NBER WORKING PAPER SERIES

ALL BANKS GREAT, SMALL, AND GLOBAL: LOAN PRICING AND FOREIGN COMPETITION

Beatriz de Blas
Katheryn Niles Russ

Working Paper 16029
http://www.nber.org/papers/w16029

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
May 2010

The authors thank participants in a number of seminars and conference panels for helpful comments, particularly Joshua Aizenman, Andy Bernard, Claudia Buch, Silvio Contessi, Linda Goldberg, Federico Mandelman, Monika Schnitzer, Viktors Stebunovs, and Diego Valderrama. An early version of this project circulated under the title¸"FDI in the Banking Sector." Beatriz de Blas gratefully acknowledges financial support from SEJ2005-05831 and ECO2008-04073 projects of the Spanish MEC, CCG08-UAM/HUM-4438.The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

All Banks Great, Small, and Global: Loan pricing and foreign competition
Beatriz de Blas and Katheryn Niles Russ
NBER Working Paper No. 16029
May 2010, Revised August 2011
JEL No. F12,F23,F32,F36,F4

ABSTRACT

Can allowing foreign participation in the banking sector increase real output, despite the imperfectly competitive nature of the industry? Using a new model of heterogeneous, imperfectly competitive lenders and a simple search process, we show how endogenous markups (the net interest margin commonly used to proxy lending-to-deposit rate spreads) can increase with FDI while the rates banks charge to borrowers are largely unchanged or actually fall. We contrast the competitive effects from cross-border bank takeovers with those of cross-border lending by banks located overseas, which in most cases reduces markups and interest rates. Both policies can increase aggregate output and generate permanent current account imbalances.

Beatriz de Blas
Dpto. A.E.: Teoría e Historia Económica
Universidad Autónoma de Madrid
C/ Francisco Tomás y Valiente, 5
28049 Madrid, Spain
beatriz.deblas@uam.es

Katheryn Niles Russ
Department of Economics
University of California, Davis
One Shields Avenue
Davis, CA 95616
and NBER
knruss@ucdavis.edu

1 Introduction

Cross-border lending by banks through local branches abroad and arms-length overseas lending exceeds $31 trillion, more than half the size of world GDP (Bank for International Settlements (2011) and World Bank (2010)). Not only is the financial industry highly globalized, it is also highly concentrated: the largest 15 multinational banks supply more than 20% of the world's private lending.[1] Studies of lending by multinational bank affiliates show that local lenders taken over by foreign banks earn higher profit margins post-merger, charging higher markups over lending costs and possibly cherrypicking the most creditworthy borrowers. Given the imperfectly competitive environment in the banking sector, under what conditions do cross-border flows of loans through multinational affiliates or arms-length lending actually increase aggregate real output, consumption, and employment?

The question is a critical one for policymakers, who face the choice of allowing foreign participation both through foreign ownership of domestic banks and arms-length cross-border lending. Although cross-border lending and takeovers, heterogeneity in bank size, and endogenous markups over lending costs are salient characteristics of the financial services industry, open economy macroeconomics lacks a framework integrating these features to evaluate policies of openness toward financial intermediaries. We build one here. We abstract from the important questions of risk-sharing and inflows of foreign funds that foreign participation may facilitate, analyzed most recently in models by Agenor and Aizenman (2008) and Ghironi and Stebunovs (2010), to focus squarely on the balance between efficiency gains and the market power that efficiency gains may either build up or erode, depending on foreign banks' mode of access. While openness to cross-border bank takeovers and cross-border lending both have the potential to expand aggregate output and employment, our analysis shows that they have very different effects on the structure of lending costs, bank profit, and interest rates charged to borrowers. Thus, the way a country liberalizes toward foreign participation in financial intermediation is not trivial.

We find that aggregate effects are larger for cross-border lending than cross border takeovers. Under either policy, gains in real aggregate variables are largest in countries where banks have very poor monitoring abilities and there are high transactions costs involved in obtaining a loan. In this case, they are 4.5% for output, 4.0% for consumption, and 7.2% for employment when opening to arms-length cross-border lending, incomparison to financial autarky. Aggregate output and employment increase by only 0.1 percent when these countries open to cross-border takeovers, with close to zero change in consumption. Gains under either policy are virtually nonexistent for countries with more advanced financial institutions, suggesting that the benefits from foreign participation for countries with highly developed financial sectors come largely through other channels, such as the risk sharing behavior vividly illustrated in recent work by Cetorelli and Goldberg (2010) or the convenience of foreign firms headquartered in the same source country. Nonetheless,

[1]The 15 largest banks according to asset size are listed in the *Euromoney* August 2006 issue's "Bank Atlas." Lending is computed from 2006 "net loans" (loans minus loan loss provisions) in the Bankscope database. World lending is computed as the sum of "net loans" in 2006 for all banks in the database.

the two types of financial openness yield very different impacts on interest rates, even in this case where they have little effect on aggregate outcomes.

In our general equilibrium model, heterogeneous banks compete through their choice of interest rate to supply an identical product (loans). We define market share through a simple search process. When firms can not apply to all banks, only to some fraction of them determined through optimization and subject to regulatory restrictions on bank reach, then even the most efficient bank's market share will be less than one. Firms can not tell what interest rate a bank will offer until they apply and get a direct quote. Once they collect a group of quotes, they negotiate, quickly and repeatedly reporting all of the rate offers to all of the offerers, accepting the lowest final rate. In this Bertrand negotiating process, each bank in the subset ultimately offers a rate equal to its marginal cost of lending... except for the lowest-cost lender. This lender can charge a markup over its marginal cost, exploiting its cost advantage over its next-best rival for a particular client. The interest rate it charges is bounded by the marginal cost of its next-best rival or if that is very high, the point where marginal revenue on the loan equals the marginal cost for the bank.

