Risk and the Corporate Structure of Banks*

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Abstract

Banks organize their foreign affiliates as separately incorporated subsidiaries, or as branches whose liabilities represent claims on the parent institution. Different risks influence this decision. Subsidiary-based corporate structures benefit from the greater protection against economic (credit) risk provided by affiliate-level limited liability, but are more exposed to the risk of capital expropriation, against which branch structures are protected. Moreover, branch structures benefit from a more efficient internal market for bank capital. Greater cross-country risk correlation and more accurate pricing of risk by investors reduce the differences between the two structures. Finally, the bank's corporate structure affects risk taking and affiliate size.

1 Introduction

In recent years, bank mergers and cross-border entry have intensified in advanced economies, and international banks have established a substantial presence in several middle-income and developing countries. Entry in these markets has taken a variety of forms, ranging from the acquisition of domestic institutions with extensive branch networks to the establishment of isolated representative offices aimed at serving niche segments. These movements have reflected a wide range of factors, including regulation in the home and host countries, competitive conditions in the target markets, and risk-management considerations. Since the mode of entry affects the degree of the parent bank's responsibility with regard to the affiliate's liabilities, it is likely to be influenced by financial and political factors.[1] The focus of this paper is the analysis of how risk, in a variety of forms, affects the organizational structure of banks' foreign operations.

Our primary focus is on the choice between setting up affiliates as either subsidiaries or as branches since this choice has important implications for the parent bank's risk exposure. Subsidiaries are locally incorporated stand-alone entities endowed with their own capital and protected by limited liability at the affiliate level. In other words, they are essentially foreign-owned local banks for which the parent bank's legal obligation is limited to the capital that has been invested. By contrast, branches are merely offices of the parent bank without an independent legal personality. As such, the liabilities of branch affiliates represent real claims on the parent bank. That risk is an important determinant of banks' choice between these two forms of organization is evident from Figure 1, which plots the proportion of foreign affiliates organized as branches in each host country against a measure of political stability relative to economic stability.[2] From the figure one discerns a clear relationship between the relative importance of political versus economic stability. When political stability is high relative to economic stability (so that macroeconomic risk is relatively more important), we see few branches as banks prefer to expand abroad by setting up subsidiaries. On the other hand, when political stability is low relative to economic stability, so that political risk is

[1] See, for example, Song (2004) and Lastra (2003).

[2] The data in the figure are from Cerruti et al. (2007)

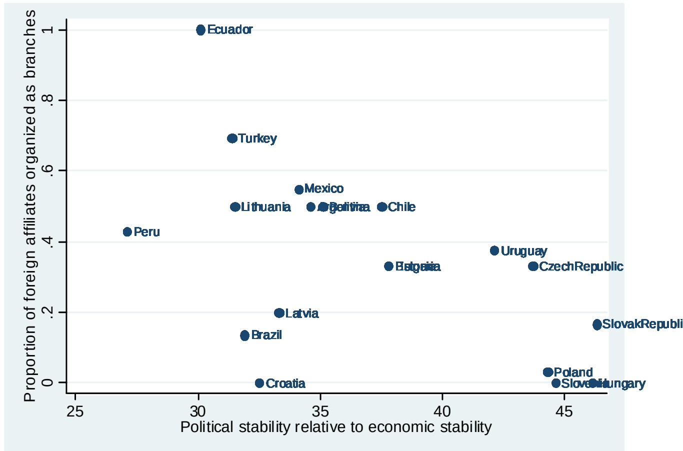

Figure 1: Percentage of Branches: The figure presents the fraction of affiliates organized as branches as a function of a measure of the difference between political and economic risk for a cross-section of countries.

of greater concern, banks generally choose to organize their foreign affiliates as branches of the parent bank, thus eschewing the limited liability protection afforded by the subsidiary structure.

The model we present explains this pattern and analyzes the implications of risk on banks' organizational form. In our model, a bank that is active across multiple markets - either national or international - can organize its operations as either branches or subsidiaries. The activities of these affiliate banks are subject to two sources of risk. First, banks are subject to credit risk in the host market. Some of this risk can arise as a result of changes in macroeconomic conditions as shocks to economic activity and interest rates affect the credit worthiness of borrowers and may lead them to default on their loans, making the affiliates' revenue uncertain. Second, in the case of foreign affiliates, host governments may engage in policies that infringe on the banks' property rights and expropriate either fully or partially the bank's revenue and capital. We refer to such actions as political risk faced by the parent bank. We assume that subsidiaries are protected by limited liability at the affiliate level, whereas for branches limited liability applies at the consolidated (parent) bank level. Banks are also subject to minimum capital requirements that in the case of subsidiaries need to be met at the affiliate level, while for the branch structure can be satisfied on a consolidated basis.

We identify two trade-offs that bear on how banks choose their corporate structure. First, there is a trade-off between the stronger limited liability protection offered by a subsidiary structure and the greater protection against property right infringements offered by the branch structure. We show that when political risks are the prevalent source of uncertainty, a branch-based structure is preferable as it keeps capital with the parent bank, thus shielding it from expropriation by the foreign government. However, when credit risk is more prevalent and of greater consequence, the more fragmented limited liability of a subsidiary-based structure provides the bank with greater protection since it shields the parent company from losses that might spillover onto its balance sheet. The second trade-off weighs the limited liability protection offered by a subsidiary structure with the benefits from a more flexible internal market for bank capital associated with the branch structure. A subsidiary-based structure is preferable when the distribution of economic risk is such that extreme shocks are likely.[3] Indeed, limited liability at the affiliate level offers protection against these kind of events. By contrast, a branch-based structure will be preferable when the likelihood that limited liability at the affiliate level will be binding is low, thus avoiding the cost of having to reallocate capital across affiliates dominates.

We also examine how factors such as (1) cross-market correlation of risk; (2) the degree to which depositors and other bank creditors price risk; and (3) banks' risk taking incentives affect the relative profitability of the branch-based and the subsidiary-based structures. We show that subsidiaries are likely to take on more risk and, consistent with empirical evidence,[4] should be, on average, larger than branches. Figure 2 illustrates this result by showing that the average affiliate size is decreasing in the proportion of affiliates that are organized as branches in the host country. This has important implications for the design of regulation as well as for the availability and allocation of credit in markets characterized by a significant presence of foreign banks. We also show that, when all bank liabilities are

[3]While Houston et al. (1997) find evidence that U.S. Bank Holding Companies establish internal markets to allocate capital among their domestic subsidiaries, they find that subsidiaries remain sensitive to their own capitalization. This is consistent with the notion that important frictions affect these markets (as suggested in Shin and Stulz, 1998).

[4]See Goldberg and Saunders (1980) and Cerutti et al. (2007).

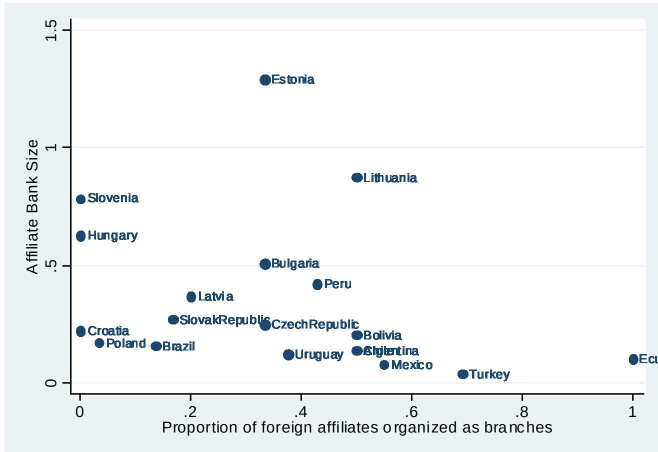

Figure 2: Affiliate Bank Size: The figure plots the average affiliate size against the proportion of affiliates in each country that are organized as branches.

correctly priced, the corporate structure finds a dual in the liability structure of the bank and the two organizational structures have the same expected profitability. In other words, a version of the Modigliani-Miller irrelevance result applies for banks' organizational structure. However, our main results continue to hold when, as is likely in practice as a result of informational frictions and implicit (or explicit) government guarantees, not all bank liabilities are correctly priced at the margin.

The main contribution of this paper is to identify different sources of risk as important determinants of a bank's corporate structure. As a bank expands into new markets, we show that the form of expansion - whether via a subsidiary or a branch - is influenced by the types of risks to which the bank will be exposed. Banks can take measures to reduce the effect of risk and to minimize the impact of losses, preserving their capital by their choice of corporate structure. The corporate structure thus becomes a function of the type of risk that is most relevant, with banks designing their organizational form to reduce the inefficiencies introduced by expropriation and to better deal with the economic risks they face as part of any expansion strategy. Our results contribute to the recent policy discussion concerning banks' limited use of the EU's “single passport” for bank entry, despite the ease of its use.[5]

[5] See, for instance, the recent speech by Padoa-Schioppa (2004), a former board member of the European Central Bank.

