Multinational banks in regulated markets: Is financial integration desirable?

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Abstract. A core question regarding the increasing share of international trade in financial services is whether this causes banks to take more or fewer risks. We study this issue in a setting where two multinational banks engage in duopoly competition for their lending in two regional markets. Each bank affiliate can choose both the lending volume and the level of monitoring, and hence risk-taking, where the risk of bank failure is partly borne by taxpayers in the bank affiliate's host country. Governments choose minimum capital requirements to optimally solve the trade-off between higher lending volumes and consumer surplus, and the expected tax losses faced by taxpayers. In this setting, we consider two types of financial integration. A reduction in the transaction costs of cross-border banking increases risk-taking by banks, harming taxpayers and potentially overall welfare. In contrast, a reduction in the costs of screening foreign firms reduces banks' risk-taking and is beneficial for consumers and taxpayers alike.

Résumé. Banques multinationales au sein de marchés réglementés : l'intégration financière est-elle souhaitable? L'importance croissante du commerce international dans les services financiers conduit-elle les banques à prendre davantage ou moins de risques? Dans cet article, nous étudions cette question fondamentale en élaborant un modèle où en matière d'octroi de prêts, deux banques multinationales s'engagent dans un duopole sur deux marchés régionaux. Chaque filiale peut choisir à la fois le volume de prêts et le niveau de contrôle, c'est-à-dire la prise de risque, la menace de défaillance reposant quant à elle partiellement sur les contribuables du pays d'accueil de la filiale. Les gouvernements

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définissent les exigences minimales de fonds propres pour trouver un point d'équilibre optimal entre de plus gros volumes de prêts et le surplus du consommateur d'un côté, et les pertes fiscales escomptées reposant sur les contribuables de l'autre. Dans ce modèle, nous examinons deux types d'intégrations financières. En matière d'activités bancaires transfrontalières, une réduction des frais de transaction augmente la prise de risque des banques, ce qui peut nuire aux contribuables et au bien-être général. En revanche, une réduction des frais de contrôle des entreprises étrangères réduit la prise de risque des banques, au bénéfice à la fois des consommateurs et des contribuables.

JEL classification: F23, F36, G18, H77

1. Introduction

THE INTERNATIONALIZATION OF the banking sector has increased rapidly over the last few decades, and in particular during the past 20 years. Total international bank lending accelerated sharply after 2000, almost quadrupling between 2000 and 2008, by which point it had reached 40% of global GDP. Since then, cross-border banking has receded noticeably, but the worldwide volume of cross-border claims is still more than twice what it was in 2000 (see figure 1).[1] More disaggregated evidence comes from a database with more than 5,000 banks in 137 countries (Claessens and van Horen 2014). This documents large increases in the presence of foreign banks in most countries since the mid-1990s, but also a substantial heterogeneity at the country level with respect to the importance of foreign banks in national banking sectors.

The financial crisis of 2008 has shown that this increasing internationalization in the banking sector is not without risk. Many banks worldwide have suffered huge losses from subprime financial products that originated in the US housing market (Diamond and Rajan 2009).[2] Financial integration was thus a key factor in transforming the crisis in the US housing market into a worldwide banking crisis, during which large financial institutions in many countries had to be rescued by taxpayer monies. In several countries, including Ireland and Iceland, the bailouts were so massive as to threaten the entire state of public finances.[3]

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1 Figure 1 incorporates all cross-border claims that arise from foreign affiliates (branches and subsidiaries) of a parent firm. See Bank for International Settlements (2010) for a discussion of the determinants of international lending before and after the 2007–2008 financial crisis.

2 Econometric evidence for a sample of large banks across the world confirms that, during this period, the exposure to the US real estate market was a factor that significantly contributed to stock market losses (Beltratti and Stulz 2012).

3 The government of Iceland decided to guarantee deposits of domestic investors but declined to guarantee the deposits of foreigners. Ireland, in contrast, bailed out both domestic and international creditors with taxpayer money. In the fiscal year 2010 alone, this caused an Irish budget deficit equal to 32% of the country's GDP.

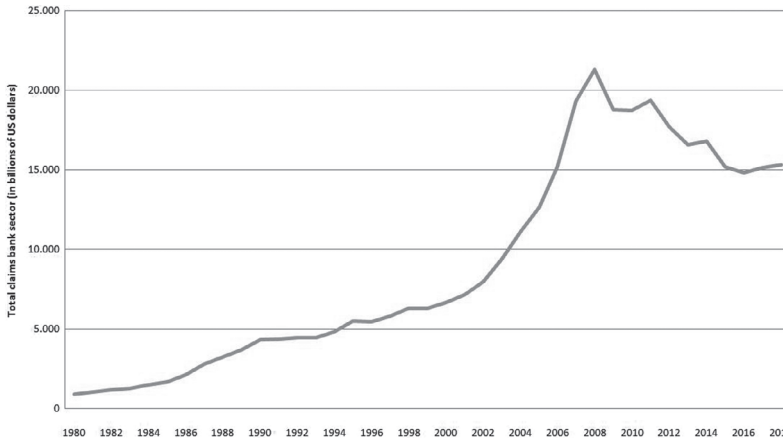

FIGURE 1 Worldwide cross-border claims of banking sectors (1980–2018)
SOURCE: Bank for International Settlements statistics, 2019; table A4. Available at `http://stats.bis.org/statx/srs/table/a4`.

The financial crisis has, therefore, reinvigorated the debate as to whether increasing internationalization in the banking industry is a desirable development that should be fostered by policy measures in order to reduce the costs of cross-border banking.[4] One important reason as to why increasing internationalization may increase the banking sector's exposure to risk is the limited information about foreign loan markets. Empirical evidence shows that "gravity models," in which distance acts as a proxy for information costs or information asymmetries, are able to explain international transactions in financial services at least as well as they can explain goods trade transactions (Portes et al. 2001, Portes and Rey 2005).

This paper takes up these debates in a two-country trade model that incorporates several characteristics of the banking sector. Our model has two multinational banks, each headquartered in one of the countries and with affiliates in both countries. The banks engage in duopoly competition in both markets, with each bank extending loans to small, competitive firms in each market through its local affiliate. Importantly, an affiliate decides not only on the quantity of its lending but also on the level of monitoring of its loans. These

4 There is also an empirical controversy about the link between financial integration and the portfolio risks of banks. Acharya et al. (2006) show, for a sample of Italian banks during the 1990s, that geographic and sectoral diversification increased the risk of banks' lending portfolios. Goetz et al. (2016) and Faia et al. (2019) find the opposite result, showing for samples of US and European banks, respectively, that geographic expansion reduces banks' risks. However, these studies are based on the risks of banks' portfolio holdings, whereas we focus on the risks implied by imperfect loan monitoring.

monitoring decisions determine the riskiness of the banks' operations in their home and foreign markets.

In our model, banks face two different types of costs. The first is the cost of operating under the legal and regulatory framework of the country in which the lending takes place. Such costs arise, for example, from disputes over lending contracts or from having to collect debt from some borrowers. We label this the "transaction cost" of lending. The second is the cost of learning about the affiliate's individual client, which we label the "information cost."[5] Both of these costs are higher for international lending than they are for domestic loans. Foreign affiliates face higher transaction costs because they have to deal with the legal system of another country. Moreover, they also face higher information costs, knowing the local firms less well than their domestic competitors do. We will show that higher transaction costs give banks a reason to *increase* the monitoring of their loans, whereas higher information costs lead them to *reduce* monitoring.

A further feature of financial markets is that governments, implicitly or explicitly, offer guarantees in the case of bank failure. Our model incorporates the fact that the riskiness of bank operations has implications for taxpayers, through the introduction of government guarantees for the savings deposits that banks use to finance their loans. Such deposit-insurance schemes exist in virtually all developed countries, and it is well known that they create a fundamental moral hazard incentive for banks (see Demirgüç-Kunt and Detriagiache 2002). In order to address the moral hazard problem that deposit insurance entails, governments can set minimum capital standards. We consequently model active governments setting optimal capital adequacy standards as their principal policy instrument, forcing banks operating within their borders to hold a minimum amount of equity for every loan they provide. In setting this capital adequacy standard, the government balances two elements: (i) the impact of its regulation on the expected costs to taxpayers that arise in the case of bank failure and (ii) the real effects that the availability of credit has for expected output and hence consumer surplus.

In this setting, the focus of our analysis is on the effects that financial integration will have on consumers and taxpayers in each country. While any reduction in the costs of cross-border lending will increase aggregate lending volumes, and hence consumer surplus, we show that the effects of financial integration on the monitoring of foreign loans differs critically depending on which international friction is reduced. If economic and financial integration lowers the transaction costs for foreign affiliates, while information costs remain unchanged, the reduced monitoring by foreign banks increases the

5 Empirical studies rarely distinguish these two types of cost for lack of detailed data. One exception is Buch (2003), who distinguishes information costs from regulatory (or transaction) costs and finds separate, positive effects of a fall in either type of costs on cross-border lending.

risks to domestic taxpayers and may also decrease welfare in both countries. In contrast, a fall in the information costs of cross-border lending will benefit taxpayers because of the resulting increased monitoring of foreign bank affiliates and will consequently be unambiguously welfare-increasing. We conclude that a closer look at which costs are reduced by financial integration may help to explain the contrasting empirical findings in the existing literature. From a policy perspective, our results imply that it is crucial for financial integration to be accompanied by policies that increase transparency and reduce information costs.