The result is a nuanced view of foreign participation in the banking sector. Allowing a more efficient foreign bank to acquire a home bank increases markups as the takeover makes the target bank even more efficient than the next best rival in each client's application pool. Yet it has little effect on interest rates charged to borrowers, since the competing set of offers does not change for their clients. Thus, it has little effect on real outcomes in the economy. In contrast, liberalization toward arms-length cross-border lending lowers interest rates. Firms respond to liberalization in this case simply by sending out a few extra applications to foreign banks. Markups fall, the efficiency of lenders supplying the average borrower falls, and so do interest rates charged on loans. With lower costs of financing working capital, firms hire more workers and expand their output.

Bank efficiency can mean a number of things– how fast a bank transforms deposits into loans, how fast and how well it liquidates nonperforming loans (loss given default), and how accurately it screens borrowers. We build a benchmark model using an information-neutral approach, motivated by the first two concepts of efficiency, and then show how one can also nest screening in the model to consider the implications of information externalities after cross-border takeovers. The precise quantitative implications of information externalities– where the biggest banks "cherry pick" or "cream skim" the most creditworthy borrowers– in the context of foreign direct investment by financial intermediaries is a subject of ongoing empirical debate which we do not resolve here. Instead, we draw insight from comparing the implications of our model in the presence of information externalities with existing empirical findings based on borrower-level banking data. We conclude that while information externalities clearly exist and even dominate in the poorest countries, the preponderance of evidence suggests that they do not outweigh the efficiency-driven effects in our benchmark model when it comes to interest rate setting by foreign-owned banks in middle- and upper-income countries.[2] Further, we use our model to estimate the parameters governing the

[2] As an example, the strong effect of information externalities wrought by foreign banks in the poorest countries is shown most recently and definitively by Detragiache, Tressel, and Gupta (2008). However, evidence of the externality disappears when they include middle- and upper-income countries in their sample.

distribution of bank size for a panel of 80 countries. For 22 countries, including about half of the OECD countries, our estimate of θ is less than 1. These distributions have a fat tail, meaning that banks in the upper quantiles of the size distribution are very big relative to the median. The result suggests that the distribution of bank size could potentially so disperse that some characteristic organic to individual banks in part drives the enormous variance in their cost of lending, in addition to variance in the quality of local pools of borrowers.

Our work helps to fill a gap in existing models of banks. A wealth of insightful studies in the banking literature illuminate the impact of market structure on markups while either requiring banks to be identical or exogenously limiting the number of banks to one, two, or three.[3] A small number of new open economy macroeconomic models analyze the role of imperfect competition in the banking sector on aggregate outcomes (Olivero (2010), Agenor and Aizenman (2008), Gerali, Neri, Sessa, and Signoretti (2010), and Ghironi and Stebunovs (2010)). They generate important new insights into phenomena such as risk sharing, market integration, and market concentration, but either assume that banks are identical or assume a constant elasticity of substitution between loans from different sources that yields a constant markup over the cost of lending. The framework closest to ours appears in Mandelman (2006 and 2010). These studies analyze very different questions and do not involve direct participation by foreign financial intermediaries. Mandelman (2006 and 2010) allows an endogenous number of heterogeneous banks to choose their (endogenous) markups, ingeniously drawing on limit pricing models in industrial organization. A distribution of markups emerges as all banks charge the same interest rate to avoid revealing their efficiency levels to competitors. In our model, banks may set different interest rates and the same bank may charge a different interest rate to different borrowers solely based on the set of competing offers that each borrower has in hand after the application process. The distinction allows us to differentiate between the effects of cross-border takeovers versus arms-length cross-border lending on the interest rates that borrowers pay on loans.

The rest of the paper is organized as follows. Section 2 explains the structure of the model in a closed economy to show how competition in the credit market drives net interest margins, interest rates, and aggregate output. Section 3 describes the micro- and macro-level impacts of participation by foreign financial intermediaries as acquirors of home banks and, separately, as arms-length lenders. We discuss in depth how the results coincide with empirical studies. Section 4 concludes with a discussion of supplemental policy prescriptions for each type of liberalization.

2 A Model of Heterogeneous Banks in Financial Autarky

The model economy is composed of consumers, firms, and banks. For simplicity, there is no depreciating physical capital and any potential shocks that could affect demand or production in

[3]See Freixas and Rochet (1997) for an excellent overview, as well as Dell'Arriccia, Friedman and Marquez (1999), von Thaden (2004), Dell'Arriccia and Marquez (2004 and 2008), Lehner and Schnitzer (2008) and Eden (2010). Freixas, Hurkens, Morrison, and Vulkan (2007) innovate by considering banks with heterogeneous screening capabilites and endogenous markups *ex ante*. *Ex post*, only one type of bank survives.

a particular period are already realized at the time agents make their decisions. Thus, we omit time subscripts in our exposition except when describing the consumer's savings behavior below. This simplified framework allows us to concentrate on the modelling of the banking sector, and still derive the key general equilibrium implications.

Our objective is to analyze the effects of financial openness on aggregate variables in two different scenarios: entry of foreign banks via mergers and acquisitions (foreign direct investment), and arms-length cross-border lending. We begin the description of the economy under financial autarky, with special emphasis on the banking sector.