There is a growing empirical literature on this issue. In particular, empirical evidence in support of our findings can be found in a recent paper by Cerutti et al. (2007), who find that subsidiaries are more common in highly risky macroeconomic environments, while branches are prevalent in countries where the main risks stem from possible government intervention and other major political events. Other empirical papers have examined what drives size and presence of the foreign operations of international banks, without necessarily focusing on the choice between branches and subsidiaries (see for example, Goldberg and Saunders, 1980, Claessens et al., 2000, Focarelli and Pozzolo, 2005, and Buch, 2003).

A related literature examines the organizational structure of U.S. bank holding companies (these have been generally subsidiary structures) and how it has been affected by regulatory changes, in particular the Riegle-Neal Act (Kane, 1996). At the domestic level, the distinction between branches and subsidiaries is somewhat less stark. In this context, limited liability at the affiliate level is less relevant given the expected obligation on the part of parent banks to support their subsidiaries according to the Federal Reserve's long standing "source of strength" doctrine. At the same time, there is evidence that despite several regulatory impediments, bank holding companies have been operating well-functioning internal markets (Houston et al., 1997).

On the theoretical front, the literature on branches and subsidiaries is somewhat scant. Recent papers by Freixas, Loranth, and Morrison (2007), Loranth and Morrison (2007), Calzolari and Loranth (2007), Harr and Ronde (2005), and Dalen and Olsen (2003) have focused on the related issue of the regulation of multinational banks, distinguishing between the appropriate regulatory framework for a branch structure versus a subsidiary structure. A paper by Kahn and Winton (2004) examines how splitting a financial institution into different subsidiaries may reduce risk-shifting problems. By placing risky loans in a subsidiary, a bank shields the rest of its portfolio from bad realizations. This in turn reduces moral hazard by increasing the cost of shifting from safe to risky assets. These papers, however, do not examine the role of different types of risk on a bank's choice of its preferred organizational form. The notion of limited liability at the subsidiary level for multi-divisional firms is modeled by Bianco and Nicodano (2006) for the case of non-financial firms. However, two important aspects are specific to banks. First, unlike for manufacturing firms whose productive assets consist primarily of machinery, most of the affiliate bank's assets represent loans whose value may be difficult to extract by other parties. Second, banks are typically subject to regulation dictating minimum capital requirements, with the additional distinction that capital kept at home is not subject to expropriation, yet may still be used to satisfy these requirements.

The rest of the paper is organized as follows: Section 2 introduces the model; Section 3 compares the different bank structures; Section 4 examines several extensions, including endogenous pricing of bank assets and liabilities; Section 5 concludes.

2 Model

Consider a bank that operates across multiple markets and can organize its affiliates as branches or subsidiaries. Define the revenue of the bank's foreign affiliate $i = 1, \ldots, N$ (i.e., the affiliate that operates in market i) as well as the bank's home office, $i = 0$, as

$$L_i P_i = L_i R_i \epsilon_i,$$

where L_i and R_i are the loan quantity and average interest rate in market i which, for now, we treat as exogenous. The term ϵ_i represents credit or economic risk in country i, modelled as an idiosyncratic noise term affecting the bank's revenue. These shocks are *i.i.d.* with $\epsilon_i \in [0, 1]$ and $\epsilon_i \sim F(\bar{\epsilon}, \sigma_i^2)$.

Affiliates are also subject to political risk, which reflects the possibility that the host government engages in actions that lead to expropriation of revenue (and capital) from the affiliate. We model this with a binary variable $q_i \in \{0, 1\}$ which takes the value 1 (full expropriation) with probability φ_i and 0 (no expropriation) with probability $1 - \varphi_i$. These political risks are uncorrelated with either economic risk or across countries.

Banks can choose between organizing their affiliates either as branches or as subsidiaries. The key difference is that a subsidiary must be separately capitalized and is protected by limited liability at the afiliate level. Letting K represent the amount of capital each bank has, this means that each subsidiary must be allocated a portion K_i of this capital such that $\sum_{i=0}^{N} K_i = K$, and also such that $K_i \geq kL_i$, where k represents the minimum capital requirement. Branches, on the other hand, are not required to hold any capital at the branch, so that the entire amount K can remain at the home institution and the capital requirement can be satisfied at the consolidated level. However, parent banks are legally responsible for the branches' liabilities.[6]

Finally, banks suffer a cost when their capital is reduced as a result of lower-than-anticipated loan returns. The simplest interpretation of such a cost is as one arising from regulatory intervention: if, because of losses, bank capital falls below the required minimum (or the bank's initial amount), regulators intervene and force the bank to undertake some costly action. Such intervention may occur even if the bank is still solvent, and occurs any time the bank's capital declines below its initial level. The shareholders and management of the bank dislike regulatory intervention. This cost therefore reflects lower future profits associated with the reduction in assets necessary to meet the capital requirement, costs incurred in trying to raise and reallocate capital quickly, regulatory intervention that forces the bank to scale down its portfolio and to liquidate profitable assets, etc. We model this by assuming that the bank bears an average cost of c per dollar of capital losses.

We restrict attention to the case where banks organize all their affiliates either as branches or as subsidiaries. In addition, we assume that there is no political risk associated with lending in the bank's home market, so that $\varphi_0 = 0$.

2.1 Branch Structure

We can write the consolidated profits for the branch structure as

$$\Pi_B = \max\left\{ L_0 P_0 - D_0 r_D + \sum_{i=1}^{N} (1 - q_i)\,(L_i P_i - D_i r_D)\,, 0 \right\} - K r_K - C_K, \tag{1}$$

where r_D is the deposit interest rate, which for simplicity we assume is the same in each country, D_i is the amount of deposits held in branch i, K is the bank's total capital, and r_K is the bank's cost of equity. C_K represents the total cost associated with a capital shortage,

[6] In practice, this distinction may be blurred by contractual arrangements such as ring-fencing of branches and regulatory pressure. However, it is nevertheless more difficult for a parent bank to refuse payment for the liabilities of a branch than for those of a subsidiary.

and is detailed below. The first term captures the fact that with branches the parent bank is liable for any losses at its affiliates, but is not subject to expropriation of its capital, which stays at home.

Since branches hold no capital, we require that each branch raise enough deposits to match its loan portfolio, $L_i = D_i$. For the case of international branching, this also guarantees that the bank does not have a currency mismatch. Then we can write Eq. (1) as

$$\Pi_B = \max \left\{ L_0 P_0 - D_0 r_D + \sum_{i=1}^{N} (1 - q_i) L_i (P_i - r_D), 0 \right\} - K r_K - C_K.$$

In its home market, the bank finances its loan portfolio with its capital in addition to any deposits, which means that $D_0 = L_0 - K$. We can therefore further simplify Eq. (1) slightly and write it as

$$\begin{aligned} \Pi_B \;=\; & \max \left\{ L_0 P_0 - (L_0 - K) r_D + \sum_{i=1}^{N} (1 - q_i) L_i (P_i - r_D), 0 \right\} - K r_K \qquad (2) \\ & - c \max \left\{ K - \max \left\{ L_0 P_0 - (L_0 - K) r_D + \sum_{i=1}^{N} (1 - q_i) L_i (P_i - r_D), 0 \right\}, 0 \right\}, \end{aligned}$$

where the last term represents the cost associated with capital depletion, C_K.

The bank needs to meet the regulatory minimum capital requirement, k, at the consolidated level, so that

$$K = K_0 \geq k \left(L_0 + \sum_{i=1}^{N} L_i \right).$$

2.2 Subsidiary Structure

In contrast to the above, each subsidiary is endowed with its own capital K_i and is protected by limited liability, so that losses do not spill over from one affiliate to the other, or to the parent bank. The parent bank, however, does have a claim on the profits of the affiliates, and thus must use them to cover any losses at home. The bank's consolidated profits, Π_S, can then be written as

$$\max\{0,\ L_0P_0 - D_0r_D + \sum_{i=1}^{N}(1-q_i)\max\{L_iP_i - D_ir_D, 0\}\} - \sum_{i=0}^{N}K_ir_K \tag{3}$$
$$-c\sum_{i=1}^{N}(1-q_i)\max\{K_i - \max\{L_iP_i - D_ir_D, 0\}, 0\}$$
$$-c\max\left\{K_0 - \max\left\{\sum_{i=1}^{N}(1-q_i)\max\{L_iP_i - D_ir_D - K_i, 0\} + L_0P_0 - D_0r_D, 0\right\}, 0\right\}.$$

Note that, in this case, the last term related to each subsidiary's capital shortage is weighted by $(1-q)$ since subsidiaries can lose their capital due to political risk. Given each subsidiary has capital equal to K_i, we have that $D_i = L_i - K_i$, for $i = 0, \ldots, N$. We can therefore rewrite Π_S as

$$\max\{0,\ L_0P_0 - D_0r_D + \sum_{i=1}^{N}(1-q_i)\max\{L_iP_i - (L_i - K_i)\,r_D, 0\}\} - \sum_{i=0}^{N}K_ir_K$$
$$-c\sum_{i=1}^{N}(1-q_i)\max\{K_i - \max\{L_iP_i - (L_i - K_i)\,r_D, 0\}, 0\}$$
$$-c\max\left\{K_0 - \max\left\{\sum_{i=1}^{N}(1-q_i)\max\{L_iP_i - (L_i - K_i)\,r_D - K_i, 0\} + L_0P_0 - (L_0 - K_0)\,r_D, 0\right\}, 0\right\}.$$

Each subsidiary needs to meet the regulatory minimum capital requirement independently, that is, $K_i \geq kL_i$ for $i = 0, 1, ..., N$. Since limited liability applies at the consolidated level for the parent bank, any profits from subsidiaries can be used to honor the parent bank's liabilities. Harr and Ronde (2003) consider "parallel-owned" banks, where each bank is protected by its own separate balance sheet. We focus instead on the more common consolidated holding structure since parallel-owned banks, while not rare, are discouraged under the Basel accord.