1.1. Related literature

Our paper combines elements from international trade theory and the literature on financial regulation. In international trade, there is a small strand of theoretical literature that explicitly examines the banking sector.[6] Following the early work by Eaton (1994), de Blas and Russ (2013) and Niepmann (2015) have analyzed banks' choices between foreign direct investment (FDI) and cross-border lending. Other papers have analyzed the spillover effects of FDI in the banking sector on the host country's banking system (Lehner and Schnitzer 2008). None of these papers incorporates any policy instruments, however. On the other hand, a sizeable literature has studied the effects of economic integration on policy competition in trade models with imperfect competition (e.g., Kind et al. 2005, Ottaviano and van Ypersele 2005, Haufler and Wooton 2010). These papers have not been applied to the specific policy issues facing the banking sector and, in particular, do not incorporate the risk-taking choices that are fundamental to banking.

To incorporate these effects, we draw on the literature on capital regulation in the banking sector. Several authors have stressed that, in a closed economy, capital regulation increases the risk buffer of banks and curbs risky behaviour (Rochet 1992, Hellman et al. 2000). Calzolari and Lorath (2011) study the regulation of multinational banks that operate through either foreign branches or subsidiaries. Acharya (2003), Dell'Ariccia and Marquez (2006) and Haufler and Maier (2019) ask whether regulatory competition leads to a "race to the top" or to a "race to the bottom" in the setting of capital standards. We link these models to the trade literature by incorporating different types of trade frictions. This allows us to study the effects of financial integration on different agents in the economy and on national welfare.

Our analysis of financial integration is related to a further strand in the literature that examines the effects of changes in market structure on banks' risk-taking decisions. Keeley (1990) has argued that *increased competition* lowers banks' profit margins and lowers their charter value. As a consequence, this reduces the loss to banks in the case of default and induces them to take

6 The general literature on trade in services and public policy is surveyed in Francois and Hoekman (2010).

greater risks. Boyd and De Nicolò (2005) show, however, that introducing a loan market will lead to a counteracting effect. In their case, *increased concentration* in the banking sector will result in higher loan rates such that borrowing entrepreneurs will choose more risky projects.[7] Faia et al. (2021) apply this competition-based approach to the analysis of global banking and show that the riskiness of bank operations decreases, if foreign expansion of banks promotes competition in local lending markets. The main difference to our model is that we focus on the (transaction and information) costs of cross-border banking, rather than on changes in the degree of competition.

The remainder of this paper is set up as follows. Section 2 introduces our trade model with goods production and cross-border lending by banks. Section 3 studies the international lending equilibrium and derives the optimal regulatory policy. Section 4 analyzes the effects of financial integration, focusing on reductions in transaction costs on the one hand and reductions in information costs on the other. Section 5 studies how financial integration feeds back to governments' optimal regulation policy. Section 6 discusses some possible extensions and section 7 concludes.

2. The model

2.1. General set-up

We consider a region composed of two countries $i \in \{1,2\}$, which are both small in the world capital market. In each country, goods are manufactured by competitive firms that have to borrow in order to be able to produce their output of non-tradeable goods. Loans are provided by two multinational banks, each having its parent company in one of the two countries and a subsidiary in the other.[8] Thus each bank can be viewed as having a domestic affiliate and a foreign affiliate, each of which is subject to the regulatory environment of the country in which it operates. Consequently, the banking sector is characterized by a duopolistic market structure in each country.

In this respect, our model is closely related to the "reciprocal dumping" model of international trade in identical products, originally developed by Brander and Krugman (1983). In the absence of international lending, each

7 Martinez-Miera and Repullo (2010) extend this analysis to imperfectly correlated risks and show that a U-shaped relationship between competition and bank risk will emerge in this case. See also Allen and Gale (2004) for an analytical synthesis of the different arguments.

8 Empirical evidence suggests that cross-border lending occurs mainly through (legally independent) subsidiaries, rather than through (legally dependent) branches of a parent bank. For example, Cerutti et al. (2007, table 1) document that, for the investment of the world's 100 largest banks in Latin America and Eastern Europe, foreign subsidiaries are three times as frequent in these countries as branches of the parent firm.

bank would be a monopolist in its domestic market. The opportunity to set up a foreign affiliate results in each bank seeking to acquire a share of its foreign market. This is done by offering loans that are fundamentally identical to those offered by the domestic incumbent but, because of the greater distance between bank and borrower, are more expensive to provide.[9]

Each bank affiliate takes a monitoring (or risk-taking) decision, in addition to its decision as to the level of lending. These decisions are affected by two frictions: (i) a "transaction cost" that is akin to trade costs in international trade models and (ii) an "information cost" about individual bank customers. Moreover, banks take into account that governments are actively involved in financial markets. In our model, governments provide deposit insurance for savings in order to cushion the effects of potential bank failures. This deposit insurance is exogenous in our model, and it will distort the banks' monitoring decisions. To limit the free-riding of banks on insured savings deposits, governments endogenously set capital requirements that specify the (minimum) share of equity that banks have to provide for their lending.

The timing in our model is as follows. In the first stage, each of the two governments simultaneously sets the equity requirements for all bank affiliates operating within its jurisdiction. In the second stage, the banks decide upon the quantity and (via monitoring) the quality of their lending in their domestic and foreign markets. In the third and final stage, firms produce output that is sold and consumed domestically. We solve the model using backwards induction.

2.2. Goods production

Homogeneous goods are produced in each country by small, competitive firms. The final consumer good is not traded, being produced exclusively for domestic consumption. The market inverse demand curve for the good is linear, with the price P_i being a function of realized domestic output X_i:

$$P_i = A_i - bX_i. \tag{1}$$

While we assume that the slope of both countries' demand functions is the same, we allow for asymmetries in demand through differences in the intercepts of the demand curves, A_i.

Competitive firms face no fixed costs of production, but each firm requires a bank loan to finance its output activity. Every firm plans to produce one unit of output using a single unit of an input. This input is the numeraire, such that a firm has to borrow a single unit of currency in order to acquire its services. Firms have the choice of borrowing from the local affiliate of either the home or the foreign bank. Each firm in country i with a loan from a bank

9 This set-up seems to characterize the conditions in international financial markets quite well. See the article "Global banks. A world of pain" in *The Economist*, March 5, 2015, which focuses on the cost disadvantages of foreign affiliates of multinational banks after the financial crisis.

headquartered in country $h \in \{1,2\}$ succeeds in production with probability q_{ih}.[10] Each firm's output is one if successful, and zero otherwise. If a firm is successful, it will sell its (unit of) output at the prevailing price P_i and use all of these earnings to repay its loan. If the firm fails, however, it earns nothing and defaults on its bank loan. We assume that there is free entry into the goods sector and consequently entry will result in firms making zero economic profits.

We denote by L_{ih} the number of loans made by the affiliate of bank h in country i; the expected gross return on lending by the bank can then be expressed as $\Lambda_{ih} \equiv q_{ih}L_{ih}$. Thus, expected output X_i in country i is

$$X_i = \Lambda_{ii} + \Lambda_{ij}. \tag{2}$$

Substituting (2) into (1) yields the expected price as a function of the expected success of the loans in market i:

$$P_i = A_i - b\left(\Lambda_{ii} + \Lambda_{ij}\right) \forall i, j, i \neq j. \tag{3}$$

The demand for bank loans can be seen as the derived demand for the consumption good that is produced by firms using these loans. Given that firms make no profits, P_i is also the repayment cost of a successful loan. Consequently, all rents that arise from (successful) goods production are transferred to the two banks in our model. This means that the banks want their loans to succeed because they will receive payment P_i only in this eventuality. In contrast, entrepreneurs will be indifferent between loans from domestic and foreign banks, even if they imply different probabilities of success, because the entrepreneurs' profit is zero in either case.

2.3. Banks

There are two multinational banks, one headquartered in each country with a subsidiary in the other country. Each bank affiliate can lend locally, but the foreign subsidiary of each bank faces higher costs of lending. Each bank treats the markets as being segmented, such that lending decisions can be made separately for each market.

Banks' funds come from two sources: (i) a combination of equity and (ii) savings deposits. Each bank affiliate receives savings deposits from the residents of its host country. In line with actual practice in virtually all OECD countries, we assume that savings deposits are insured by the host country's government.[11] The main argument for deposit insurance is that it prevents bank runs and thereby stabilizes the banking system (Diamond and Dybvig 1983). For analytical simplicity, we further assume that the coverage of deposit insurance is complete.

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10 As we will argue below, this probability of success equals the level of monitoring offered by the lending bank.