2.1 Households

There is a continuum of households in the interval $[0, 1]$. Individuals in this economy consume a final good and work in the firms which produce it. They have funds each period that are deposited at a bank in return for an interest payment. Households are assumed to own both firms and banks, so at the end of every period they receive dividends from these activities.

The utility function of the representative consumer is given by:

$$u(q_t, \mathtt{h}_t) = \frac{q_t^{1-\rho}}{1-\rho} - \frac{\mathtt{h}_t^{1+\frac{1}{\gamma}}}{1+\frac{1}{\gamma}},$$

where q_t is consumption and $\mathtt{h}_t$ is labor supply in period t. The exogenous parameters ρ and γ are, respectively, the coefficient of relative risk aversion and the elasticity of labor supply. Each consumer maximizes utility by choosing consumption, labor supply and deposits

$$\max_{q_t, \mathtt{h}_t, d_{t+1}} \sum_{t=0}^{\infty} \beta^t u\left(q_t, \mathtt{h}_t\right)$$

subject to the following budget constraint:

$$d_{t+1} + q_t \leq (1 + r_t) d_t + w_t \mathtt{h}_t + \Pi_t^F + \Pi_t^B,$$

where d_t are one-period deposits at the banks, w_t is the real wage, $1 + r_t$ is the gross market interest rate on deposits, and Π_t^F, and Π_t^B are total profits remitted as dividends from firms and banks, respectively. We assume that the market for deposits is perfectly competitive and consumers are indifferent with regard to the banks where they deposit their funds. The Euler condition from the consumer's maximization problem yields the long run the rate of interest on deposits, $\bar{r} = \frac{1}{\beta} - 1$.

2.2 Firms

There is a continuum of perfectly competitive firms in the interval $[0, 1]$ that produce the final good devoted to consumption. They are owned by consumers and can remit profits to consumers in the form of dividends. Let the aggregate price level of the homogeneous domestically produced final

good ($p \equiv 1$) be the numeraire. Technology is given by $y(i) = Ah(i)^{1-\alpha}$, where $h(i)$ is the amount of labor employed by firm i and $y(i)$ is the amount of the final good that it produces.

Every period, in order to produce, firms need to hire workers. They have no initial funds, so they borrow the wage bill from the financial intermediaries. There is a continuum $J < 1$ of banks in the economy. Firms can apply to any bank for a loan. We suppose for now that all firms are identical in terms of their risk profile to focus on the interaction between bank efficiency and deregulation, but relax this assumption later. A fraction $0 < \lambda < 1$ of firms are hit by a random exit shock in any period and replaced by new entrants, so that the number of firms in the market is kept constant over time. Firms are otherwise identical in every respect except the interest rate they negotiate with a bank. The number of banks to which a firm applies for a loan is limited by one of two things, either the application fee charged by each bank, v, or regulatory constraints that *de facto* or *de jure* limit the number of banks competing over a particular customer to be no more than $\bar{n}$. The regulatory constraints may derive from geographic segmentation or regulations governing the market for a particular type of credit instrument.

We will see below that each additional loan offer improves firms' bargaining power when negotiating the final loan contract, so they want to apply to as many banks as possible. In the absence of the application fee, firms would apply to all banks. In practice, each firm applies to the same fraction of banks, $n(i) = n$ for all i, $0 < n < 1$.The actual number of loan applications $n(i)J$ that the firm sends out must always be positive and is the minimum of an unrestricted optimum ($\tilde{n}$) and the restricted number of competitors allowed by regulators,

$$n = \min\{\tilde{n}, \bar{n}\}.$$

The problem of the firm therefore consists of two parts. First, each firm chooses how many applications to send, $\tilde{n}$, taking into account the effect of the negotiated interest rate on profit. Then, the firm maximizes expected profit $E[\pi^F(i)]$ subject to technology and the financing costs,[4]

$$\max_{\tilde{n}} \left\{ \int_{\overline{r}}^{\infty} \max_{h(i), l^d(i)} \left[Ah(i)^{1-\alpha} - wh(i) - r(i)l^d(i) \right] dF_{1:\tilde{n}}(r(i)) - \tilde{n}Jv \right\}.$$

subject to

$$l^d(i) \leq wh(i),$$

where $l^d(i)$ is the total amount of loans borrowed by the firm, $r(i)$ is the interest rate charged on loans to firm i; A is an aggregate productivity parameter, and $F_{1:\tilde{n}}(r(i))$ is the probability that the best offer a firm i gets after applying for loans from $\tilde{n}$ different banks stipulates an interest rate less than or equal to $r(i)$. This probability is the same for all firms as long as they submit the same number of loan applications. Notice that the expected profit is computed over the probability-weighted range of interest rates that the firm obtains from its applications. We show below that the expected interest rate is falling in the number of applications. We assume that the new entrants

[4]We focus on steady-state analysis and thus omit time subscripts. Since the subjective discount factor for consumers who own firms equals a constant (β) in steady state, we ignore the discount factor without loss of generality.

simply take over the headquarters of the failing firms, including their banking relationships, so that each new firm captures the value of the search by its predecessor– it need not search again unless it elects to do so.