3 Comparison of Corporate Structures

The branch structure has two advantages. First, it benefits from keeping the capital at home, thus shielding it from the risk of expropriation by the foreign government in which the affiliate operates. This benefit manifests itself through higher leverage at foreign affiliates and lower domestic deposit liabilities and, hence, higher profits in case of foreign expropriation. Second, it benefits from pooling capital at the holding company level, hence reducing the risk of costly recapitalizations or regulatory interventions when an affiliate suffers a negative shock. By contrast, the subsidiary structure enjoys limited liability at the affiliate level which protects the parent bank from economic/credit losses that arise at its subsidiary institutions. The bank's choice of corporate structure is influenced by these two different forces: the protection from economic risk relative to political risk; and the protection of limited liability versus the benefits from an internal market for bank capital. For ease of exposition, in what follows we focus on one factor at a time.

3.1 Economic Risk versus Political Risk

Start by focusing on the trade-off between protection from economic risk and political risk. To isolate this effect, let us ignore for now the costs associated with capital losses and regulatory intervention, i.e., assume $c = 0$. We can then state the following result:

Lemma 1 *There always exists a probability of expropriation φ_i large enough that $E[\Pi_B] > E[\Pi_S]$.*

Proof: For $\varphi_i = 1$, and $c = 0$, we have

$$\Pi_B - \Pi_S = \max\{L_0 P_0 - (L_0 - K)\, r_D, 0\} - \max\{L_0 P_0 - (L_0 - K_0)\, r_D, 0\} \geq 0,$$

and hence

$$E[\Pi_B] - E[\Pi_S] > 0.$$

Therefore, there must exist a value of $\varphi_i < 1$ such that $E[\Pi_B] - E[\Pi_S] > 0$ for any larger value of φ_i. ■

The lemma states that when political risk is sufficiently high, expected bank profits are higher under a branch structure than under a subsidiary structure. The intuition for this result stems from the protection of the bank's capital that is provided by the branch structure. Even if a foreign government appropriates all the revenue from the bank's foreign affiliate, none of the parent bank's capital will be subject to expropriation, thus reducing the losses to the parent bank associated with foreign political actions.

Lemma 2 *For* $\varphi_i = 0$*, and* $c = 0$*,* $E[\Pi_B] < E[\Pi_S]$*.*

Proof: With no political risk, it is easy to see that if for the parent bank and all the affiliate banks $L_i P_i > (L_i - K_i) r_D$, then $\Pi_B = \Pi_S$. However, if for any affiliate i, $L_i P_i < (L_i - K_i) r_D$, then $\Pi_B < \Pi_S$. Hence, it must be that $E[\Pi_B] - E[\Pi_S] < 0$. ■

In contrast to the previous result, this second lemma states that when there is no political risk, the branch structure is strictly inferior to a subsidiary structure. To understand this result, note that when political risk is not a concern and there are no losses associated with capital depletion, the only losses to which banks are subject are losses due to credit risk or to macroeconomic shocks that lead to reductions in revenue. With a branch structure, whenever the affiliate's revenue is not enough to cover its deposits, the parent bank becomes liable and must, to the best of its ability, make the affiliate's depositors whole. By contrast, a subsidiary with insufficient revenue to repay depositors will simply default, saving the parent company from having to absorb the affiliate's losses.

Since expected bank profits are continuous in the political risk parameter φ_i, we can now conclude the following.

Proposition 1 *If* $c = 0$*, there must exist some* $\overline{\varphi} \in (0, 1)$ *for which* $E[\Pi_B] - E[\Pi_S] = 0$*, and such that* $E[\Pi_B] < E[\Pi_S]$ *for* $\varphi_i < \overline{\varphi}$ *and* $E[\Pi_B] > E[\Pi_S]$ *for* $\varphi_i > \overline{\varphi}$*.*

The proposition establishes that a branch-based corporate structure will be preferred when political risk is relatively high, whereas a subsidiary form will be optimal when the level of political risk is low. The latter case corresponds to a situation where the predominant risk faced by financial institutions is not expropriation by foreign authorities, but rather credit or macroeconomic risk in the affiliates' portfolios. Therefore, a restatement of this result is that a subsidiary structure is optimal when credit risk is relatively more important than political risk, and that a branch structure will be preferred otherwise.

We should note that, since the focus of Proposition 1 is on political risk, it does not explain the preponderance of branch networks within country, where political risk that affects the affiliates but not the parent bank is likely to be minimal. For instance, banks within the U.S. often have a large branch network and will frequently expand across state or county boundaries via branches, even though it is unlikely that there is much cross-state political risk. We discuss this issue in the next section.

3.2 Regulatory Intervention

Recall that in the previous section we assumed that $c = 0$, so that there was no cost to banks of suffering capital losses. As argued above, such losses may arise as a result of direct regulatory intervention (fines, activity restrictions, etc.), or more indirectly as banks find it costly to recapitalize quickly and may have to give up profitable lending opportunities in the short run.

In this section, we turn to the trade-off between the benefits from an internal market for bank capital and those from limited liability at the affiliate level by letting $c > 0$. This time, we simplify calculations and isolate this effect by making the opposite extreme assumption that there is no political risk, so that $\varphi_i = 0$.

We can now write profits for the branch structure as

$$\begin{aligned}\Pi_B &= \max\left\{L_0P_0 + \sum_{i=1}^{N} L_i\left(P_i - r_D\right) - \left(L_0 - K\right)r_D, 0\right\} - Kr_K \\ &\quad -c\max\left\{K - \max\left\{L_0P_0 - \left(L_0 - K\right)r_D + \sum_{i=1}^{N} L_i\left(P_i - r_D\right), 0\right\}, 0\right\}\end{aligned}$$

where c is the average cost associated with capital depletion. Profits for the subsidiary structure become

$$\begin{aligned}\Pi_S &= \max\{0, \left(L_0P_0 - \left(L_0 - K_0\right)r_0\right) + \sum_{i=1}^{N} \max\left\{L_iP_i - \left(L_i - K_i\right)r_i, 0\right\}\} \\ &\quad -c\sum_{i=1}^{N} \max\{K_i - \max\{L_iP_i - \left(L_i - K_i\right)r_D, 0\}, 0\} \\ &\quad -c\max\left\{K_0 - \max\left\{\sum_{i=1}^{N} \max\{L_iP_i - \left(L_i - K_i\right)r_D - K_i, 0\} + L_0P_0 - D_0r_D, 0\right\}, 0\right\}\end{aligned}$$

We first consider the case where the risk structure of banks' loan portfolios is such that limited liability at the affiliate level is never binding: $L_i P_i - (L_i - K_i) r_D \geq 0$ for all i, which simply amounts to a restriction on the range of values for ϵ_i, in that ϵ_i should not be too small. This simplified case isolates the effect of the cost of intervention in a setting where there is otherwise no difference between the two possible structures, branches or subsidiaries. As such, this case highlights the benefits stemming from what is in essence an internal market for bank capital to which banks with branch structures have easy access, while those with subsidiary structures find it more difficult to reallocate capital across affiliates.[7]

Lemma 3 *Assume $L_i P_i - (L_i - K_i) r_D \geq 0$ $\forall i$, and $\varphi_i = 0$. Then, for $c > 0$, $\Pi_B \geq \Pi_S$ and $E[\Pi_B] > E[\Pi_S]$.*

Proof: See the Appendix. ■

The lemma establishes that when banks face costs arising from losses of capital yet economic risk is contained, they benefit from organizing their affiliate in a branch structure rather than a subsidiary structure. The intuition is that by having a branch structure the bank is able to reallocate capital from one branch (or from the parent institution) with a surplus of capital to one with a shortage as a result of poor performance on its loan portfolio. One reason a branch may have a surplus, of course, is because of earnings in excess of the amount of capital invested. By reallocating (or rather, by consolidating) capital, the bank is able to avoid regulatory intervention and can thus reduce its costs. By contrast, it may be more difficult to reallocate capital across separate subsidiaries. Therefore, any subsidiary with poor earnings will have to bear the cost of covering its own capital losses.[8]

To generalize the result to the case where shocks are such that limited liability at the affiliate level may offer the bank protection from economic losses, define $\lambda = \Pr(L_i P_i -$

[7] This simply reflects the notion that the parent bank cannot easily move capital from one legally incorporated and separately capitalized subsidiary into another. Likewise, the bank cannot costlessly move capital from the parent into one of the subsidiaries.

[8] We note that the term "internal capital market" has sometimes, in the literature on corporate finance, been taken to mean an ability to redirect funds into more productive projects. This usage is somewhat different from ours, in that here the internal market for capital represents the fact that branch networks are able to meet regulatory requirements on a consolidated basis, and thus have an ability to deploy capital in order to avoid regulatory intervention.