11 See Barth et al. (2006) for an overview of deposit insurance schemes around the world.

Deposit insurance is well known to cause moral hazard effects for banks (Demirgüç-Kunt and Detriagiache 2002). In order to protect its taxpayers, the banking regulator in country i, therefore, imposes a capital adequacy standard, k_i, representing the minimum proportion of bank lending that must be backed by the bank's equity. We assume that each bank can raise sufficient equity such that its lending volume is not constrained. However, equity finance is more expensive than using local savings deposits. Specifically, we assume that depositors demand a risk-free return, normalized to unity, because they are protected against potential losses by the deposit insurance scheme. In contrast, the bank's cost of equity is $\rho > 1$ because it includes a risk premium.[12] Given that equity is strictly more expensive for banks compared with savings deposits, profit-maximizing banks in our model will never hold more capital than is legally required.

We further assume that, for each bank affiliate, the risks of its loans are perfectly correlated. Thus, all the firms receiving financing from a particular bank face the same probability of success, reflecting the level of support they receive through the bank's monitoring decision, and all succeed or fail together.[13]

With these specifications, the costs of providing a loan for bank i's affiliates in its domestic and foreign markets i and j, respectively, are given by

$$\begin{aligned} C_{ii} &= \rho k_i + q_{ii}(1-k_i), \\ C_{ji} &= \rho k_j + q_{ji}\big(1-k_j\big) + \tau. \end{aligned} \tag{4}$$

The first two terms in each expression give the capital costs of each affiliate. These are a weighted function of the cost of equity (weight k_i) and the cost of deposits (weight $1 - k_i$). While the (opportunity) cost of equity must always be paid by the bank, the cost of deposits will be borne by the bank only in the case of success. When one affiliate fails (with probability $1 - q_{hi}$), the cost of deposits will be assumed by the deposit insurance fund, and hence by the taxpayers, of the affiliate's host country. This implicit subsidization of deposits is captured in the second terms in (4). Note that, because each affiliate is an independent legal entity, each can draw on the deposit insurance fund of its host country, irrespective of the financial situation of the multinational bank's other affiliate.[14] An

12 Fixing the cost of equity at an exogenous rate above the cost of savings deposits is a standard assumption in the literature (e.g., Dell'Ariccia and Marquez 2006, Allen et al. 2011). We will further discuss this assumption in section 6.

13 Again, this is a frequent simplification in the related literature (e.g., Boyd and De Nicolò 2005, Dell'Ariccia and Marquez 2006) that we will further discuss in section 6.

14 With legally independent affiliates, there is no legal obligation for a solvent parent firm to come up for the losses of its subsidiaries, or vice versa (see Dell'Ariccia and Marquez 2010). Arguably, this is one of the reasons why multinational banks frequently choose legally independent subsidiaries, rather than branches, for their foreign operations (cf. footnote 8).

increase in the capital requirement k_h reduces this implicit subsidy to the bank and thus raises an affiliate's cost of capital C_{hi}.

Finally, the term τ in the second expression in (4) reflects the additional transaction cost of supplying a loan through an affiliate in the bank's foreign market.[15] Such costs arise, for example, from the extra legal and advisory services that are needed for a foreign-based bank to comply with the tax and regulatory system of the host country, to deal with disputes over the loan contract or to collect debt from some of its borrowers. These costs are often transaction-specific. For example, banks frequently sell their claims to a third, local party at a discount in order to avoid potential litigation costs associated with recovering the loan (a transaction known as "factoring"). The existence of such transaction costs for cross-border banking is consistent with the empirical evidence that international transactions in financial services are falling in the distance between the parent country and the host country of a multinational banking affiliate (Portes et al. 2001, Portes and Rey 2005).

2.3.1. Monitoring decision

We assume that a bank affiliate can affect the probability that a firm succeeds through the level of monitoring, or support, that it provides. In our model, monitoring is best interpreted in a setting of "relationship lending," where banks provide specific information or other support to each entrepreneur (Boot and Thakor 2000).[16] The greater the monitoring, the greater the likelihood that the good will be produced and sold and the higher the probability that the loan will be repaid. Suppose that the likelihood of a firm's success is linear in monitoring such that (with the appropriate normalization) q_{hi} of monitoring by the affiliate of bank i to a firm in country h yields a probability of industrial success equal to q_{hi}. Thus, monitoring of q_{hi} results in the bank's expected earnings on the loan equalling $q_{hi}P_h$.

While monitoring raises the expected return on a loan, it is costly to provide. We assume that monitoring costs are quadratic in the amount of monitoring and that they are sufficiently large that there will never be perfect monitoring in equilibrium. For domestic loans, the monitoring costs of bank i are given by $sq_{ii}^2/2$, where $s(>0)$ is a constant. Foreign loans face greater monitoring costs as a result of higher information costs for foreign customers. For example, the foreign affiliate of a multinational bank may involve a local bank as an intermediary in its lending transactions because of the latter's superior information about the borrowing clients. In such a case, the profit margin of

15 Transaction costs also arise for the domestic affiliate of a multinational, but these costs are normalized to zero in our analysis.

16 This active role of banks corresponds to their reaping the entire expected profit from the lending transaction. The same would not be true in a moral hazard set-up where the monitoring of banks induces the entrepreneur to supply more effort and hence increase the probability of success (Besanko and Kanatas 1993).

the local bank would directly increase the information costs of a cross-border loan transaction. In our model, these costs are specified as $s(1+\sigma)q_{ji}^2/2$, where $\sigma(>0)$ captures the additional information costs of foreign loans.

2.3.2. Bank profits

A multinational bank based in country i has total expected operating profit Π_i, which is the sum of the net expected earnings of its home and the foreign affiliates. This can be written as

$$\Pi_i = \Pi_{ii} + \Pi_{ji}, \tag{5}$$

where Π_{ii} and Π_{ji} are the expected profits of bank i in countries i and j, respectively:

$$\begin{aligned} \Pi_{ii} &\equiv \left(P_i q_{ii} - C_{ii} - \frac{s}{2} q_{ii}^2\right) L_{ii}, \\ \Pi_{ji} &\equiv \left(P_j q_{ji} - C_{ji} - \frac{s(1+\sigma)}{2} q_{ji}^2\right) L_{ji}. \end{aligned} \tag{6}$$

In (6), the costs of finance are as given in (4), while the last term in each expression represents the monitoring costs for domestic and foreign loans, respectively.

We assume that each bank can raise enough capital to satisfy the government's equity requirements for any level of lending that they wish to make in each market.[17] Each multinational bank makes independent decisions regarding its lending through its domestic and the foreign affiliates. The financial products provided by domestic and foreign bank affiliates to firms in a particular market need not be the same, in that the level of monitoring of loans adopted by the domestic affiliate may differ from that chosen by the competing foreign affiliate. Given the symmetry of the model, we focus on determining the lending decisions made in country i.

Total lending in country i will result from each bank affiliate in that market choosing its optimal number of loans, given its rival's lending decision.[18] Substituting (4) and (3) into (6) yields the following expression for bank i's expected profits from lending in its domestic market:

$$\Pi_{ii} = \left[\left(D_i - b\Lambda_{ij}\right) q_{ii} - \left(\frac{s}{2} + bL_{ii}\right) q_{ii}^2 - \rho k_i\right] L_{ii}, \tag{7}$$

where, for notational convenience, we let $D_i \equiv A_i - (1 - k_i)$. As we would expect, the bank's expected profits depend not only on the volume of its

17 This assumption connects our model to the standard setting in the trade literature. It differs, however, from some analyses of capital regulation in which equity is assumed to be fixed and the capital requirement directly determines the total level of lending (e.g., Dell'Ariccia and Marquez 2006).

18 We assume that each bank behaves as a Cournot competitor in that, in making its decision as to the quantity of loans that it will offer in a market, it assumes that its competitor's response will be to maintain its level of lending.

lending in the market but also on its rival's expected gross return on lending, Λ_{ij}.

Similarly, bank j's expected profits from lending in country i are Π_{ij} and through substitution can be written as

$$\Pi_{ij} = \left[(D_i - b\Lambda_{ii}) q_{ij} - \left(\frac{s(1+\sigma)}{2} + bL_{ij} \right) q_{ij}^2 - \rho k_i - \tau \right] L_{ij}. \tag{8}$$

3. Market equilibrium and welfare

Formally, we study the following two-player game. Bank $i \in \{1,2\}$ chooses volumes of loans and monitoring levels $L_{ii}, L_{ji}, q_{ii}, q_{ji} \geq 0$, where $j \neq i$ is bank i's foreign market. Expected profits for bank i are given in (5), (7) and (8). We investigate the Nash equilibria of this game. Thus, in equilibrium, bank i solves

$$\max_{q_{ii}, q_{ji}, L_{ii}, L_{ji}} \Pi_i \Big(q_{ii}, q_{ji}, L_{ii}, L_{ji}, q_{ij}^*, q_{jj}^*, L_{ij}^*, L_{jj}^* \Big),$$

where the equilibrium choices of bank $j \neq i$ are denoted by an asterisk. Hence, each bank maximizes its profits in both markets through its choice of loan volumes and monitoring, taking as given its rival's choices in the same market.