Recent developments in the finance literature show that the payment of dividends solves an important agency problem that shareholders in many countries find more important than completely avoiding external financing costs (see DeAngelo, DeAngelo, and Stulz (2006) and Denis and Osobov (2008), for instance).[5] For simplicity, we assume that this agency problem is extreme and that in equilibrium, stockholders insist upon remission of all profits as stockholder dividends, forcing the firm to externally finance all working capital:

$$l^d(i) = wh(i). \tag{1}$$

The first-order condition with respect to labor gives labor demand by the representative firm,

$$h(i) = \left(\frac{(1-\alpha)A}{(1+r(i))w}\right)^{\frac{1}{\alpha}}, \tag{2}$$

and the first order condition with respect to $\tilde{n}$ is

$$\int_{\bar{r}}^{\infty} \left[A(1-\alpha)h(i)^{-\alpha} + w\right] \frac{\partial h(i)}{\partial r(i)} \frac{\partial r(i)}{\partial \tilde{n}} dF_{1:\tilde{n}}(r(i)) = \tilde{n}Jv. \tag{3}$$

2.3 The banking sector

Banks take deposits from households and lend funds to firms. Each bank has an idiosyncratic managerial efficiency. For analytical tractability below, we assume that these efficiency levels vary across banks such that the cost c of lending one unit for a bank picked at random is Weibull distributed. In our information-neutral benchmark model, the cost parameter is analogous to a monitoring cost if one imagines each borrower as naively applying for a loan to finance a project from banks that have a differing ability to force the firm to pursue a good project versus a bad one.[6] It can also be a repudiation cost as in Kiyotaki and Moore (1997) if the banks can not screen or monitor, but liquidate firms in default (sell them off to the new entrants) with differing efficiency levels. Or, it can simply represent managerial know-how in converting deposits into loans quickly. In Section 3.2, we introduce default and show that the cost can also represent the frequency of errors when screening. The key is that the cost drives a wedge between the rates that banks pay on deposits and the minimum interest rates they can charge to lenders, whether it is due to risk, efficiency, or both.

[5]Specifically, DeAngelo, DeAngelo, and Stulz (2006) find that the 25 largest publicly traded U.S. companies with a history of paying dividends in 2002 could have amassed cash holdings of 51% of assets rather than 6% of assets through retained earnings. Yet they chose to hold long-term debt worth more than 20% of their assets rather than self-financing. The authors build the case that stockholders do not want to leave large amounts of retained earnings in the hands of managers, who could otherwise use firm profits without monitoring by lenders and possibly against the interests of stockholders. Denis and Osobov (2008) find similar evidence for a panel of industrialized countries.

[6]We are grateful to Monika Schnitzer for this suggestion.

As mentioned above, there is a measure of banks $J < 1$ in the economy, a number that can be taken as exogenous or determined endogenously by a free entry condition shown in Appendix B.2. The important factor is the number of banks that each firm applies to for a loan. Let $C_k(i) \geq 1$ for all k denote the non-interest cost parameter of the kth most efficient bank within the group of nJ banks that a firm i applies to for a loan. For now, we motivate these costs as management and operating costs that slow the transformation of deposits into performing loans or liquidation costs in the case of firms hit by exit shocks, but below we also consider them in terms of risk and screening. The bank's cost per dollar of loans supplied is $\bar{r}C_k(i)$, which includes the risk-free rate $\bar{r}$ paid to depositors derived from the Euler equation of the consumer's problem.

Each firm negotiates with the banks it applies to, forcing banks to compete so that only the bank making the lowest final offer to a particular firm will be chosen as the firm's lender. Given the direct price competition, the bank with the lowest cost among all of the banks to which a firm submitted applications becomes the sole lender.[7] The unit cost function for the low-cost lender to firm i is thus $\bar{r}C_1(i)$, with $\bar{r}C_1(i) = \min\{\bar{r}C_k(i)\}$. Further, this low-cost lender can not charge more than the marginal cost of its next-best competitor for the firm's business. Otherwise it will be undersold. The low-cost lender would like to charge the profit maximizing interest rate,[8]

$$\tilde{r}(i) = \bar{m}\bar{r}C_1(i),$$

where $\bar{m} = \frac{1}{1-\alpha}$ is the maximum markup a bank will charge given the firm's technological constraints. However, the lender can only charge $\bar{m}$ if its next-best competitor is much less efficient, so that it does not bound the lender's choice of interest rate: $\bar{r}C_2(i) > \bar{m}\bar{r}C_1(i)$. We assume that regulatory policy and coordination costs exist limiting the extent of domestic mergers and in order to focus on cross-border mergers below. We begin our analysis from a point where all domestic merger opportunities by assumption already have been exhausted, so that very efficient banks are not engaged in the process of buying up competitors to drive up their markup to $\bar{m}$.

The duopolistic competition between banks competing for individual borrowers implies that the lending-to-deposit rate spread is ultimately endogenous. Thus, we have the interest rate negotiated by firm i given by

$$r(i) = \min\left\{\frac{C_2(i)}{C_1(i)}, \bar{m}\right\} \times \bar{r}C_1(i),$$

with profit from the transaction for the bank supplying credit to firm i equal to

$$\pi^B(i) = r(i)l^s(i) + v - \bar{r}d(i),$$

where $l^s(i)$ represents loans supplied by the best bank negotiating with firm i, v is the application

[7] A very small number of banks will never be the low cost lender in any firm's pool of offers. These banks which lose out in every negotiation and do not lend to firms sell their deposits in the interbank market at the risk-free interest rate $\bar{r}$. The distributions of bank lending costs described below provide a built-in weighting to account for this phenomenon.