$(L_i - K_i)\, r_D < 0$). Now, considering that from Lemma 3 we know that for $c = 0$, $E[\Pi_B] < E[\Pi_S]$, we have the following proposition:

Proposition 2 *For any $\lambda > 0$, there exists a $\overline{c} > 0$, such that for $c < \overline{c}$, $E[\Pi_B] < E[\Pi_S]$ and for $c \geq \overline{c}$, $E[\Pi_B] > E[\Pi_S]$.*

Proof: The result follows directly from the continuity of $E[\Pi_B]$ and $E[\Pi_S]$ with respect to c and the results in Lemmas 2 and 3. ■

This proposition establishes a trade-off between the protection against extreme shocks offered by limited liability at the affiliate level and the benefits associated with an internal market for bank capital when shocks are smaller. We note as well that these results can be used to shed light on banks' holding of capital buffers against negative shocks to their loan portfolios. Since the bank incurs a cost when its level of capital is reduced, banks may have an incentive to hold an additional buffer above and beyond the regulatory minimum k to reduce the likelihood of having to bear this cost. In this context, one prediction of our analysis is that, since subsidiary-based corporate structures face higher expected costs associated with capital depletions, banks structured as subsidiaries should have incentives to hold larger capital buffers on aggregate than would branches.

An alternative way to isolate the benefits stemming from an internal market for bank capital of a branch structure is by looking at the effects of regulatory intervention on the different corporate structures for a well diversified group. To this end, assume that opportunities at each affiliate are all symmetric, so that $L_i = \frac{1}{N}L$, and that consequently with a subsidiary structure each foreign affiliate is allocated an amount of capital equal to $K_i = \frac{1}{N}K$.

Proposition 3 *For any $c > 0$, there is a value N' such that, for $N > N'$, we have $E[\Pi_B] - E[\Pi_S] > 0$.*

Proof: See the Appendix. ■

The proposition establishes that when the bank is well diversified across its affiliates, a branch structure will always be preferred when the costs associated with capital depletion are sufficiently high. The intuition for this result is similar to that for Lemma 3, in that diversification reduces the likelihood that the bank will suffer a negative shock to capital at the consolidated level, even if a potentially large number of individual affiliates may have negative shocks. With a sufficiently large network of branches, being able to meet the capital requirement at the consolidated level significantly reduces the expected costs of regulatory intervention or lost lending opportunities that accompany a negative shock to capital. We note, however, that it is important that the risks across affiliates be sufficiently uncorrelated, as otherwise increasing the size of the network need not improve diversification opportunities (we discuss this issue further in the next section).

4 Extensions and Robustness

In this section, we relax some of the assumptions in the model. First, we analyze the effect of correlation of credit risk across countries on our results. We also endogenize the rates of return in the model. Then, we show that while expected profits are invariant across corporate structures when all risks are fully priced, our results continue to hold as long as the pricing for a fraction of the bank's liabilities is insensitive to risk. To economize on notation and focus directly on each effect, we assume throughout this section that $c = 0$, so that there is no additional cost to a bank that finds itself undercapitalized. We also assume throughout this section that the parent bank has only one foreign affiliate ($N = 1$).

4.1 Cross-country Correlation of Risks

One likely important determinant of banks' preferred organizational structures is the way in which economic risk is distributed across countries. We have shown that a subsidiary structure is optimal for the parent institutions when economic risk is the major concern, since the shield against potential losses that is provided by limited liability is maximized when the bank's structure is fragmented, as it is under a subsidiary structure. In the analysis so far we have assumed that all shocks are *i.i.d.* However, when economic risks in the foreign affiliates are correlated with the risks faced domestically, the additional protection afforded by limited liability at the affiliate level will be reduced, since then losses in a bank's foreign operations will tend to occur contemporaneously with losses in the home country. In the extreme case of perfect correlation across countries, the effect of economic risk on bank profits under the two organizational forms will be the same. This discussion is summarized in the following result, which we prove in the next two subsections.

Proposition 4 *The difference in expected profits between a subsidiary structure and a branch structure,* $E[\Pi_S] - E[\Pi_B]$*, is decreasing in the cross-country correlation of economic risks.*

Intuition for this result can be obtained by focusing on what happens in the case of identical countries. Consider a situation where all affilitiates in our model are identical in all respects: $L_i = L$ and $R_i = R$ for all i. Then, in the absence of political risk and with fully correlated economic risks, so that $\epsilon_i = \epsilon$, we have $\Pi_S = \Pi_B$. Indeed, under these conditions, if one affiliate goes under, so will all other affiliates. Hence, if limited liability is binding at the affiliate level it will also be binding on a consolidated basis, and banks obtain no benefit from a fragmented capital structure. Put differently, there are no states of the world in which a foreign affiliate is in difficulty but the home country is not, and vice versa. As risks become less correlated, however, the probability that some affiliates and the parent bank remain profitable while other affiliates fail increases. When that happens, the difference between Π_S and Π_B also increases.

To study the effect of increased correlation more formally, we present two simplifications of the model. The first, which focuses on an extremely simple binary structure for the economic shocks, presents a simple intuition for the effects of an increase in correlation between a bank's foreign and domestic activities. The second case generalizes the result to a broader class of distribution functions for the economic shock, focusing on a uniform distribution to obtain closed form solutions.

4.1.1 Binary Shocks

Consider the simplest case where economic shocks are binomial: $\epsilon_i \in \{0, 1\}$, and there is no political risk. Then, the following table describes the realized profits for the branch and the subsidiary structures in the four possible states of the world.

	$\epsilon_1 = 1$	$\epsilon_1 = 0$
$\epsilon_0 = 1$	$\Pi_S = \Pi_B > 0$	$\Pi_S = L_0 R_0 - (L_0 - K_0) r_D - K r_K$ $\Pi_B = \max \{L_0 R_0 - (L_0 - K) r_D - L_1 r_D, 0\} - K r_K$
$\epsilon_0 = 0$	$\Pi_S = \Pi_B \geq -K r_K$	$\Pi_S = \Pi_B = -K r_K$

We can now write

$$E[\Pi_S] - E[\Pi_B] = \Pr(\epsilon_0 = 1, \epsilon_1 = 0) \min \{L_0 R_0 - (L_0 - K_0) r_D, L_1 r\},$$

and since $\frac{\partial \Pr(\epsilon_0=1,\epsilon_1=0)}{\partial corr(\epsilon_0,\epsilon_1)} < 0$, we have $\frac{\partial E[\Pi_S]-E[\Pi_B]}{\partial corr(\epsilon_0,\epsilon_1)} < 0$. This establishes Proposition 4 for this simple case. To the extent that economic risk is likely more correlated within-country than across countries, this result is consistent with the stylized fact that, while subsidiaries are the prevalent form of organization for banks' cross-border activities,[9] domestically banks tend to be organized as branch networks.

Note as well that this has the following further implication:

Corollary 1 *The threshold value of political risk* $\overline{\varphi}$ *for which* $E[\Pi_S]-E[\Pi_B] = 0$ *is decreasing in the cross-country correlation of economic risks.*

4.1.2 Uniformly Distributed Shocks

Consider the more general case where economic shocks are distributed over some fixed closed interval, and the correlation structure for shocks across countries can be described by a single parameter α (we maintain the assumption that there is political risk). Specifically, the domestic economic shock is distributed as follows: $\epsilon_0 \backsim U[0,1]$, and the shock at the affiliate is characterized by $\epsilon_1 = \alpha\epsilon_0 + (1-\alpha)\eta$, with $\eta \backsim U[0,1]$. Remember that $\Pi_S > \Pi_B$ requires that *i)* $L_0 P_0 - (L_0 - K_0) r_D > 0$, and *ii)* $L_1 P_1 - (L_1 - K_1) r_D < 0$. Let us define $\underline{\epsilon_0}$ and $\underline{\epsilon_1}$ as the break-even values of the shocks, under the subsidiary structure, for the domestic activities of the parent bank and of the affiliate, respectively. That is

$$\begin{aligned} \underline{\epsilon_0} R L_0 - (L_0 - K_0) r_D &= 0 \\ \underline{\epsilon_1} R L_1 - (L_1 - K_1) r_D &= 0 \end{aligned}$$

[9] Cerutti et al (2007) find that about two-thirds of banks' foreign affiliates are subsidiaries.

To isolate the effect of correlation in credit risk across countries, we eliminate any effects that may be introduced by asymmetries in the sizes of the countries by assuming that $L_0 = L_1$ and $K_0 = K_1$. This will imply that $\underline{\epsilon_0} = \underline{\epsilon_1}$.

The following table describes the realized profits for the branch and the subsidiary structures in the four possible states of the world. Note that, as before, the only case in which profits differ is when the affiliate makes losses, but the parent bank (under the subsidiary structure) does not.