3.1. Optimal bank choices

Partially differentiating bank i's profits in (7) with respect to monitoring levels and loan volumes in its domestic market and solving yields the respective equilibrium values:

$$q_{ii} = \sqrt{\frac{2\rho k_i}{s}}, \tag{9a}$$

$$L_{ii} = \frac{1}{2b} \left[\frac{D_i - b\Lambda_{ij}}{q_{ii}} - s \right], \tag{9b}$$

where a check of the second derivatives ensures that these values are consistent with profit maximization.

Equation (9a) shows that the bank's optimal monitoring of loans is independent of the volume of lending and is determined entirely by cost parameters and the capital requirement. As the equity requirement is increased, or the cost of funding through equity rises, the bank will increase its monitoring effort in order to improve the chances that its lending to firms will be successful. Moreover, and intuitively, an increase in the cost of monitoring s will reduce the domestic affiliate's optimal level of monitoring.

Turning to equation (9b), we can see that the higher monitoring cost s enters directly and negatively into the expression for L_{ii}, but it also has a positive impact through reducing the monitoring level q_{ii}. Multiplying (9a) and (9b) gives the expected gross return on lending $\Lambda_{ii} = q_{ii} L_{ii}$, which is declining in the cost of domestic monitoring. Thus, if the cost of monitoring were to decline, the bank's expected gross return would increase.

Similarly, the optimal volume and quality of lending by bank j in its foreign market can be determined by partially differentiating (8) and solving to obtain equilibrium values for monitoring and lending:

$$q_{ij} = \sqrt{\frac{2(\rho k_i + \tau)}{s(1+\sigma)}}, \tag{10a}$$

$$L_{ij} = \frac{1}{2b}\left[\frac{D_i - b\Lambda_{ii}}{q_{ij}} - s(1+\sigma)\right]. \tag{10b}$$

Comparing (10a) with (9a) shows that the higher cost of monitoring foreign loans $s(1 + \sigma)$ results in bank j monitoring its loans less well compared with bank i's lending to its domestic market. In contrast, the additional transaction cost τ faced by foreign lenders leads them to monitor these loans more closely. Because the unit cost of foreign lending exceeds that of domestic lending, the foreign affiliate j has an incentive to invest more in trying to ensure the success of its borrowers. In sum, these effects imply that the higher transaction cost and the higher information cost of foreign lending have *opposite* implications for the foreign affiliate's optimal level of monitoring. Finally, as was the case for lending by the domestic bank, higher monitoring costs reduce Λ_{ij}, the quality-adjusted lending by the foreign bank.

3.2. The lending equilibrium

Combining (9b) and (10b), we can solve for the equilibrium levels of lending by each bank in country i. First, we can express the market interaction in the form of best response functions in terms of each bank's expected gross return on its lending:

$$\Lambda_{ii}(\Lambda_{ij}) = \frac{D_i - sq_{ii}}{2b} - \frac{\Lambda_{ij}}{2},$$

$$\Lambda_{ij}(\Lambda_{ii}) = \frac{D_i - s(1+\sigma)q_{ij}}{2b} - \frac{\Lambda_{ii}}{2}.$$

Solving these simultaneous equations yields the equilibrium lending in country i:

$$\Lambda_{ii} = \frac{D_i - 2sq_{ii} + s(1+\sigma)q_{ij}}{3b}, \tag{11a}$$

$$\Lambda_{ij} = \frac{D_i + sq_{ii} - 2s(1+\sigma)q_{ij}}{3b}. \tag{11b}$$

Because $s(1 + \sigma)q_{ij} > sq_{ii}$ holds from (9a) and (10a) (because of higher transaction and monitoring costs of foreign lending), it follows that $\Lambda_{ii} > \Lambda_{ij}$. Thus, in equilibrium, the domestic bank's expected gross return on its lending exceeds that of its foreign competitor.

Substituting (11a) and (11b) into (2) yields the equilibrium expected output in country i:

$$X_i = \frac{2D_i - sq_{ii} - s(1+\sigma)q_{ij}}{3b} = \frac{2D_i - \sqrt{2s\rho k_i} - \sqrt{2s(1+\sigma)(\rho k_i + \tau)}}{3b}, \qquad (12)$$

showing that expected output is falling in both the information costs and the transaction costs faced by the foreign bank affiliate.

Similarly, the volume of loans in market i by each bank can be found by substituting the optimal monitoring levels (9a) and (10a) into the expressions for expected gross returns on lending (11a) and (11b). Remembering that $\Lambda_{ih} \equiv q_{ih}L_{ih}$, we get

$$L_{ii} = \frac{D_i - 2sq_{ii} + s(1+\sigma)q_{ij}}{3bq_{ii}}, \qquad (13a)$$

$$L_{ij} = \frac{D_i + sq_{ii} - 2s(1+\sigma)q_{ij}}{3bq_{ij}}. \qquad (13b)$$

This completes the description of the duopolistic market equilibrium. We summarize our results in the following proposition.

Proposition 1. *In the lending equilibrium, the following properties hold:*

(*i*) *In each country, the expected gross return on lending by the domestic affiliate exceeds that of the foreign affiliate,* $\Lambda_{ii} > \Lambda_{ij}$.

(*ii*) *Monitoring by the foreign affiliate is rising in the transaction costs* τ *and falling in the information costs* σ. *Domestic affiliates monitor their loans more than do foreign affiliates,* $q_{ii} > q_{ij}$, *if and only if* σ *is large in relation to* τ.

Proposition 1 finds some support in empirical studies. Beck et al. (2018, table 11) show that, for a detailed data set from Bolivia, domestic banks have a better ex post loan performance than do foreign banks, measured either by the probability of arrears or default or by the net return on loans. They also find that this result is strongest when foreign banks are not able to effectively mitigate the credit risk arising from their higher informational costs. Agarwal and Hauswald (2010) find analogous results for the national lending patterns of a large US bank, which exhibits higher loan default ratios when the distance to the customer is larger (table 7). They also show that these higher default ratios are caused by lower screening levels for the more distant customers, which in turn are driven by their higher information costs.

In an extended framework where borrowing risks are heterogeneous, foreign banks have a further alternative. Rather than choosing a lower *level* of monitoring for a given project, they can choose projects with inherently low monitoring *costs*. Historically this happened, for example, in the financing of Canadian railways, where British investment was dominant in the second half of the 19th century. This concentration can be explained by the low information costs in this sector, relative to the size of the investment, which minimized the informational disadvantage faced by British vis-à-vis North American investors (Carlos and Lewis 1995).

3.3. Welfare and optimal capital regulation

We consider a representative consumer in each country, with quasi-linear utility of the form $U_i = A_i X_i - bX_i^2/2 + Z$, which gives rise to the demand function for good X in (1). To keep our welfare analysis as simple as possible, we assume that banks, while having their headquarters and affiliates in the two countries, are owned by shareholders in a third country. This corresponds to a setting where the two countries in the region are small in the world capital market and shareholders in each country hold portfolios that are fully diversified internationally. This assumption implies that the representative consumer's market income is fixed in our analysis because firms make zero profits by assumption and the return to savings is fixed by the government's deposit insurance scheme. This leaves consumer surplus in market X_i and (negative) tax revenues as the two components of domestic welfare that are of interest.[19]

We express national welfare in country i, W_i, as a weighted sum of consumer surplus (CS_i) and tax revenues (G_i), attaching the welfare weight $\gamma \geq 1$ to tax revenues:

$$W_i = CS_i + \gamma G_i, \gamma \geq 1. \tag{14}$$

The conventional motivation for the (weakly) higher welfare weight on tax revenues is that a deadweight cost of taxation must be incurred when financing the losses from the deposit insurance scheme. An additional reason in the present context is that the bank failures that give rise to tax losses may cause further negative externalities that are not explicitly modelled here.

From the demand curve (1), substituting equilibrium output (12), it is straightforward to determine the level of consumer surplus in equilibrium:

$$CS_i = \frac{bX_i^2}{2} = \frac{[2D_i - sq_{ii} - s(1+\sigma)q_{ij}]^2}{18b}. \tag{15}$$

Households' exposure to the risk of failed loans depends on two elements: (i) the volume of unsuccessful loans and (ii) the share of the cost that is borne by the taxpayer, as opposed to being absorbed by the banks' shareholders. The first of these can be written as $[L_{ii} + L_{ij} - X_i] = [(1 - q_{ii})L_{ii} + (1 - q_{ij})L_{ij}] > 0$, the difference between the total loan volume advanced and the quantity of output that is successfully produced. With banks facing a binding capital requirement of k_i, taxpayers have to pay for the remaining share of losses, $(1 - k_i)$. Consequently, the tax losses arising from deposit insurance for failed loans are

$$G_i = -(1 - k_i)[L_{ii} + L_{ij} - X_i] < 0. \tag{16}$$

Increasing a nation's equity requirement k_i shifts more of the burden of failure from taxpayers to the shareholders of the bank. This will affect national

19 In the regulatory literature, these assumptions correspond to a consumer surplus standard (see Farrell and Katz 2006).

welfare through the changes in equilibrium volumes of lending, monitoring and production.

