}^2}{4} - \frac{\overline{F}R_0}{\alpha}(1-\alpha)}} < 0$, it follows that $\frac{\partial WF_O^{NMBD}}{\partial \alpha} > 0$, if $X - \frac{F_1^{*2}}{2\overline{F}} > 0$.

As in the case without market breakdown it holds that $F_1^* < F_0^* = X - R_0$,

the above condition is a fortiori fulfilled if $2\overline{F}X > (X - R_0)^2$.

As $\overline{F} > X - R_0$, this condition holds and $\frac{\partial WF_O^{NMBD}}{\partial \alpha} > 0$.

- The derivatives of the welfare functions with respect to X are given by

$$\frac{\partial WF_C^{MBD}}{\partial X} = 0$$

$$\frac{\partial WF_C^{NMBD}}{\partial X} = \alpha > 0,$$

$$\frac{\partial WF_O^{MBD}}{\partial X} = \frac{\alpha}{\overline{F}}(X - R_0) > 0,$$

$$\frac{\partial WF_O^{NMBD}}{\partial X} = \alpha > 0.$$

A3.8 Proof of Proposition 3.5: Comparative Statics Welfare w.r.t. $\overline{\mathbf{F}}$

- $\dfrac{\partial WF_O^{MBD}}{\partial \overline{F}} = 0$

- $\dfrac{\partial WF_O^{MBD}}{\partial \overline{F}} = -\dfrac{1}{2\overline{F}^2}\alpha(X - R_0)^2 < 0.$

- $\dfrac{\partial WF_O^{NMBD}}{\partial \overline{F}} = \dfrac{1}{8}\dfrac{\left(\alpha - \sqrt{\alpha^2 - \frac{4\alpha R_0}{\overline{F}}(1-\alpha)}\right)^2}{\sqrt{\alpha^2 - \frac{4\alpha R_0}{\overline{F}}(1-\alpha)}} > 0.$

A3.9 Proof of Proposition 3.6: Welfare Financial Market Liberalization

Recall that there is market breakdown (MBD) in the closed economy for $X < \frac{R_0}{\alpha}$ and in the open economy for $X < X_1 = \frac{R_0(2-\alpha+\sqrt{\cdot})}{\alpha+\sqrt{\cdot}}$ with $\sqrt{\cdot} = \sqrt{\alpha^2 - \frac{4\alpha R_0}{\overline{F}}(1-\alpha)}$.

It holds that $\frac{R_0}{\alpha} < X_1$ if $0 < (\alpha - \sqrt{\cdot})\underbrace{(1-\alpha)}_{>0}$,

which with $\frac{4\alpha R_0}{\overline{F}}(1-\alpha) > 0$, $\sqrt{\cdot} < \sqrt{\alpha^2}$ and therefore $\sqrt{\cdot} < \alpha$, is fulfilled $\forall \alpha \epsilon [0,1]$.

It follows that for $X < \frac{R_0}{\alpha}$, there is MBD in the closed and open economy.

For $\frac{R_0}{\alpha} \leq X < X_1$, there is MBD in the open but not in the closed economy.

And, for $X \geq X_1$, there is no MBD neither in the closed nor in the open economy.

Comparing Welfare:

$\underline{1) X < \frac{R_0}{\alpha}:}$

$\Delta WF = WF_O^{MBD} - WF_C^{MBD} = \alpha \frac{F_0^*}{\overline{F}}(X - R_0) - \frac{1}{2}\frac{\alpha}{\overline{F}}F_0^{*2} - 0 = \frac{\alpha}{2\overline{F}}(X - R_0)^2 > 0.$

$\underline{2) \frac{R_0}{\alpha} \leq X < X_1:}$

$\Delta WF = WF_O^{MBD} - WF_C^{NMBD} = \alpha \frac{F_0^*}{\overline{F}}(X - R_0) - \frac{1}{2}\frac{\alpha}{\overline{F}}F_0^{*2} - (\alpha X - R_0) = \frac{\alpha}{2\overline{F}}(X - R_0)^2 - (\alpha X - R_0).$

At the minimum value for X, which is given by $X = \frac{R_0}{\alpha}$, it holds that $\Delta WF = \frac{R^2(1-\alpha)^2}{2\alpha\overline{F}} > 0.$

With the assumption $\overline{F} > X - R_0$, it follows that the derivative is given by $\frac{\partial \Delta WF}{\partial X} = -\frac{1}{\overline{F}}\alpha\left(\overline{F} - X + R_0\right) < 0.$

Solving $\frac{\alpha}{2\overline{F}}(X - R_0)^2 - (\alpha X - R_0) = 0$ for X yields the two threshold candidates

$X_{WF1,2} = \overline{F} + R_0 \pm \sqrt{\overline{F}^2 - \frac{2\overline{F}R_0(1-\alpha)}{\alpha}}.$

The solution candidate with $+\sqrt{\cdot}$ can be excluded as it contradicts the condition $\overline{F} > X - R_0.$

Thus the candidate for the threshold level is $X_{WF} = \overline{F} + R_0 - \sqrt{\overline{F}^2 - \frac{2\overline{F}R_0(1-\alpha)}{\alpha}}.$[113]
We finally have to check that X_{WF} does lie in the parameter range $[\frac{R_0}{\alpha}; X_1)$:

Consider the lower threshold first.

$X_{WF} \geq \frac{R_0}{\alpha}$ if

$\overline{F} - \frac{R_0(1-\alpha)}{\alpha} > \sqrt{\overline{F}^2 - \frac{2\overline{F}R_0(1-\alpha)}{\alpha}}.$

As both sides are positive, squaring both sides yields after some algebraic simplifications $\frac{(1-\alpha)^2 R_0^2}{\alpha^2} > 0.$

Hence, it holds that $X_{WF} \geq \frac{R_0}{\alpha}.$

Consider the upper threshold next.[114]

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[113]With the condition $\overline{F} > \frac{(1-\alpha)4R_0}{\alpha}$ the term under the square root is always positive.

[114]Note that X_1 can also be written as $X_1 = \frac{\overline{F}}{2} - \sqrt{\frac{\overline{F}^2}{4} - \frac{\overline{F}R_0(1-\alpha)}{\alpha}} + R_0.$ This is derived by setting $F_0^* = X - R_0$ equal to F_1^* which in equilibrium holds at $X_1.$

$X_{WF} < X_1$ if $\frac{\overline{F}}{2} - \sqrt{\frac{\overline{F}^2}{4} - \frac{\overline{F}R_0(1-\alpha)}{\alpha}} < \sqrt{\overline{F}^2 - \frac{2\overline{F}R_0(1-\alpha)}{\alpha}}$.

Again as both sides are positive, squaring yields after some algebraic simplification

$-\sqrt{\frac{\overline{F}^2}{4} - \frac{\overline{F}R_0(1-\alpha)}{\alpha}} < \frac{\overline{F}}{2} - \frac{R_0(1-\alpha)}{\alpha}$.

With $\overline{F} > \frac{4R_0(1-\alpha)}{\alpha}$ this is definitely fulfilled.

It follows that $WF_O^{MBD} - WF_C^{NMBD} > 0$ for $X < X_{WF}$, and $WF_O^{MBD} - WF_C^{NMBD} \leq 0$ for $X \geq X_{WF}$.

3)$X_1 \leq X$:

$\Delta WF = WF_O^{NMBD} - WF_C^{NMBD} = \alpha X - R_0 - \frac{1}{2}\frac{\alpha}{\overline{F}}F_1^{*2} - (\alpha X - R_0) = -\frac{1}{2}\frac{\alpha}{\overline{F}}F_1^{*2} < 0$.

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