	$\epsilon_1 \geq \underline{\epsilon_1}$	$\epsilon_1 < \underline{\epsilon_1}$
$\epsilon_0 \geq \underline{\epsilon_0}$	$\Pi_S = \Pi_B > 0$	$\Pi_S = L_0 P_0 - (L_0 - K_0) r_D - K r_K$ $\Pi_B = \max \{L_0 P_0 - (L_0 - K) r_D - L_1 (P_1 - r_D), 0\} - K r_K$
$\epsilon_0 < \underline{\epsilon_0}$	$\Pi_S = \Pi_B \geq -K r_K$	$\Pi_S = \Pi_B \geq -K r_K$

We can now write $E[\Pi_S] - E[\Pi_B]$ as

$$\Pr\left(\epsilon_0 \geq \underline{\epsilon_0}, \epsilon_1 < \underline{\epsilon_1}\right) E\left[\min\left\{L_0 P_0 - (L_0 - K_0) r_D, -(K - K_0) r_D - L_1 (P_1 - r_D)\right\}\right], \quad (4)$$

where the expectation is conditional on $\epsilon_0 \geq \underline{\epsilon_0}$ and $\epsilon_1 < \underline{\epsilon_1}$. While we relegate the formal proof of Proposition 4 to the appendix, we note that it relies on the fact that as the correlation between ϵ_0 and ϵ_1 increases (i.e., as α increases), $\Pr\left(\epsilon_0 \geq \underline{\epsilon_0}, \epsilon_1 < \underline{\epsilon_1}\right)$ must decrease since it becomes less likely that one bank is profitable while the other one loses money. Similarly, the second term representing the difference in the expected payoffs conditional on $\epsilon_0 \geq \underline{\epsilon_0}$ and $\epsilon_1 < \underline{\epsilon_1}$ must also get smaller as α increases since domestic profits are more likely to be low when the foreign affiliate makes losses as the correlation increases. Thus, an increase in the correlation of credit risk across countries reduces the value of the protection afforded by limited liability at the affiliate level for a subsidiary structure, and makes a branch structure relatively more attractive.

4.2 Endogenous Rates on Deposits

So far, we have assumed that the affiliates' cost of funds is exogenous and does not depend on the organizational structure of the bank. In practice, however, this cost is likely to reflect, at least to some extent, the different liability structures behind the two organizational forms.

While deposits are often covered by some form of insurance, the rate investors demand on other bank liabilities such as CD's or subordinated debt depends on the riskiness of the bank's portfolio.[10] It is possible that endogenizing the rates of return on deposits as well as other liabilities could tilt the balance in favor of one structure or the other. Formally, this would imply that the threshold value of expropriation risk $\overline{\varphi}$ above which branches are preferred could shift up or down once we allow the return on banks' liabilities to adjust for risk.

To study this formally, it is useful to again specialize the model slightly. Consider once more the case where economic shocks to the affiliate have a binomial structure: $\epsilon_1 \in \{0, 1\}$. In addition, assume that there is no risk in the parent bank's market, so that $\epsilon_0 = 1$, and that the relative sizes of the parent bank and the affiliate are such that the parent bank would not go under even when the affiliate is a branch and suffers a negative shock ($\epsilon_1 = 0$). Under these simplifying conditions, the liabilities of the parent bank will be remunerated at the risk free rate r^*. The affiliate will pay a rate $r_b = \frac{r^*}{1-\varphi}$ when organized as a branch and the higher rate $r_s = \frac{r^*}{\theta(1-\varphi)}$ when organized as a subsidiary, where $\theta = \Pr(\epsilon_1 = 1)$. We can now state the following result.

Proposition 5 *When all the bank's liabilities are priced to fully reflect risk, expected profits are invariant across organizational structures:* $E[\Pi_S] = E[\Pi_B]$.

Proof: The expected profits for the subsidiary structure are

$$E[\Pi_S] = L_0 R_0 - (L_0 - K_0)\, r^* + \theta\,(1-\varphi)\,(L_1 R_1 - (L_1 - K_1)\, r_s) - K r_K$$

while for the branch structure they are

$$E[\Pi_B] = L_0 R_0 - (L_0 - K)\, r^* + (1-\varphi)\,(\theta L_1 R_1 - L_1 r_b) - K r_K.$$

We can then write

$$E[\Pi_S] - E[\Pi_B] = -K_1 r^* - \theta\,(1-\varphi)\,(L_1 - K_1)\, r_s + (1-\varphi)\, L_1 r_b.$$

[10] See, for example, Martinez-Peria and Schmukler (2001).

Substituting for r_s and r_b yields

$$E[\Pi_S] - E[\Pi_B] = -K_1 r^* - \theta(1-\varphi)(L_1 - K_1)\frac{r^*}{\theta(1-\varphi)} + (1-\varphi)L_1\frac{r^*}{(1-\varphi)} = 0,$$

demonstrating that there is no difference in the expected profits of a bank with a branch structure and one with a subsidiary structure. ■

With risk neutral creditors and symmetric information, this result reflects a version of the Modigliani-Miller theorem that usually states that capital structure is irrelevant when markets are complete. Indeed, the corporate structure of the bank has a dual in its liability structure since it is the fragmented capital structure implicit in a subsidiary arrangement that affords the parent bank protection from the failure of its affiliates and can increase value in those circumstances.

While the Modigliani-Miller irrelevance result represents a useful benchmark, in practice it is unlikely that *all* bank liabilities are correctly priced at the margin. First, asymmetric information between banks and creditors prevents the latter from correctly pricing risk. Second, the widespread use of deposit insurance insulates a large portion of bank liabilities from market discipline.

We therefore examine the case where only a portion of each bank's liabilities (e.g., deposits) are covered by a government sponsored deposit insurance scheme, and the remainder are uninsured and must offer a rate to investors that reflects any risk borne by them. Specifically, suppose that a portion $1-\gamma$ of the affiliate's liabilities is insured and hence priced as risk-free, while the pricing for the remaining portion, γ, correctly reflects the risk of repayment. An alternative interpretation is that market participants expect a bailout of the bank's liabilities with probability $1-\gamma$. Assume that there is political risk in the market where the affiliate operates, but not at home. Then we can write the following proposition:

Proposition 6 *For any* $\gamma < 1$*, there is a value* $\overline{\varphi}(\gamma) < 1$ *such that* $E[\Pi_B] > E[\Pi_S]$ *for* $\varphi > \overline{\varphi}(\gamma)$*, and* $E[\Pi_B] < E[\Pi_S]$ *for* $\varphi < \overline{\varphi}(\gamma)$*.*

Proof: See the Appendix. ■

This proposition extends our main result from Proposition 1 to the case of partial pricing of the bank's liabilities. In particular, it establishes that as long as all risk is not perfectly reflected in the pricing of the bank's liabilities, a branch structure will be preferred when political risk is high, while a subsidiary structure will be optimal when political risk is low and therefore credit risk is the primary concern. For $\gamma = 1$, all risk is priced correctly, and the two structures become equivalent, as in Proposition 5.

4.3 Endogenous Rates of Return on Bank Assets

Up to now we have assumed that the rate of return banks obtain on their loans, R_i, is exogenous and does not depend on the scale of foreign operations for each bank. While this is consistent with an oligopolistic market structure where banks are protected by barriers to competition, in more contestable markets we would expect returns to reflect market characteristics and competitive forces.

In principle, considerations about competition among lenders may affect not only the form of entry, but also the scale of entry to the extent that increasing the size of foreign operations reduces the return to those operations. For instance, holding the scale of a bank's operations constant, each bank should require a larger return for its subsidiaries as partial compensation for the political risk it faces, which manifests itself in an expropriation by the foreign government of any capital moved abroad. Moreover, this increase in compensation should be increasing in φ_i, the level of political risk, widening the gap in the required return for the bank between the subsidiary case and the branch structure.

In equilibrium, of course, banks should allocate their resources in such a way that the marginal return in each market is the same, thus endogenizing the scale of each bank's operations across affiliates. We show in this section that allowing banks to determine the scale of their operations does not affect the qualitative nature of our results, and yields additional implications related to the difference in sizes of affiliate branches versus subsidiaries.

To study how banks may adjust their scale to reflect market conditions as well as their choice of organizational form, in what follows we assume that R_i is a decreasing function of L_i: $R'(L_i) < 0$, so that more lending means that the per loan return must decrease. Since we now allow banks to choose the size of their portfolios, we assume that banks can raise an unlimited amount of deposits at a price r_D, as well as capital at a cost of r_K. We also impose the constraint that banks must satisfy the minimum capital requirement, $k \leq \frac{K}{L}$, and we assume that this capital requirement will always be binding, which implies that $K = kL$ for the total amount of lending done by each bank. This also means, of course, that a subsidiary must satisfy $K_i = kL_i$. As above, we assume that there is one subsidiary, $i = 0, 1$, that any risk the bank faces is only at the subsidiary level, and that $\epsilon_1 \in \{0, 1\}$, so that the economic risk structure is binary. In what follows, the superscripts S and B refer to the loan portfolio choices of the subsidiary structure and the branch structure, respectively. We can now write the expected profits for the branch and subsidiary structures, respectively, as

$$\begin{aligned}
E[\Pi_B] &= L_0^B R_0 \left(L_0^B\right) - \left(L_0^B - k\left(L_0^B + L_1^B\right)\right) r_D - k\left(L_0^B + L_1^B\right) r_K \\
&\quad + (1-\varphi)\left(\theta L_1^B R_1 \left(L_1^B\right) - L_1^B r_D\right) \\
E[\Pi_S] &= L_0^S R_0 \left(L_0^S\right) - \left(L_0^S - kL_0^S\right) r_D - k\left(L_0^S + L_1^S\right) r_K \\
&\quad + (1-\varphi)\,\theta\left(L_1^S R_1 \left(L_1^S\right) - \left(L_1^S - kL_1^S\right) r_D\right),
\end{aligned}$$

where $\theta = \Pr(\epsilon_1 = 1)$ and $\varphi = \Pr(q = 1)$, as before.