The direct effect of increasing the capital requirement k_i is to raise the cost of capital for all bank affiliates operating in country i. The higher costs of capital induce banks to monitor their loans more carefully. Differentiating (9a) and (10a) gives:

$$\frac{dq_{ii}}{dk_i} = \frac{\rho}{sq_{ii}} > 0,$$
$$\frac{dq_{ij}}{dk_i} = \frac{\rho}{s(1+\sigma)q_{ij}} > 0.$$

We can use these derivatives, noting that $dD_i/dk_i = 1$, to calculate the impact of changing the capital requirement on expected output and consumer surplus:

$$\frac{dCS_i}{dk_i} = bX_i\frac{dX_i}{dk_i} = \frac{X_i}{3}\left[2 - \rho\left(\frac{1}{q_{ii}} + \frac{1}{q_{ij}}\right)\right] < 0. \tag{17}$$

As monitoring is incomplete ($q_{ii}, q_{ij} < 1$) and $\rho > 1$, expected output and hence consumer surplus unambiguously decline with a stricter capital requirement. Given that any loans that are made are more closely monitored as a result of a tougher capital requirement, the fact that expected output falls clearly indicates that the volume of lending in the market is reduced.

The impact on tax revenues in (16) is obtained by differentiating (12), (13a) and (13b) with respect to k_i:

$$\frac{dG_i}{dk_i} = \frac{(1-k_i)}{3b}\left[\frac{\rho}{q_{ii}q_{ij}}\left(2 - q_{ii} - q_{ij} + \frac{2\left(q_{ii} - q_{ij}\right)^2}{q_{ii}q_{ij}}\right) + \left(\frac{2q_{ii}q_{ij} - q_{ii} - q_{ij}}{q_{ii}q_{ij}}\right)\right]$$
$$+(1-k_i)\rho\left(\frac{L_{ii}}{sq_{ii}^2} + \frac{L_{ij}}{s(1+\sigma)q_{ij}^2}\right) + L_{ii}(1-q_{ii}) + L_{ij}(1-q_{ij}) > 0. \tag{18}$$

While cumbersome, this expression is unambiguously positive.[20] This reflects the fact that less lending is taking place, the remaining lending is better monitored in equilibrium and more of the burden of responsibility for failed loans is being switched to the banks, away from taxpayers.

We now turn to the optimal capital standard for country i in our model. It is clear that welfare in country i depends only on its own capital standard k_i and not on that of country j. This is seen from the fact that both consumer surplus and tax revenue depend only on the lending in country i (L_{ii}, L_{ij}) and on the monitoring levels (q_{ii}, q_{ij}) chosen by bank affiliates located in country i

20 Specifically, the squared bracket in the first line in (18) can be shown to be unambiguously positive because the first term in the squared bracket dominates the second term for $\rho > 1$.

(cf. equations (9a), (10a), (13a) and (13b)). Hence, we only have to ensure that $W_i(k_i)$ is quasi-concave in k_i. The second-order condition is too complex to be derived and signed in general. In appendix A1, we therefore analyze the benchmark case where foreign affiliates face no extra costs ($\tau = \sigma = 0$) and banks are symmetric competitors in each market. For this case, we derive conditions under which the second-order condition can be unambiguously signed as negative (see (A3) and (A5) in appendix A1). In the following, we will assume that these conditions are fulfilled and that the second-order condition also holds in the general case with positive levels of τ and σ.

In the next step, we analyze the conditions under which each country will choose a strictly positive capital requirement k_i^*. For this to occur, it must hold that $\partial W_i/\partial k_i > 0$ when evaluated at $k_i = 0$. Appendix A2 shows that this will always be fulfilled in our model. Moreover, it remains true even if we incorporate the negative effect of k_i on the domestic bank's profit Π_i into the government's objective function. Intuitively, at $k_i = 0$, the monitoring of domestic loans is zero from (9a) so that all loans fail. At the same time, domestic lending approaches infinity because the bank will not incur any cost on these loans (see (4)). Together, this implies that losses for taxpayers are infinite at $k = 0$. Hence, for any positive value of the tax revenue weight γ, governments will find it optimal to choose a positive capital requirement k_i. We summarize these results in the following proposition.

Proposition 2. *Optimal capital requirements in both countries are strictly positive,* $k_i^*, k_j^* > 0$.

Proof. See appendix A2. ∎

We can also ask which country has the higher capital requirement. From the implicit function theorem and the second-order sufficient condition for a maximum, we get

$$\frac{dk_i^*}{dA_i} = \frac{d^2W/(dk_i dA_i)}{-(dW^2/dk_i^2)} \Longrightarrow sign\left(\frac{dk_i^*}{dA_i}\right) = sign\left(\frac{d^2W_i}{dk_i dA_i}\right).$$

Calculating the cross-derivative, we get

$$\frac{d^2W_i}{dk_i dA_i} = \frac{2}{9b}\left[2 - \left(\frac{\rho}{q_{ii}} + \frac{\rho}{q_{ij}}\right)\right] + \frac{(1-k_i)\rho\gamma}{3b}\left[\frac{1}{sq_{ii}^3} + \frac{1}{s(1+\sigma)q_{ij}^3}\right] + \frac{\gamma}{3b}\left[\frac{1}{q_{ii}} + \frac{1}{q_{ij}} - 2\right]. \tag{19}$$

The first term in (19) is negative, whereas the last two terms are positive. Therefore, there is not an unambiguous relationship between country size, as measured by the demand intercept A_i, and the optimal capital requirement k_i^*. However, we can see from (19) that the two last terms are more likely to dominate the first, and hence the larger country has the higher capital standard when the welfare weight of tax revenues (γ) is high and the cost of equity (ρ) is low. Intuitively, higher capital standards are attractive

for both countries under these conditions. Because the large country has both the higher consumer surplus and the higher tax losses, it has the larger incentive to increase the capital requirement when these conditions are fulfilled.

4. Financial integration

Improvements in technology or information can reduce the cost to a bank of lending in a foreign market. This enhances the entry of financial institutions into foreign markets and has implications for the overall level of lending, as well as for the quality of loans. In our model, we have two parameters that capture different elements of financial integration. First, a reduction in the transaction cost parameter τ facilitates access to the foreign market but leaves unchanged the extra costs of monitoring foreign loans. Second, improved information on foreign loans is captured by a decrease in the foreign information cost parameter σ. As we shall show, changes in these two parameters have very different welfare implications in the model.

4.1. Reduced transaction costs for cross-border lending

We initially consider the effect of reducing the transaction cost τ of dealing with a foreign tax and regulatory system, recalling that we have normalized the transaction costs of domestic banks to zero (see footnote 15). In this interpretation, transaction costs are reduced, in particular, by international harmonization of the relevant laws and regulations in the banking sector. One important example in the European Union (EU) was the introduction of a "single banking licence" (through the principle of mutual recognition) in the Second Banking Directive, which became effective in 1992. Another example is the current initiative to create a capital markets union among the EU member states. A core element in this initiative is the increased use of "simple, transparent and standardized" securitization, which is aimed explicitly at reducing the costs of cross-border lending (see European Commission 2015a, b).

The direct impact of changing τ in our model falls on the foreign bank affiliate. The decline in its transaction cost will reduce the incentive for the foreign bank to monitor its loans in the market (see equation (10a)). This will lead to increasingly poorly monitored foreign loans competing with the local bank's lending.

The impact on consumer surplus in market i, using (12), is

$$\frac{dCS_i}{d\tau} = bX_i \frac{dX_i}{d\tau} = -\frac{(\Lambda_{ii} + \Lambda_{ij})}{3q_{ij}} < 0, \tag{20}$$

which implies an increase in consumer surplus as a result of falling transaction costs for foreign lending. This reflects the fact that the reduced transaction cost makes lending by the foreign bank cheaper and consequently more

available. This aggregate effect can be decomposed into the impact on the effective lending levels of each bank. Using (11a) and (11b) gives

$$\frac{d\Lambda_{ii}}{d\tau} = \frac{1}{3bq_{ij}} > 0,$$
$$\frac{d\Lambda_{ij}}{d\tau} = -\frac{2}{3bq_{ij}} < 0.$$

The reduction in Λ_{ii} following a decrease in τ results from a fall in the home affiliate's lending volume L_{ii}, while the success probability q_{ii} of the home affiliate is unchanged from (9a). For the foreign affiliate, the decrease in τ induces an increase in the lending volume L_{ij}, which more than compensates for the reduced success probability q_{ij} resulting from less monitoring. In sum, reducing the foreign bank's transaction cost leads to increasingly poorly monitored foreign lending crowding out the local bank's loan offering.