[8] We write the bank's simple profit-maximization problem used to derive this interest rate in Appendix B.1. It is the rate for which the marginal cost of lending equals marginal revenue on any loan.

fee paid by firm i to the bank, and $d(i)$ is the amount of deposits received by the bank from households.[9] Due to data constraints, many studies have used net interest rate margins as a proxy for the spread between $r(i)$ and $\bar{r}$ when analyzing the impact of financial sector liberalization on borrowing costs. Few authors have had access to actual data on lending and deposit rates and instead rely on measures of the net interest margin (NIM). However, using the model we can show that the markup is closely related to the NIM. The log markup is given by

$$\log m(i) = \log r(i) - \log \bar{r} C_1(i)$$

The "wide" NIM on loans to firm i,[10] equal to total interest revenues minus total interest expenditures divided by assets equals

$$\begin{aligned} NIM(i) &= \frac{r(i) l^s(i) - \bar{r} d(i)}{l^s(i)} \\ &= r(i) - \bar{r} C_1(i), \end{aligned}$$

where we have used $d(i) = C_1(i) l^s(i)$. Thus, the model's depiction of markups is easily reconciled with existing empirical research. An increase in the markup as lending costs fall implies an increase in the NIM.

2.4 Distributions for cost parameters and the markup

To close the model, we need to specify the distribution of costs for banks, which allows one to calculate the distribution for markups. We assume that the cost parameters across the measure J of banks are Weibull distributed,

$$G(c) = 1 - e^{-T(c-1)^\theta},$$

with positive support over $[1, \infty)$.[11] The probability that a bank can loan out funds for less than the rate of interest on deposits (i.e., $c < 1$) is zero. In our benchmark case, which we expand in Section 3.2, the probability of default and the cost of recouping defaulted loans is fully embodied

[9] Since households are indifferent regarding where to deposit, the amount of deposits held in any particular bank, $d(i)$, differs across banks only due to differences in banks' requirements for deposits to make loans. Banks transform the deposits they receive into loans through the following technology:

$$l^s(i) = \frac{d(i)}{C_k(i)}, \forall C_n(j) > 1; \tag{4}$$

that is, more efficient banks (lower $C_k(j)$) would be able to supply more loans out of deposits than less efficient ones because their superior monitoring gives them lower expected losses. We assume for simplicity that bank working capital is thus drawn from deposits, but the same cost structure would result even if working capital were derived from the funds of bank owners, since the opportunity cost of putting up the funds would be the rate of interest on deposits.

[10] This is definition 4w in Brock and Rojas-Suarez (2000, p.122) and is also used by Claessens, Demirguc-Kunt, and Huizinga. (2001), among numerous others.

[11] This is akin to assuming that banks draw an efficiency parameter z from a Fréchet distribution of the form $F(z) = 1 - e^{-Tz^{-\theta}}$, given a support over $(0, 1]$ and with unit cost given by $c\bar{r} = \frac{\bar{r}}{z}$. The Weibull function used here implies that the marginal cost of loaning one dollar is greater than or equal to the gross deposit rate ($c > 1$). The Fréchet distribution is also known as the "inverse Weibull."

in this cost parameter. We assume that firms randomly select the banks to which they send loan applications, so the probability that firm i submits an application to any particular bank is $\frac{n}{J}$.[12] The share of firms served by a bank with cost parameter c is simply

$$s(c) = ndG_{1:n}(c) = n^2\theta JT(c-1)^{\theta-1}e^{-nJT(c-1)^{\theta}},$$

where $G_{1:n}(c)$ is the probability that a bank with a cost parameter no higher than c serves any individual firm.[13] This share is decreasing in the number of applications nJ and decreasing in the lending cost c at an increasing rate, so banks with lower costs are progressively bigger.

Given n competitors for firm i's business, let c_1 represent the efficiency level of the most efficient (lowest-cost) lender and c_2 the efficiency level of the second most efficient (second lowest-cost) lender in the group of firm i's nJ loan applications. Using a standard formula from order statistics (Rinne 2009, p.24) one can derive the joint density for the two lowest record values, $g_{n,n-1}(c_1, c_2)$ and the marginal density for c_2,

$$g_2(c_2) = nJ(nJ-1)\theta T\left(c_2-1\right)^{\theta-1} e^{-T(c_2-1)^{\theta}(nJ-1)}$$

This marginal distribution for the cost of the second-best rival for any given borrower's business depends on the number of loan applications n that the borrowers submit. We use this parameter to embody the concept of contestability examined empirically in the cross-country banking study by Claessens and Laeven (2004).

The markup charged by the bank lending to firm i is $M(i) = \frac{r(i)}{\bar{r}C_1(i)}$. The lowest-cost bank ($C_1(i)$) wants to charge the highest markup possible subject to both the cost of its next most efficient competitor ($C_2(i)$) for firm i's business *and* the elasticity of the firms' demand for loans embodied in $\overline{m}$, which ensures that the bank does not extract more interest than the firm can generate in profit from the loan. The markup it charges is given by

$$M(i) = \min\left\{\frac{C_2(i)}{C_1(i)}, \bar{m}\right\}.$$

We assume that bank efficiency levels are constant over time, making the markup a constant unless there is an influx of new competitors due to liberalization.

2.4.1 Simulating the distribution of markups

Before simulating the distribution of markups, we estimate for 80 countries the parameters T, θ, and the minimum cost, which up to now we have supposed to be one, but actually could be as

[12] The subset of banks to which a firm applies need not be completely randomly selected. If there is merely a small degree of uncertainty surrounding the interest rate offer before applying to a bank, the model can transform into a constant elasticity of substitution framework, as described by Anderson, de Palma, and Thisse (1992), in which case the setup takes a form very similar to Bernard, Eaton, Jensen, and Kortum (2003) and Atkeson and Burstein (2007). The qualitative results are similar to those here.