We can now establish the following result.

Lemma 4 *Both the subsidiary and the branch structures choose the same portfolio size in their domestic market:* $L_0^B = L_0^S$. *In the foreign market, for* $\varphi > \frac{(1-k)(1-\theta)}{1-\theta(1-k)}$, $L_1^B > L_1^S$, *while for* $\varphi < \frac{(1-k)(1-\theta)}{1-\theta(1-k)}$, $L_1^B < L_1^S$.

Proof: See the Appendix. ■

This result establishes that when political risk is high relative to macroeconomic risk, banks with a branch structure will optimally choose a larger affiliate than those with a subsidiary structure. The intuition stems from the fact that when a bank expands the scale of its affiliate, it increases its overall cost since it must raise additional capital at a marginal cost of r_K, as well as raise additional deposits at cost r_D. As φ increases, however, the likelihood that the deposits will have to be repaid decreases, reducing the expected payment made by the parent bank. Since branch structures finance a higher fraction of their loan portfolios with deposits from the market in which the affiliate operates, their reduction in expected payment is larger than for a subsidiary structure. Therefore, banks with branch structures have higher incentives to hold larger portfolios than do subsidiary structures when political risk is high.

While the result addresses the issue of affiliate size as a function of the bank's corporate structure, it does not conclude anything concerning the optimal corporate structure. The following result addresses this issue.

Proposition 7 *For* $\varphi > \frac{(1-k)(1-\theta)}{1-\theta(1-k)}$*,* $E[\Pi_B] > E[\Pi_S]$*, while for* $\varphi < \frac{(1-k)(1-\theta)}{1-\theta(1-k)}$*,* $E[\Pi_B] < E[\Pi_S]$*.*

Proof: See the Appendix. ■

The proposition establishes that when political risk is sufficiently high, a branch structure will be optimal, whereas a subsidiary structure will dominate when political risk is relatively low. This result therefore confirms the basic finding in Proposition 1 concerning the optimal corporate structure for the case where banks adjust their investment decisions to reflect the risks and returns in each market. Specifically, banks adjust their scale of operations in response to the political risk they face (φ), the macroeconomic risk (as measured by the probability that $\epsilon_1 = 1$, given by θ), and the opportunities for lending (R_i) in each market. Our main result is therefore robust to endogenizing banks' lending activities in each market.

Note finally that the cutoff value in Proposition 7, $\varphi = \frac{(1-k)(1-\theta)}{1-\theta(1-k)}$, is the same cutoff value of φ that guarantees that a branch will be bigger than a subsidiary ($L_1^B > L_1^S$), as found in Lemma 4. We can therefore conclude that $E[\Pi_B] > E[\Pi_S]$ whenever $L_1^B > L_1^S$, which is the case for $\varphi > \frac{(1-k)(1-\theta)}{1-\theta(1-k)}$. Moreover, since both L_1^B and L_1^S are decreasing in φ, this finding delivers an interesting implication: banks operating with a subsidiary structure should have on average larger affiliates than those operating with a branch structure, in terms of the size of the affiliate's loan portfolio. This is consistent with the evidence documented in Figure 2. This suggests that the corporate structure of a bank across markets, when chosen optimally, has implications for the availability and allocation of bank credit in each market in which the bank operates.

4.4 Endogenous Bank Risk Taking

Throughout, we have allowed capital to play the role of a buffer in partially shielding depositors (or the deposit insurance fund) from negative shocks to the bank's portfolio. However, so far it has not played its more classical role of providing the bank with incentives to reduce risk taking. Excessive risk taking on the part of banks is indeed one major rationale for capital regulation. In this section, we consider the case where banks can affect the riskiness of their loan portfolio. In particular, we assume that banks can, at a cost, reduce the risk of default of their loan portfolio in the affiliate market by screening and monitoring clients. Specifically, assume that the bank can choose a monitoring effort $\beta \leq 1$, with associated average cost $\frac{v\beta}{2}^2$. Monitoring reduces the risk of the project, so that successful projects repay the associated loans with probability β.[11] Note that this specification assumes that risk choices are made at the parent level.

Consider again the expressions for the expected profits of the branch and subsidiaries structures, respectively, including the terms related to bank monitoring.

$$
\begin{aligned}
E[\Pi_B] &= L_0 R_0 - (L_0 - K)\, r_D - r_K K + (1-\varphi)\left(\beta_B \theta L_1 R_1 - L_1 r_D\right) - \frac{v\beta_B^2}{2} L_1 \\
E[\Pi_S] &= L_0 R_0 - (L_0 - K_0)\, r_D - r_K K + \beta_S (1-\varphi)\, \theta \left(L_1 R_1 - (L_1 - E_1)\, r_D\right) - \frac{v\beta_S^2}{2} L_1.
\end{aligned}
$$

Under these assumptions we can state the following result.

Proposition 8 *There exists a* $\widetilde{\varphi} < 1$ *such that* $E[\Pi_B] > E[\Pi_S]$ *for* $\varphi > \widetilde{\varphi}$ *and* $E[\Pi_B] < E[\Pi_S]$ *for* $\varphi < \widetilde{\varphi}$.

Proof: See the Appendix. ■

This proposition extends our main result to the case where banks endogenously chose the riskiness of their portfolio, and once again establishes that when political risk is relatively high, banks will prefer to organize their corporate structure as branches rather than

[11] One simple interpretation of monitoring is as ex ante loan screening, so that the bank can expend costly resources in identifying safer projects.

subsidiaries. In essence, under a branch structure the bank has much to lose from the failure of its foreign affiliate, since the parent bank is obligated to pay back all claims against the affiliate. As a result, for a given level of risk and lending activity, a branch-based corporate structure will have higher incentives to monitor its foreign loan portfolio. A bank with a foreign subsidiary will have lower incentives to monitor because of the limited liability benefit, and will thus have a lower cost of monitoring.[12] However, when political risk is high, the benefit to monitoring decreases, and the bank's main concern becomes to shield its capital by keeping it at home, which is achieved by using a branch structure.

5 Discussion and Conclusions

This paper studies banks' corporate structure choices, focusing on two commonly observed alternative arrangements. We show that subsidiary structures shield the parent bank from large losses at the affiliate level thanks to the limited liability that applies at each subsidiary. This corporate structure is thus valuable when the parent bank is most concerned about minimizing its credit risk exposure across the varied markets in which it may operate. By contrast, a branch structure offers no such protection, but does allow the parent bank to retain its capital locally even as it operates in foreign markets. The bank's capital is thus shielded from the risk that a foreign authority may expropriate some or all of the bank's operations.

We also argue that, even in cases where there is little political risk for a bank's foreign affiliates, a branch structure may nevertheless be optimal if the bank faces large costs arising from depletions of capital. These capital losses may occur as a result of poor performance of the loan portfolio or macroeconomic shocks that reduce the return to the bank. In such instances, the greater ability to redeploy bank capital and meet the regulatory capital standards on a consolidated basis afford the branch structure with an advantage over a subsidiary structure, and may explain why branches are often favored when choosing to expand domestically.

[12] In the proof of Proposition 8 we establish that $\beta_B > \beta_S$, i.e., monitoring by a bank with a branch structure is always greater than that by a bank with a subsidiary structure.

The analysis clearly abstracts from a number of real world considerations that may affect a bank's choice of corporate structure, such as differential taxation, regulatory restrictions on how banks are permitted to expand abroad, etc. Nevertheless, our analysis points out how banks can design their organization structures to better cope with two primary sources of risk, namely political and credit risk. The predictions of our model regarding banks' organizational forms are consistent with the extant empirical literature on this topic (e.g., Cerutti et al., 2007). Moreover, our analysis has implications for the relative sizes of branches versus subsidiaries, and for the risk-taking characteristics of the different structures.