As a result, the domestic taxpayer is faced with the prospect of bailing out failed loans, where the portfolio of lending has shifted towards foreign loans that are becoming less well monitored as τ declines. Differentiating tax revenue in (16) with respect to τ and substituting the foreign bank's optimal monitoring level from (10a) gives

$$\frac{dG_i}{d\tau} = (1-k_i)\left[\frac{L_{ij}}{(2\rho k_i + \tau)} + \frac{1}{3bq_{ij}}\left(\frac{2q_{ii} - q_{ij} - q_{ii}q_{ij}}{q_{ii}q_{ij}}\right)\right]. \tag{21}$$

The first term in the squared bracket in (21) gives the change in tax revenue for taxpayers in country i as a result of the reduced monitoring by the foreign bank j. This effect is unambiguously negative for a fall in cross-border transaction costs τ. The second term in (21) reflects the changed risk exposure as a result of the changes in the level and the composition of total lending. A sufficient condition for this effect to also be unambiguously negative for a fall in τ is that, in the initial equilibrium, the domestic bank i monitored its loans at least as well as the foreign bank j, i.e., $q_{ii} \geq q_{ij}$.[21]

Combining the effects on consumer surplus and tax revenues in (20) and (21) in the welfare function (14) shows that the welfare effects of lower transaction costs for foreign lending are generally ambiguous. In other words, a reduction in transaction costs τ *may* have negative welfare effects in each of the two countries. Intuitively, this is more likely to be the case when the tax revenue losses from failed banks weigh heavily in the national welfare function (γ_i is large). A negative net welfare effect of a fall in τ is also more likely in our model for lower capital requirements k_i, resulting in taxpayers being more exposed to bank failures that occur in their home country. Finally, note from the first term in (21) (which is negative for a fall in τ), that this term will be

21 Recall from proposition 1(ii) that q_{ii} may be either larger or smaller than q_{ij}, in general. The condition $q_{ii} \geq q_{ij}$ will be fulfilled if, in the initial equilibrium, the transaction cost for foreign lending τ is not too high, relative to the extra information cost of foreign lending, σ.

larger the smaller the initial level of τ. In this case, the second term in (21) will also be negative for a fall in τ (see footnote 21). Therefore, a fall in the transaction costs τ of foreign lending is more likely to be welfare-decreasing the lower the initial level of these costs.

We summarize these results in the following proposition.

Proposition 3. *A reduction in the transaction costs for foreign lending τ raises consumer surplus and it lowers tax revenues in both countries when $q_{ii} \geq q_{ij}$ holds. The total effect on welfare is more likely to be negative if: (i) the valuation of tax revenue γ_i is high, (ii) capital requirements k_i are low and (iii) the initial level of τ is low.*

There are clear similarities in our results to those of the Brander and Krugman model. The lower transaction costs of cross-border lending encourages lending by the foreign bank in the domestic market, contesting the market power of the local incumbent and expanding the aggregate loan volume. However, there are also striking differences. In our setting, the banks' loans are not identical and increasingly poorly monitored foreign loans drive out local lending. Therefore, citizens are likely to enjoy greater consumption levels from a policy of increasing the market access of the foreign bank, but as taxpayers, they will face an increasing burden in having to bail out the banks as more poor-quality loans fail.

4.2. Reduced information costs abroad

We now turn to the effects of a decline in the foreign information cost parameter σ. As we have argued above, these costs arise from the affiliate of a foreign-based bank being less familiar with the customers in the country, compared with a local bank affiliate.[22] As a result, foreign affiliates often rely on the *costly* intermediation services of a local bank. One example of reducing such cross-country, consumer-information costs are credit registers, which publicize financial data on bank customers. Such credit registers exist in most developed countries, and the data are collected either by private credit bureaux or by public agencies (typically central banks).[23] Another example is stress tests for banks, which have been carried out by supervisory agencies in all OECD countries since the financial crisis. Stress tests provide information on the liquidity

22 In empirical work, these information costs are generally proxied by geographical distance and a different language; see Buch (2003), Portes and Rey (2005) or Kleinert and Toubal (2010). Of these studies, Buch (2003) distinguishes information costs from regulatory (or transaction) costs and finds separate, positive effects of a fall in either type of costs on cross-border lending.

23 Giannetti et al. (2010) use these sources to assemble a comprehensive data set for the EU27 member states over the period 1999–2007. They show that the existence of public credit registers, in particular, has a positive impact on the market entry of foreign-based multinational banks.

of banks in other countries. This reduces the information costs for cross-border lending because a substantial share of lending abroad is to foreign financial institutions (even though this is not modelled here) and because foreign banks may be involved as intermediaries in lending to final customers.

As was the case for foreign transaction costs τ, changes in σ have a direct effect only on the monitoring decision of the foreign affiliate. From (10a), we obtain

$$\frac{dq_{ij}}{d\sigma} = \frac{-q_{ij}}{2(1+\sigma)} < 0.$$

Hence, in contrast to the impact of lowering τ, which leads to less monitoring of the foreign affiliate's loans, reductions in σ induce the foreign bank to increase its monitoring, and hence the quality of its lending in the domestic market (see proposition 1(ii)). Intuitively, the core difference is that a fall in transaction costs τ reduces the bank's *reward* from monitoring, whereas a fall in information cost σ cuts the *cost* of monitoring.

The impact on consumer surplus in equilibrium is

$$\frac{dCS_i}{d\sigma} = bX_i \frac{dX_i}{d\sigma} = -\frac{sq_{ij}(\Lambda_{ii} + \Lambda_{ij})}{6} < 0. \tag{22}$$

The rise in consumer surplus as σ falls reflects the increase in the aggregate gross returns on lending by the two banks. Once again, this aggregate change results from a change in the composition of lending, where the rise in the expected return on lending of the foreign affiliate dominates the decline in that of the local bank:

$$\frac{d\Lambda_{ii}}{d\sigma} = \frac{sq_{ij}}{6b} > 0,$$
$$\frac{d\Lambda_{ij}}{d\sigma} = -\frac{sq_{ij}}{3b} < 0.$$

The change in tax revenues resulting from the changed monitoring and lending decisions is

$$\frac{dG_i}{d\sigma} = (1-k_i)\left[\frac{-L_{ij}}{2(1+\sigma)} + \frac{s\left(2q_{ii} - q_{ij} - q_{ii}q_{ij}\right)}{6bq_{ii}}\right]. \tag{23}$$

The first term in this expression gives the change in tax revenue that results from the change in the monitoring decision of the foreign affiliate. This effect unambiguously increases tax revenues for a fall in information costs σ. The second term reflects the changed level and composition of lending. If $q_{ii} \geq q_{ij}$, this effect will counteract the first effect, reflecting the increased aggregate lending volume in country i. Appendix A3 shows that a sufficient condition for (23) to be negative, and hence for a fall in σ to increase tax revenues, is that $D_i \geq s(1 + 2\sigma)$. Hence, country i's loan market must be sufficiently large, relative to the information costs borne by the foreign affiliate. If this condition is fulfilled, then a fall in the foreign information cost parameter σ increases *both* consumer surplus and tax revenues and, therefore, unambiguously raises welfare in each country.

We summarize our results in the following proposition.

Proposition 4. *A reduction in the information costs for foreign lending σ raises consumer surplus. It also raises tax revenue, and hence unambiguously increases total welfare, if $D_i \geq s(1 + 2\sigma)$, which ensures that the market size is sufficiently large relative to the information costs of the foreign bank.*

Proof. See appendix A3. ∎

A comparison of propositions 3 and 4 reveals that the effects of financial integration can be very different, depending on the type of impediment to cross-border lending that is lowered. In particular, if the transaction costs for foreign loans are reduced, while the information costs for these loans remain unchanged, then financial integration may well have detrimental welfare effects. This could be the case, for example, when deregulation is accompanied by internationally harmonized laws and regulations so that transaction costs for foreign lending are low, while information costs for foreign loans remain high. In contrast, the effects of falling cross-border information costs are almost certain to be beneficial for the banks' host countries. The core reason behind these diverging welfare implications are the opposite effects that reductions in transaction costs and cross-border information costs have on the monitoring decision of the foreign bank's affiliate.

5. Financial integration and optimal regulation

In this section, we analyze how reductions in the foreign transaction-cost parameter τ and the foreign information cost parameter σ affect the optimal choice of the capital requirement. The determinants of the optimal capital requirement, as discussed in section 3.3, are too complex to allow us to answer this question analytically. We, therefore, consider some numerical examples that highlight the patterns of optimal responses. All of our numerical examples assume that countries are fully symmetric and, therefore, country subscripts are omitted.[24]

Figure 2 illustrates the results from a first set of numerical simulations that show the effects of reducing the compliance cost parameter τ on the optimal level of capital regulation k^*. The figure shows three lines, each corresponding to different values of γ, the welfare weight on tax revenues.

In figure 2, we see that, in all of the three cases illustrated, a fall in transaction costs τ has a U-shaped relationship with the optimal capital requirement k^*, which first falls and then rises as τ is lowered. This non-monotonous adjustment of k^* stems from the fact that reductions in τ reduce monitoring

24 In our calculations, the parameter values are as follows: $A = 10$, $b = 1$, $s = 5$ and $\rho = 2$. As we vary one type of cost, the other remains constant such that $\sigma = 0.5$ as τ varies, while $\tau = 0.5$ as σ changes.