[13] $G_{1:n}(c) = 1 - e^{-nJT(c-1)^{\theta}}$ is the cumulative distribution of the first order statistic from $G(c)$ given n random draws (applications). We discretize the measure of banks J in the simulations below.

large as the money multiplier. Results are reported in Table 1. Using the ratio of deposits to loans reported in Bankscope to proxy for the cost parameter of each bank in each country and without using any priors, we find that our estimates for θ spread fairly evenly around estimates reported for manufacturing firms by Bernard, Eaton, Jensen, and Kortum (2003, hereafter BEJK). We find a median T of 0.48, corresponding to Spain, and a median θ among OECD countries of 1.52, corresponding to Denmark. For half of our sample and 25 of the 30 OECD countries, the entire 95% confidence interval for θ lies below 2, implying that the distribution is fat-tailed. Given that lower cost is associated with higher market share (increasingly so as costs fall) and the fact that the first order statistic from samples taken from a Weibull distribution is also Weibull, with the same shape parameter as the underlying distribution, then the distribution of bank size will also be fat-tailed. We believe that this enormous dispersion in bank size supports the view that in addition to any variation in the quality of their local pools of borrowers, organic management practices of the banks themselves must also govern their cost efficiency, and thus their individual size.

Using the median estimates for T and θ, a simple simulation demonstrates that we obtain a distribution of markups with a probability density of roughly Pareto shape, shown in Figure 1a, similar to BEJK (2003) from which we draw the type of Bertrand competition used here. The simulation is done by first taking 100 cost draws (i.e. we discretize the total number of banks J to equal 100)[14] from a Weibull distribution of the form given by $F(c)$ above. We suppose there are 1000 firms and that the application cost is small enough that they each decide to send 10 loan applications, drawing 10 of the 100 lending cost parameters. For each firm, we determine $C_1(i)$, the lowest c drawn from this sample of 10, and $C_2(i) = c_2$, the second lowest draw. The markup is computed as $\min\left\{\frac{C_2(j)}{C_1(j)}, \bar{m}\right\}$, where $\bar{m}$ is calibrated using the maximum net interest margin from a sample of 80 countries in Bankscope in the year 2000. The parameter $\bar{m}$ is approximately 1.25.[15] Finally, the entire distribution of lending costs, markups, and interest rates is simulated 1000 times. The x-axis of Figure 1 is the markup value, and the y axis the probability that any of the markups is within a narrow bin of markup values.

2.4.2 Contestability

Notice that we have set the number of potential rivals equal to 10 in this example. Because the distribution of markups here is not separable from the distribution of c_2, it also depends on the level of contestability n in the market (as seen in the formula for $g(c_2)$ above). To illustrate, Figure 1b shows the probability density for markups if the level of contestability is extremely low– the application cost is high enough that nJ is only two. The number of banks in the entire banking industry charging very low markups (near $m = 1$) is dramatically reduced, shifting the mass of the density to the right, toward $\bar{m} = \frac{1}{1-\alpha}$. In fact, as n grows, the distribution appears more

[14]The qualitative results do not depend on the value of J. We can not observe how many banks a firm is aware of when deciding how many loan applications to submit, so we examined the robustness of our results to values of J from 15 to 500.

[15]Specifically, Bankscope reports a maximum net interest margin of a little more than 22 percent.

Pareto-like, matching the stylized distribution in BEJK.[16] Due to its impact on the distribution of markups, increasing contestability (an increase in n) on average reduces the interest rate charged to any particular firm.

2.5 Aggregation and Equilibrium

We see in equations (1) and (2) that the amount of credit demanded by any firm i depends on the interest rate it negotiates with the bank, $r(i)$. The total amount of loans demanded is given by

$$l^d = \int_0^1 l^d(i)di = \int_0^1 wh(i)di = [(1-\alpha)A]^{\frac{1}{\alpha}} w^{\frac{\alpha-1}{\alpha}} \int_0^1 (1+r(i))^{-\frac{1}{\alpha}} di.$$

The next step is to define equilibrium and the properties of the steady state. An equilibrium under autarky is defined by a set of quantities and prices such that households, firms, and banks solve their maximization problems, while clearing the markets for labor, goods, and loans: $\{q, p, w, h, y, \bar{r}, l, d, l(i), d(i), r(i), n\}$. For simplicity and without loss of generality in the closed economy, we assume that regulation is a binding constraint, so that $n = \bar{n}$. The equilibrium conditions emerge from the consumer's intertemporal optimization (derived Appendix A); the firm's demand for labor and loans; banks' price setting; the goods, deposit, and loan market clearing conditions; and the aggregate supply of loans. These are shown for the steady state in Table 2. Given the duopolistic setup, the interest rate charged by any given bank will depend on the second most efficient rival for each firm. We use simulations of the model to analyze the evolution of the spreads and all associated macro outcomes.

3 The markup, financial sector openness, and the cost of funds

From this point, the characterization of financial sector liberalization is important to predict the impact of liberalization on interest rate spreads. We start by expanding the model to allow arms-length loans from banks located abroad, increasing the ease with which home firms can apply to and borrow from banks located overseas. "Importing" bank loans from abroad in this way can have very different implications for the distribution of markups than allowing cross-border takeovers. In a financially open economy, home firms will apply to $n_h J$ domestic banks, plus $n_h^* J$ foreign banks in search of a loan. The expected markup decreases in the number of applications abroad. At the same time, the expected cost of the best bank a firm finds within one particular country is decreasing in the number of applications, but at a decreasing rate (the first derivative of $E[C_1(i)]$ with respect to $n_h J$ and $E[C_1^*(i)]$ with respect to $n_h^* J$ are both positive, but the second derivatives are negative). Simulations in Figure 2 for two identical countries calibrated as described above demonstrate that the distribution of markups and interest rates under autarky stochastically

[16] In a somewhat simpler framework, de Blas and Russ (2010) explain analytically why this distribution converges to Pareto as n grows.

dominate the distributions under cross-border lending.