6 Appendix: Proofs

Proof of Lemma 3: Under the assumption we can write the difference in profits, $\Pi_B - \Pi_S$, as

$$c\sum_{i=0}^{N}(K_i - L_iP_i + (L_i - K_i)\,r_D) - c\max\{K - \max\{\sum_{i=1}^{N}(L_iP_i - L_ir_D) + L_0P_0 - (L_0 - K)\,r_D, 0\}, 0\},$$

that is

$$\Pi_B - \Pi_S = c\sum_{i=0}^{N}(K_i - L_i\,(P_i - r_D) - K_ir_D) - c\max\{K - \sum_{i=0}^{N}(L_i\,(P_i - r_D) + Kr_D)\,, 0\},$$

or

$$\Pi_B - \Pi_S = c\sum_{i=0}^{N}(K_i - L_i\,(P_i - r_D) - K_ir_D) - c\max\{\sum_{i=0}^{N}(K_i - L_iP_i + (L_i - K_i)\,r_D)\,, 0\}.$$

If for all affiliates i, $K_i - [L_iP_i - (L_i - K_i)\,r_i] \geq 0$, then:

$$\Pi_B - \Pi_S = c\sum_{i=0}^{N}(K_i - L_i\,(P_i - r_D) - K_ir_D) - c\sum_{i=0}^{N}(K_i - L_iP_i + (L_i - K_i)\,r_D) = 0.$$

If, however, there exist one or more affiliates for which $K_i - [L_iP_i - (L_i - K_i)\,r_i] < 0$, we must have that $\Pi_B - \Pi_S > 0$. Therefore, $\Pi_S \leq \Pi_B$ in all instances, and $E[\Pi_S] < E[\Pi_B]$. ■

Proof of Proposition 3: With symmetry across countries, each domestic market is exactly $\frac{1}{N}$ of the global banking market. Consider then the expression for bank profits in the case where the bank has a branch network, and focus on the last term representing the cost of being insufficiently capitalized:

$$C_B(N) = c\max\left\{K - \max\left\{\frac{1}{N}\sum_{i=0}^{N}L\,(P_i - r_D) + Kr_D, 0\right\}, 0\right\},$$

Letting $N \to \infty$, we have

$$\begin{aligned}\lim_{N\to\infty} C_B(N) &= c\lim_{N\to\infty}\max\left\{K - \max\left\{\frac{1}{N}\sum_{i=0}^{N}L\,(P_i - r_D) + Kr_D, 0\right\}, 0\right\} \\ &= c\max\left\{K - \lim_{N\to\infty}\max\left\{\frac{1}{N}\sum_{i=0}^{N}L\,(P_i - r_D) + Kr_D, 0\right\}, 0\right\} \qquad (5)\end{aligned}$$

The Law of Large Numbers (LLN) establishes that $\lim_{N\to\infty}\max\left\{\frac{1}{N}\sum_{i=0}^{N}L\left(P_i-r_D\right),0\right\}>0$ almost surely since $E[P_i]\geq r_D$ by assumption to guarantee viability of the market. This also implies that $\lim_{N\to\infty}\max\left\{\frac{1}{N}\sum_{i=0}^{N}L\left(P_i-r_D\right)+Kr_D,0\right\}\geq Kr_D\geq K$. Therefore, it must be that $\lim_{N\to\infty}C_B(N)=0$.

By contrast, for the subsidiary structure, we have:

$$\begin{aligned} C_S(N) &= c\frac{1}{N}\sum_{i=1}^{N}\max\{K-\max\{L\left(P_i-r_D\right)+Kr_D,0\},0\} \\ & c\frac{1}{N}\max\left\{K-\max\left\{\sum_{i=1}^{N}\max\{L\left(P_i-r_D\right)+Kr_D,0\}+L\left(P_0-r_D\right)+Kr_D,0\right\},0\right\}. \end{aligned}$$

Letting $N\to\infty$, we have that $\lim_{N\to\infty}C_S(N)$ is equal to

$$\begin{aligned} & c\lim_{N\to\infty}\frac{1}{N}\sum_{i=1}^{N}\max\{K-\max\{L\left(P_i-r_D\right)+Kr_D,0\},0\} \\ & c\lim_{N\to\infty}\max\left\{\frac{K}{N}-\max\left\{\frac{1}{N}\sum_{i=1}^{N}\max\{L\left(P_i-r_D\right)+Kr_D,0\}+L\left(P_0-r_D\right)+Kr_D,0\right\},0\right\}. \end{aligned}$$

The first part of this expression converges a.s. to $c\left(K-\Pr(\epsilon_i<\overline{\epsilon})E[LP_i-(L-K)\,r_D|\epsilon_i<\overline{\epsilon}]\right)>0$, where $\overline{\epsilon}=\frac{K+(L-K)r_D}{LR_i}$. The second part of the expresssion is non-negative, which implies that $\lim_{N\to\infty}C_S(N)>0$. Therefore, for any $c>0$, $\lim_{N\to\infty}\left(E[\Pi_B]-E[\Pi_S]\right)>0$, as desired.

■

Proof of Proposition 4: Consider how this difference in profits from (4) changes with α, which measures the degree of correlation between ϵ_0 and ϵ_1. We can write

$$\Pr\left(\epsilon_0\geq\underline{\epsilon_0},\epsilon_1<\underline{\epsilon_1}\right)=\Pr\left(\epsilon_0\geq\underline{\epsilon_0}\right)\cdot\Pr\left(\epsilon_1<\underline{\epsilon_1}|\epsilon_0\geq\underline{\epsilon_0}\right).$$

Since $\Pr\left(\epsilon_0\geq\underline{\epsilon_0}\right)$ is invariant with respect to α, we can focus on $\Pr\left(\epsilon_1<\underline{\epsilon_1}|\epsilon_0\geq\underline{\epsilon_0}\right)$. This can be written as

$$\int_{\underline{\epsilon_0}}^{1}\Pr\left(\epsilon_1<\underline{\epsilon_1}|\epsilon_0=\epsilon\right)d\epsilon$$

since $\epsilon_0\backsim U\left[0,1\right]$. In turn we can write

$$\Pr\left(\epsilon_1<\underline{\epsilon_1}|\epsilon_0=\epsilon\right)=\Pr(\alpha\epsilon+(1-\alpha)\,\eta<\underline{\epsilon_1}=\begin{cases}\frac{\underline{\epsilon_1}-\alpha\epsilon}{1-\alpha} & \text{if } \underline{\epsilon_1}>\alpha\epsilon \\ 0, & otherwise\end{cases}.$$

which implies that

$$\int_{\underline{\epsilon_0}}^{1} \Pr\left(\epsilon_1 < \underline{\epsilon_1} | \epsilon_0 = \epsilon\right) d\epsilon = \int_{\underline{\epsilon_0}}^{\frac{\underline{\epsilon_1}}{\alpha}} \frac{\underline{\epsilon_1} - \alpha\epsilon}{1-\alpha} d\epsilon$$

We can now differentiate this probability with respect to α to obtain

$$\frac{\partial}{\partial\alpha}\left(\int_{\underline{\epsilon_0}}^{\frac{\underline{\epsilon_1}}{\alpha}} \frac{\underline{\epsilon_1} - \alpha\epsilon}{1-\alpha} d\epsilon\right) = \frac{1}{2}\frac{\left(2\alpha\underline{\epsilon_1} - \alpha\underline{\epsilon_0} - \underline{\epsilon_1}\right)\left(\underline{\epsilon_1} - \alpha\underline{\epsilon_0}\right)}{\left(\alpha-1\right)^2\alpha^2}.$$

Since the denominator is positive, this derivative will be negative if and only if

$$\left(2\alpha\underline{\epsilon_1} - \alpha\underline{\epsilon_0} - \underline{\epsilon_1}\right)\left(\underline{\epsilon_1} - \alpha\underline{\epsilon_0}\right) < 0$$

The second term must be positive since $\Pr\left(\epsilon_1 < \underline{\epsilon_1} | \epsilon_0 = \epsilon\right)$ only for $\underline{\epsilon_1} > \alpha\epsilon$, so that the integral is constructed only for values so that $\underline{\epsilon_1} > \alpha\underline{\epsilon_0}$. Therefore, the expression will be negative if and only if

$$2\alpha\underline{\epsilon_1} - \alpha\underline{\epsilon_0} - \underline{\epsilon_1} < 0 \Longleftrightarrow \underline{\epsilon_1}\left(2\alpha - 1\right) < \alpha\underline{\epsilon_0}.$$

This condition is satisfied for $\underline{\epsilon_0} \leq \underline{\epsilon_1}$, so that we obtain

$$\frac{\partial}{\partial\alpha}\Pr\left(\epsilon_1 < \underline{\epsilon_1} | \epsilon_0 \geq \underline{\epsilon_0}\right) < 0.$$

Look now at the expected difference conditional on $\epsilon_1 < \underline{\epsilon_1}$ and $\epsilon_0 \geq \underline{\epsilon_0}$:

$$E\left[\min\left\{L_0P_0 - \left(L_0 - K_0\right)r_D, -\left(K - K_0\right)r_D - L_1\left(P_1 - r_D\right)\right\} | \epsilon_1 < \underline{\epsilon_1}, \epsilon_0 \geq \underline{\epsilon_0}\right]$$

The first term is invariant with respect to α. For the second term, the only component that changes with α is $-L_1\left(P_1 - r_D\right)$. So we will focus on

$$E\left[-L_1P_1 | \epsilon_1 < \underline{\epsilon_1}, \epsilon_0 \geq \underline{\epsilon_0}\right]$$

Following the same strategy as before, for any $\epsilon \geq \underline{\epsilon_0}$, the distribution for ϵ_1 conditional on $\epsilon_1 < \underline{\epsilon_1}$ is $U\left[\alpha\epsilon, \underline{\epsilon_1}\right]$ for $\alpha\epsilon < \underline{\epsilon_1}$. It follows that

$$E\left[-L_1P_1 | \epsilon_1 < \underline{\epsilon_1}, \epsilon_0 = \epsilon\right] = -L_1R\frac{\alpha\epsilon + \underline{\epsilon_1}}{2},$$

which is clearly decreasing in α. Again, since this applies for any $\epsilon \geq \underline{\epsilon_0}$, we can now conclude that $\frac{\partial(E[\Pi_S]-E[\Pi_B])}{\partial\alpha} < 0$, as desired. ■