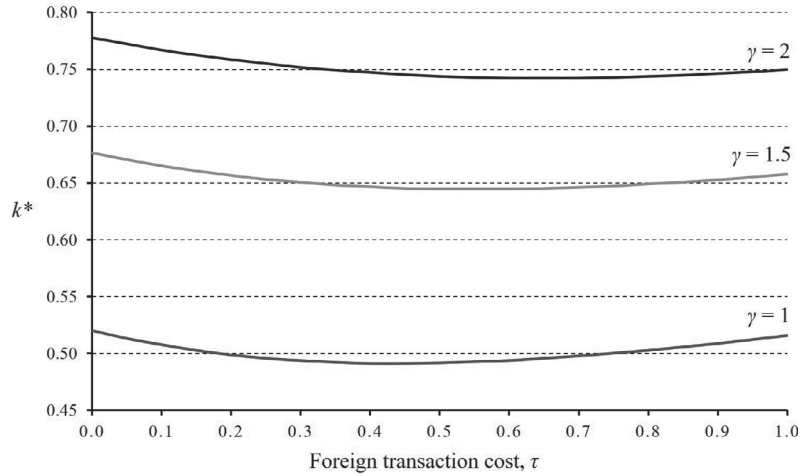

FIGURE 2 Transaction costs and optimal regulation

by the foreign affiliate (proposition 1(ii)) and also reduce tax revenues (proposition 3). At high initial levels of τ, tax losses are therefore moderate because of low levels of foreign lending and high levels of monitoring of foreign loans. In this situation, a fall in transaction costs that makes foreign lending cheaper will be boosted by a falling capital requirement k^* in order to maximize its beneficial impact on consumer surplus. At low levels of τ, in contrast, foreign lending is large and poorly monitored. Therefore, the optimal k^* rises to reduce the government's tax losses.

In our discussion of equation (18), we determined that the impact of reductions in τ on tax revenue depends on the weight of tax revenue in the welfare expression. As the weight on tax revenues is increased (higher values of γ), the optimal capital requirements are generally higher for any level of τ, thus shifting more of the burden of responsibility for failed loans onto the banks and away from taxpayers. But the non-monotonicity of k^* as τ falls is seen in all three examples, and it remains even for higher levels of γ.

In figure 3, we turn to the effects of reducing the extra information cost of foreign lending, σ. Once again, we consider the impact of reductions in this cost on the optimal capital requirement k^* and find, as with changes in τ, that the relationship is non-monotonic. In this case, however, the optimal capital constraint has an inverted U-shape with respect to reductions in σ.

This response of k^* to a continuous fall in σ arises, in contrast to that for a reduction in τ, because a fall in σ increases the monitoring of foreign loans (proposition 1(ii)) and reduces tax losses under mild conditions (proposition 4).[25] At

25 Note that the condition in proposition 4 is sufficient, but not necessary, for tax losses to fall when σ falls. This result is always true in our numerical examples, even when the condition in proposition 4 is violated.

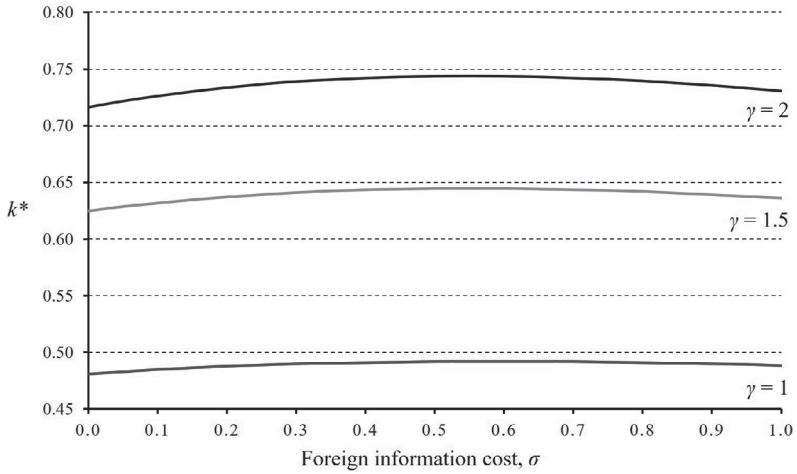

FIGURE 3 Information costs and optimal regulation

high levels of σ, monitoring of foreign loans is thus low, and this is counteracted by rising levels of optimal capital regulation k^*. As σ becomes very low and monitoring of foreign loans is high, tax losses will fall, permitting a reduction in k^* to increase consumer surplus. Once again, the capital standard k^* is higher the greater the welfare weight γ on tax revenues.

6. Discussion

Our model makes a number of simplifying assumptions to keep the analysis tractable while incorporating two frictions to international lending. In this section, we briefly discuss how relaxing some of these assumptions would affect our results.

A first assumption is that the cost of equity, ρ, is exogenously fixed. In a more general setting, the (unit) cost of equity can be expected to fall when capital requirements are increased, and hence the bank's risk would be divided among more equity owners. In such a case, the effects of higher capital requirements on a bank's output and monitoring would then be partially offset by a simultaneous fall in ρ (see equation (4)). However, empirical studies show that a *full* offset does not occur so that stricter capital requirements continue to increase the banks' costs of capital even when ρ is endogenous (Baker and Wurgler 2015). Another possible implication of endogenizing the cost of equity is that banks may choose positive levels of monitoring as a commitment device, even in the absence of any capital requirements (i.e., for $k = 0$); see Allen et al. (2011). Hence, the result that optimal capital requirements are strictly positive in equilibrium (proposition 2) may no longer be unconditional in this extended setting.

Second, our model assumes that the risks of loans in a bank are perfectly correlated in each country. The main additional effect arising from an imperfect correlation of risks is that the failure probability of the bank will generally be lower than the failure probability of each individual loan (Martinez-Miera and Repullo 2010). Introducing this property into the cost functions of banks (equation (4)) would result in the probability with which the bank has to pay the deposit costs now being higher than the monitoring level q_{ii}. This would lead to higher expected costs per loan for each bank affiliate, as the implicit government subsidy for each bank loan falls. This, in turn, would lead to less lending and more monitoring by banks in equilibrium, relative to the case where loans are perfectly correlated. Moreover, the taxpayers' exposure to bank failures would fall, likely resulting in a lower capital requirement in the government's optimum.

A third assumption is that all loans are equally sized in our model and that banks are identical. If loans of different size were incorporated, transaction and information costs would have to be split into fixed and variable components. How loans of different size are affected by financial integration would then depend on whether a fall in transaction or information costs reduces primarily the fixed or the variable cost component. Moreover, incorporating loans of different size would also imply some heterogeneity between banks, typically in terms of different costs of monitoring (Kopecky and VanHoose 2006, Haufler and Maier 2019). The parallel international trade literature in the presence of firm heterogeneity (Melitz 2003) has shown that falling trade costs can be expected to increase the productivity gap between the high-cost and the low-cost banks. In our set-up, the bank with the lower (monitoring) cost would therefore benefit disproportionately from financial integration, but what this implies for the welfare of the country hosting this bank is far less clear.

7. Conclusion

In this paper, we have set up a two-country model with multinational banks that are engaged in duopoly competition in both their home and foreign markets. Loans are made to competitive, productive firms and therefore have real effects on the economy. Banks face limited liability when their loans fail because their funds come partly from savings deposits that are guaranteed by national governments. This part of the default risk is effectively shifted to taxpayers, causing a moral hazard problem in terms of the banks' monitoring decisions and distorting their lending activities towards the foreign market. Governments choose capital requirements so as to maximize domestic welfare, given the exogenous weights they put on the interests of taxpayers and consumers.

In this setting, we have analyzed the effects of financial integration on the decisions of banks and hence on aggregate national welfare. We find that the desirability of integration depends crucially on the type of costs for cross-border lending that are reduced. If financial integration is mainly associated

with a fall in transaction costs, the monitoring levels for foreign loans will fall. More risky foreign lending may then replace safer domestic lending in equilibrium, with adverse consequences for taxpayers and, potentially, aggregate welfare. On the other hand, if financial integration is driven mainly by a fall in the information costs for foreign loans, then the optimal monitoring of these loans will rise and both consumers and taxpayers can be expected to benefit from this sort of financial integration. These opposing effects of financial integration offer an explanation for the conflicting empirical evidence linking the growth in banks' cross-border lending to their levels of risk-taking.

In conclusion, financial integration that merely reduces the transaction costs of cross-border lending can be harmful to a country, unless it is accompanied by measures that reduce the information costs specific to foreign lending. This result is particularly relevant for the EU, where the "single banking licence" has significantly lowered transaction costs for cross-border lending and plans are underway to reduce these costs further in a capital markets union. Our results suggest that it is then essential for the EU to simultaneously reduce the information costs of foreign lending. The Single Supervisory Mechanism of the European banking union represents a step in this direction by providing information on the liquidity of the EU's largest banks and by harmonizing the standards of financial institutions, among which a substantial part of cross-border lending occurs. Another measure would be to make national public credit registers mandatory for all member states and to share the information collected in these credit registers.