Thus, a firm concentrates search in its home country, but always chooses to send at least one application abroad, subject to the size of the foreign application fee. However, Buch (2005), Buch, Driscoll and Ostergaard (2010) and Degryse and Ongena (2005) all find that distance presents frictions that inhibit lending. Degryse and Ongena (2005), in particular, find that distance leads to price discrimination in interest rate setting across markets. In our theory, a bank's markups will decrease with greater distance from the borrower and increase with greater distance between the borrower and competing banks, as the extra costs of lending at a distance eat away profit margins. A foreign bank that has the lowest total cost of lending to a home firm i charges the interest rate $r'(i)$, given by

$$r'(i) = \min\left\{\frac{C_2(i)}{\delta C_1^*(i)}, \bar{m}\right\} \times \bar{r}\delta C_1^*(i),$$

with $\delta > 1$. Yet our simulations in Figure 2 show that reducing the distance friction from 10 percent of marginal cost to zero has only a very small for symmetric countries with high contestability ($n_h J = n_f^* J = 10$). Quantitatively, we find that distance matters little whenever the distribution of bank cost parameters is fat-tailed ($\theta < 1$) or close to fat-tailed ($\theta < 2$), as we find in our estimation above for two-thirds of our 80-country sample. Under this condition, the technological superiority of the best banks overpowers the distance friction when it comes to price competition, even though Figure 2 shows that the distance does increase the marginal cost of lending in a way that affects interest rates more distinctly. However, in results not reported here, we find a more noticeable effect of distance on markup behavior when the distribution of firm costs is less disperse ($\theta > 3$).

Next, we consider liberalization that allows foreign takeovers of home banks. In doing so, we provide a theoretical motivation for why spreads may actually increase relative to interest rates among banks taken over by a foreign parent, but *without increasing interest rates*, as documented in empirical studies discussed below. The intuition is straightforward and hinges on heterogeneous levels of efficiency among banks. First, consider a world where banks cannot make overseas loans, but can buy existing banks overseas to lend in the local market. Buch (2003) reports evidence suggesting that parent banks are more efficient than the banks they acquire. Suppose that the foreign bank is more efficient than a home bank with cost parameter c, $c^* < c$, but the unit cost of the merged bank after a foreign takeover is some average of the two technologies. For instance, let the unit cost of lending to any firm i after the buyout be given by

$$c^M = c^{*\frac{1}{\delta_{fdi}}} c^{1-\frac{1}{\delta_{fdi}}},$$

with $\delta_{fdi} \geq 1$.[17] The foreign bank may introduce better computers, worker training, branch security, or improved screening and monitoring technologies that put information already collected

[17]The assumption is in the spirit of Nocke and Yeaple's (2007) modeling of foreign direct investment given mobile versus immobile technologies–the technology here is partially mobile, as the foreign parent must rely on the acquired firm for some know-how to help navigate the local market. In a more elaborate framework with asymmetric information, the acquired bank might have important information about the creditworthiness of local borrowers.

by the target to better use in administering loans.

Because the foreign bank will be able to improve the operations of the home branch after a merger, it can charge lower lending rates, lend out more money, and increase profit in the targeted bank. We assume that mergers take place through equity swap arrangements such that the merged banks splits profits according to the cost shares of the target and the parent resources ($1 - \frac{1}{\delta_{fdi}}$ and $\frac{1}{\delta_{fdi}}$, respectively). Firms do not have to re-apply for loans from targeted banks after a takeover if they are already borrowing from the target. However, firms do have to apply and pay the requisite application fee to get an updated offer from any other merged bank, even if they have applied to the targeted bank in the past. Moreover, they do not know which banks other than their current lender have merged. This friction implies that the takeovers only affect the current clients of targeted banks. Takeovers do not induce switching unless the merged lender raises rates above the next-best offer that the firm reported when negotiating its original rate.

The merger process starts with the most efficient bank in each country looking for a partner. A cross-border takeover occurs if the profit that a target bank j would earn after a merger is at least as large as its current profit, given its current client base: $\frac{\pi^{B,M}(j)}{\delta_{fdi}} > \pi^B(j)$. A target has to be efficient to be attractive as a match. Yet it can not be so efficient that it already makes a very high profit ($\pi^B(j)$). Thus, the most efficient banks and the least efficient banks in each country are the least likely targets of a foreign takeover. When countries have asymmetric levels of financial development, the resulting pattern of takeovers mirrors the *limited global advantage hypothesis* tested by Berger, DeYoung, Genay, and Udell (2000). Specifically, banks from a country with superior management technologies will be able to take over targets at the upper end of the domestic efficiency spectrum in the host market (U.S.-owned banks tend to operate with greater cost efficiency than competing domestic banks abroad, for instance). However, foreign-owned banks originating in countries with inferior technologies will only be able to purchase banks toward the lower end of the efficiency spectrum in a more financially developed host market, so the efficiency of foreign-owned banks will be lower on average than their domestic counterparts.