Proof of Proposition 6: The expected interest rate on the affiliate's deposits under the subsidiary structure is

$$r_s = \frac{\gamma r^*}{\theta(1-\varphi)} + (1-\gamma) r^*,$$

while for the branch structure it is

$$r_b = \frac{\gamma r^*}{(1-\varphi)} + (1-\gamma) r^*.$$

As above, we can write the difference in the expected profits as

$$E[\Pi_S] - E[\Pi_B] = -K_1 r^* - \theta(1-\varphi)(L_1 - K_1) r_s + (1-\varphi) L_1 r_b$$

We can now substitute for r_s and r_b to obtain

$$E[\Pi_S] - E[\Pi_B] = (1-\gamma) r^* \left[(1-\varphi) L_1 (1-\theta) - K_1 (1-\theta(1-\varphi))\right].$$

For $\varphi = 0$, $E[\Pi_S] - E[\Pi_B] = (1-\gamma)(1-\theta) r^* [L_1 - K_1] > 0$, while for large enough values of φ it is obviously negative.[13] ■

Proof of Lemma 4: The set of FOC's are given as

$$\frac{\partial E[\Pi_S]}{\partial L_0^S} = R_0\left(L_0^S\right) + L_0^S R_0'\left(L_0^S\right) - (1-k) r_D - r_K k = 0$$

$$\frac{\partial E[\Pi_S]}{\partial L_1^S} = (1-\varphi)\theta\left(R_1\left(L_1^S\right) + L_1^S R_1'\left(L_1^S\right) - (1-k) r_D\right) - r_K k = 0$$

$$\frac{\partial E[\Pi_B]}{\partial L_0^B} = R_0\left(L_0^B\right) + L_0^B R_0'\left(L_0^B\right) - (1-k) r_D - r_K k = 0$$

$$\frac{\partial E[\Pi_B]}{\partial L_1^B} = (1-\varphi)\left(\theta R_1\left(L_1^B\right) + \theta L_1^B R_1'\left(L_1^B\right) - (1-k) r_D\right) - r_K k + k r_D = 0$$

From the first and the third conditions we see immediately that, in equilibrium, $L_0^B = L_0^S$.

To determine L_1, we can use the above to write:

$$\frac{\partial E[\Pi_S]}{\partial L_1} - \frac{\partial E[\Pi_B]}{\partial L_1} = \theta(1-\varphi)(R_1 - (1-k) r) - r_K k - ((1-\varphi)(\theta R_1 - r) - r_K k + rk),$$

[13] Note that this solution implicitly requires a restriction on the parameters. Namely, R needs to be large enough that both structures are viable for large values of φ.

which simplifies to

$$\frac{\partial E[\Pi_S]}{\partial L_1} - \frac{\partial E[\Pi_B]}{\partial L_1} = -\left(1-\theta\left(1-\varphi\right)\right)k + \left(1-\theta\right)\left(1-\varphi\right)$$

From here we see that, for $\varphi < \frac{(1-k)(1-\theta)}{1-\theta(1-k)}$, $\frac{\partial E[\Pi_S]}{\partial L_1} > \frac{\partial E[\Pi_B]}{\partial L_1}$, which implies that $L_1^S > L_1^B$. Conversely, for $\varphi > \frac{(1-k)(1-\theta)}{1-\theta(1-k)}$, $\frac{\partial E[\Pi_S]}{\partial L_1} < \frac{\partial E[\Pi_B]}{\partial L_1}$, and so $L_1^S < L_1^B$. Finally, note that, for $R_1(L_1)$ sufficiently large, both $L_1^S, L_1^B > 0$ for $\varphi = \frac{(1-k)(1-\theta)}{1-\theta(1-k)}$. ■

Proof of Proposition 7: Consider again the expressions for the expected profits of the branch and subsidiaries structures:

$$E[\Pi_B] = L_0^B R_0\left(L_0^B\right) - \left(L_0^B - k\left(L_0^B + L_1^B\right)\right) r_D - r_K k\left(L_0^B + L_1^B\right) + (1-\varphi)\left(\theta L_1^B R_1\left(L_1^B\right) - L_1^B r_D\right)$$

$$E[\Pi_S] = L_0^S R_0\left(L_0^S\right) - \left(L_0^S - kL_0^S\right) r_D - r_K k\left(L_0^S + L_1^S\right) + (1-\varphi)\,\theta\left(L_1^S R_1\left(L_1^S\right) - \left(L_1^S - kL_1^S\right) r_D\right)$$

Recall that at the optimum both bank structures choose the same portfolio size in the home country, $L_0^B = L_0^S$. The difference in the expected profits, $E[\Pi_B] - E[\Pi_S]$, can then be written as

$$kL_1^B r_D - r_K k\left(L_1^B - L_1^S\right) + (1-\varphi)\left(\theta L_1^B R_1\left(L_1^B\right) - \theta L_1^S R_1\left(L_1^S\right) - L_1^B r_D + \theta L_1^S\left(1-k\right) r_D\right)$$

Let L_1^{S*} be the optimal portfolio size in market 1 for the subsidiary structure. Now suppose that the bank with the branch structure chooses the same amount to lend in affiliate 1 as the subsidiary structure, $L_1^B = L_1^{S*}$, for all parameter values. We can now write the difference as

$$\begin{aligned} E[\Pi_B] - E[\Pi_S] &= kL_1^{S*} r_D - r_K k\left(L_1^{S*} - L_1^{S*}\right) + \\ &\quad (1-\varphi)\left(\theta L_1^{S*} R\left(L_1^{S*}\right) - \theta L_1^{S*} R\left(L_1^{S*}\right) - L_1^{S*} r_D + \theta L_1^{S*}\left(1-k\right) r_D\right) \\ &= L_1^S r_D\left(k + (1-\varphi)\left(\theta\left(1-k\right) - 1\right)\right) \end{aligned}$$

This difference will be greater than zero if and only if

$$k + (1-\varphi)\left(\theta\left(1-k\right) - 1\right) > 0$$

which is satisfied for

$$\varphi > \frac{\left(1-k\right)\left(1-\theta\right)}{1-\theta\left(1-k\right)}$$

Therefore, for $\varphi > \frac{(1-k)(1-\theta)}{1-\theta(1-k)}$, we have that $E[\Pi_B] - E[\Pi_S] > 0$ for $L_1^B = L_1^{S*}$. A fortiori, it must therefore be true that $E[\Pi_B] - E[\Pi_S] > 0$ when L_1^B is chosen optimally. Moreover, as argued above, for $R_1(L_1)$ sufficiently large, both $L_1^S, L_1^B > 0$ for $\varphi = \frac{(1-k)(1-\theta)}{1-\theta(1-k)}$. ■

Proof of Proposition 8: From the first order conditions with respect to β we obtain:

$$\begin{aligned}\beta_B &= \min\left\{\frac{\theta\,(1-\varphi)\,R_1}{v}, 1\right\}\\ \beta_S &= \min\left\{\frac{\theta\,(1-\varphi)}{v}\left(R_1 - r_D\,(1-k)\right), 1\right\}\end{aligned}$$

that means that screening is always higher under the branch structure. Substituting these values in the profit expressions and imposing $K_1 = kL_1$, we obtain:

$$E[\Pi_S] - E[\Pi_B] = L_1 r_D\left((1-\varphi) - k - \frac{\left(\theta\,(1-k)\,(1-\varphi)\right)^2}{v}\left(\frac{R_1}{(1-k)} - \frac{r_D}{2}\right)\right).$$

This difference converges to $-kL_1r_D$ for φ going to 1,and it is easy to see that

$$\frac{\partial\left(E[\Pi_S] - E[\Pi_B]\right)}{\partial\varphi} < 0$$

Now impose the optimal level of monitoring for the branch structure, β_B, on both structures. We, then, have:

$$E[\Pi_S] - E[\Pi_B] = L_1 r_D\left(-\,(1-k)\,\frac{\theta^2\,(1-\varphi)^2\,R_1}{v} - k + (1-\varphi)\right)$$

that for $\varphi = 0$ becomes

$$E[\Pi_S] - E[\Pi_B] = L_1 r_D\,(1-k)\left(1 - \frac{\theta^2 R_1}{v}\right) > 0$$

since we must have that $\beta_B = \frac{\theta R_1}{v} \leq 1$. Hence a fortiori $E[\Pi_S] > E[\Pi_B]$ when we let allow for β to be optimally chose in each structure at $\varphi = 0$. From these results it follows that there exists a $\widetilde{\varphi} < 1$ such that $E[\Pi_S] > E[\Pi_B]$ for $\varphi < \widetilde{\varphi}$ and $E[\Pi_S] < E[\Pi_B]$ for $\varphi > \widetilde{\varphi}$. It remains to be shown that at such $\widetilde{\varphi}$ both structures are viable. However, it is evident that for any $\widetilde{\varphi}$ there exists a $\overline{v}$ small enough such that both structures are viable. ■

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