Many more interesting questions can be raised. One possible extension would be to introduce a more complex output sector that is characterized by imperfect competition and some market power vis-à-vis banks in determining the equilibrium loan rate. Another extension would be to incorporate a richer set of government policies. One example would be for host countries to apply differentiated capital ratios for domestic and foreign affiliates, reflecting the different failure rates of loans (whereas current risk weights under the Basel process depend on the asset classes of banks). Similarly, it would be possible to consider policy measures that impact upon foreign lenders alone, say through a special levy on the costs of lending by non-domestic institutions. We leave these extensions to further research.

APPENDICES

Appendix A1: Second-order condition of government's problem

We consider a simplified setting where the foreign affiliate faces no additional costs such that $\tau = \sigma = 0$. Hence, we can define $q_i \equiv q_{ii} = q_{ij}$ and $L_i \equiv L_{ii} = L_{ij}$. The first-order condition for the government's problem then simplifies to

$$\frac{dW_i}{dk_i}=\frac{X_i}{3}\left(1-\frac{\rho}{q_i}\right)+\gamma\left[\frac{(1-k_i)}{3}\frac{(1-q_i)}{q_i}\left(\frac{\rho}{q_i}-1\right)+\frac{(1-k_i)\rho L_i}{sq_i^2}+L_i(1-q_i)\right]=0. \tag{A1}$$

Differentiating with respect to k_i and using (9a), (12) and (11a) gives

$$\frac{d^2W_i}{dk_i^2}=\frac{2}{9b}\left(1-\frac{\rho}{q_i}\right)^2+\frac{X_i\rho^2}{3sq_i^3}-\frac{\gamma}{3}\frac{(1-q_i)(\rho-q_i)}{q_i^2}-\frac{\gamma(1-k_i)\rho}{3sq_i^3}\left(\frac{2\rho}{q_i}-\rho-1\right)$$
$$+\frac{\gamma\rho(1-k_i)}{sq_i^2}\frac{dL_i}{dk_i}-\frac{2\gamma(1-k_i)\rho^2L_i}{sq_i^4}-\frac{\gamma\rho L_i}{sq_i^2}+\gamma(1-q_i)\frac{dL_i}{dk_i}-\frac{\gamma\rho L_i}{sq_i}. \tag{A2}$$

The first two terms in (A2) are positive, whereas all other terms are negative. We first combine the second term in the first line with the third term in the second line. Note that $X_i = 2L_iq_i$; these terms sum to

$$\Gamma\equiv\frac{\rho L_i}{sq_i^2}\left(\frac{2\rho}{3}-\gamma\right)\leq 0\Longrightarrow\rho\leq\frac{3\gamma}{2}. \tag{A3}$$

Next, we combine the first term in the first line of (A2) with the last two terms in the second line. Using (11a) gives

$$\Delta\equiv\frac{1}{9bq_i^2}\left[2(q_i-\rho)^2+3\gamma(1-q_i)(q_i-\rho)-\frac{3\gamma\rho(D_i-sq_i)}{sq_i}\right]. \tag{A4}$$

This is more likely to be positive if ρ is large relative to γ. Moreover, it is straightforward to establish that the expression in the square bracket in (A4) is rising in q_i. We therefore substitute the maximum permissible values for ρ (from condition (A3)) and for q_i ($q_i = 1$) into (A4) to get a sufficient condition for Δ to be non-positive. This is

$$\Delta<\tilde{\Delta}\equiv\frac{2}{9bq_i^2}\left[(\rho-1)^2-\rho^2\frac{(D_i-s)}{s}\right]\leq 0\Longrightarrow D_i>\frac{s[\rho^2+(\rho-1)^2]}{\rho^2}. \tag{A5}$$

Condition (A5) specifies that the market size in each country must be sufficiently large, relative to the information cost parameter s. If conditions (A3) and (A5) are both fulfilled, then the second-order condition in (A2) is unambiguously negative.

Appendix A2: Proof of proposition 2

We base our analysis on an extended welfare objective that also includes the profits of the domestic multinational bank, such that $\tilde{W}_i = CS_i+\gamma G_i+\Pi_i$. We first derive the effect of a change in the capital ratio on the domestic banks profits, as given in (5) and (6). Noting that k_i affects only the profits of the home affiliate, Π_{ii}, we get

$$\frac{\partial \Pi_{ii}}{\partial k_i} = \Psi - \frac{4\rho L_{ii}}{3}; \Psi \equiv \left[1+\rho\sqrt{\frac{s(1+\sigma)}{2(\rho k_i+\tau)}}\right]\sqrt{\frac{2\rho k_i}{s}}\left[\frac{2[D_i+\sqrt{2s(1+\sigma)(\rho k_i+\tau)}]}{9b\sqrt{\frac{2\rho k_i}{s}}} - \frac{4s}{9b}\right]. \tag{A6}$$

Differentiating $\tilde{W}_i$, we then get

$$\begin{aligned}\frac{d\tilde{W}_i}{dk_i} > \ & \frac{X_i}{3}\left[2-\rho\left(\frac{1}{q_{ii}}+\frac{1}{q_{ij}}\right)\right]+\gamma(1-k_i)\rho\left[\frac{L_{ii}}{sq_{ii}^2}+\frac{L_{ij}}{s(1+\sigma)q_{ij}^2}\right] \\ & + \ \gamma[L_{ii}(1-q_{ii})+L_{ij}(1-q_{ij})]+\Psi-\frac{4\rho L_{ii}}{3},\end{aligned} \tag{A7}$$

where the first term on the RHS of (A7) corresponds to dCS_i/dk_i in (17), the second and third terms correspond to the last two terms of dG_i/dk in (18) and the remaining terms are from (A6). The positive first term in (18) is omitted, yielding a sufficient condition for $d\tilde{W}_i/dk_i > 0$.

Using $X_i = \Lambda_{ii} + \Lambda_{ij} = q_{ii}L_{ii} + q_{ij}L_{ij}$ and factoring out L_{ii} and L_{ij} gives

$$\begin{aligned}\frac{d\tilde{W}_i}{dk_i} > & L_{ii}\left[\frac{2q_{ii}-\rho}{3}+\gamma\frac{(1-k_i)\rho}{sq_{ii}^2}+\gamma(1-q_{ii})-\frac{4\rho}{3}\right] \\ & + L_{ij}\left[\frac{2q_{ij}-\rho}{3}+\gamma\frac{(1-k_i)\rho}{s(1+\sigma)q_{ij}^2}+\gamma(1-q_{ij})\right]+\Psi.\end{aligned} \tag{A8}$$

Evaluating at $k_i = 0$ gives $q_{ii}|_{k=0} = 0$ and $q_{ij}|_{k=0} > 0$ for $\tau > 0$ from (9a) and (10a). Hence, the second term in the squared bracket in the first line of (A8) must dominate all others, and we immediately get

$$\left.\frac{d\tilde{W}_i}{dk_i}\right|_{k=0} \to +\infty, \tag{A9}$$

which proves proposition 2.

Appendix A3: Proof of proposition 4

Substituting (13b) into (23) and rearranging gives, in a first step,

$$\frac{dG_i}{d\sigma} = \frac{(1-k_i)[-D_i q_{ii}+\Omega]}{6bq_{ii}q_{ij}(1+\sigma)}, \text{ where} \tag{A10}$$

$$\Omega \equiv 4s(1+\sigma)q_{ii}q_{ij} - sq_{ii}^2 - s(1+\sigma)q_{ij}^2 - s(1+\sigma)q_{ii}q_{ij}^2. \tag{A11}$$

Adding and subtracting $s\sigma q_{ii}^2$ and $2s(1+\sigma)q_{ii}(1-q_{ij})$, and rearranging, we can rewrite Ω as

$$\Omega = 2s(1+\sigma)q_{ii} - s[(1+\sigma)q_{ii}(1-q_{ij})^2 + q_{ii}\left[1+\sigma(1-q_{ij})\right] + (1+\sigma)(q_{ii}-q_{ij})^2].$$

Reinserting into (A10) and rearranging gives

$$\begin{aligned}\frac{dG_i}{d\sigma} =& \frac{(1-k_i)}{6bq_{ii}q_{ij}(1+\sigma)}(-q_{ii}[D_i - s(1+2\sigma)]) \\ &-\Big(s[(1+\sigma)q_{ii}(1-q_{ij})^2 + q_{ii}\sigma(1-q_{ij}) + (1+\sigma)(q_{ii}-q_{ij})^2]\Big).\end{aligned} \tag{A12}$$

The second line in (A12) is unambiguously negative. Hence, $[D_i - s(1 + 2\sigma)] > 0$ in the first line is a sufficient condition for $dG_i/d\sigma$ to be negative.

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