What is the impact of the mergers on markups? The matching process generates a distribution of markups under direct investment liberalization that stochastically dominates the distribution of the markup under either autarky or loan liberalization. The markup increases in all merged banks that were not already charging $\bar{m}$. The markup never increases for local banks that are not bought out by foreigners. To show the overall effect on the distributions, we use the same data from the simulation above, paired with data generated for a foreign country using an identical process. Then, each bank in each country makes an offer to the most efficient overseas bank that has a cost draw inferior to its own, continuing down the efficiency spectrum until all potential matches are made, with no more than one acquisition per parent bank. The distribution of markups under FDI liberalization lies to the right of (stochastically dominates) the distribution under autarky shown in Figure 3, meaning FDI increases the average markup in the host country. Efficiency gains and pressure from incumbent rivals prevent the increased markups from translating into higher borrowing costs. Since it arises from the acquiror's cost advantage, the increased markup is

completely offset by the fall in costs: the average interest rate is virtually unchanged, and actually falls a miniscule amount: the mergers increase banking sector efficiency to a degree that supercedes the impact of increased market power within targeted banks. This is evident in the bottom panel of Figure 3– the cumulative distribution of interest rates for financial FDI is almost identical to that for autarky. Thus, we can say unequivocally that FDI need not increase lending rates, even though it increases markups.

This result stands in stark contrast to the effect of arms-length cross-border lending seen in Figure 3. In the top panel, the cumulative distribution function for markups under loan liberalization billows to the left, above the cumulative distribution for autarky. Thus, while the distribution of markups under FDI stochastically *dominates* the distribution under autarky, we see in Figures 3 and 4 that the distribution of markups under loan liberalization is stochastically *dominated by* the autarkic distribution. Further, while lending costs fall under both FDI and cross-border lending, interest rates fall substantially only when foreign loans originate abroad.

3.1 Empirical evidence on loan pricing after foreign takeovers

How realistic are our results for cross-border takeovers? The most salient fact emerging from studies of liberalization in the banking sector is that common measures of lending-to-deposit rate spreads in local banks taken over by foreign financial institutions do not fall, in part due to an increase in market power. Martinez Peria and Mody (2004) find that net interest margins are the same or higher for foreign-owned banks compared to their domestic counterparts in a study of five Latin American countries. The margins are greater for banks entering via M&As and, importantly, the effect decreases with the age of the merger. Vera, Zambrano-Sequin, and Faust (2007) show that net interst margins in Venezuela increased approximately 4 percent within four years of the influx of foreign participation initiated by the passage of legislation in 1994. Manzano and Neri (2001) also note an increase in net interest margins in the three years following the Philippines' liberalization toward foreign entry in 1994. Barajas, Steiner and Salazar (1999) report not only that increasing measures of spreads followed an influx of foreign participants in Columbia's banking sector in 1992-96, but also that the increase was in large part attributable to increased market power.

In addition, it is likely that when NIMs rise after mergers, it is due at least in part to the transfer of superior technology just as in the model. Claessens, Demirgüç-Kunt, and Huizinga (2001) find reduced profitability but no change in the net interest margins of domestic banks following entry by foreign competitors and that foreign owned banks have higher net interest margins and profits than domestic banks in developing countries but not in industrialized countries. It is also clear that heterogeneity is important in a model of mergers and acquisitions in the banking sector. Vennet (2002) documents that acquiring banks in cross-border mergers within the euro area are larger, more efficient, more profitable, and have higher loan-to-asset ratios. Buch (2003) interprets evidence from aggregate variables as indicating that parent banks are more efficient than the banks they acquire overseas. Efficiency also correlates with bank size in the model and the data. In particular, Demirgüç-Kunt, Laeven, and Levine (2004) find using individual bank balance sheet

data that large banks have lower non-interest expenses, including personnel costs. Thus, when cross-border mergers and acquisitions (M&As) take place, one can expect that they will involve a larger, more efficient foreign bank taking over a smaller, less efficient domestic bank.

While these studies examine the behavior of bank-level net interest margins before and after a foreign takeover and show that NIMs increase after takeovers as in our model, only a few examine interest rates at the borrower- or loan-level. Hetland and Mjos (2010) find that both domestic and foreign takeovers of Norwegian banks between 1997 and 2008 led to lower interest rates and expanded availability of credit post-merger. Recent studies of domestic takeovers in the United States (Erel 2011) using loan-level interest rates and Spain (Montoriol-Garriga 2008) using interest rates reported at the firm level echo this finding, reporting a drop of 10-15 basis points in post-merger interest rates charged to *continuing* customers. In a study of Italian firms, Sapienza (2002) finds that 75% of mergers resulted in a drop in interest rates, while 10 percent resulted in higher rates. Among the sample where rates fell, she reports a drop of about 20 basis points to continuing customers. These studies can not observe what happens to customers who switch banks post-merger to measure a composition effect. However, we discuss below how these findings relate to issues of cherry picking in our model.

3.2 Risk and Cherry Picking

An important literature modelling information and risk in lending suggests that a reduction in lending costs for the lowest-cost lender may increase markups and lending rates, as it allows the lender to exploit an information advantage over its next best rival in any pool of banks. This mechanism is often associated with "cherry picking" or "cream skimming" superior borrowers. Dell'Arriccia and Marquez (2008), for instance, brilliantly show that reductions in the cost of funds (the deposit rate) can result in increased interest rates charged to all borrowers. The idea is that a drop in the deposit rate for a bank that already has a lower cost of funds allows it profitably to expand its lending to lower-quality borrowers. The best bank then leaves only the very worst borrowers– the ones with the lowest likelihood of repayment– for its rival to serve. The drop in the marginal cost of the best bank ends up increasing the marginal cost of its rivals through the cherry picking effect.

In our model, we might think of the cost parameter as reflecting the ability of the bank to screen its loan applicants. As a very simple example, suppose that a *predetermined* fraction γ of firms will either default, with $0 \leq \gamma < 1$, which results in an exogenous portion μ of the loan principal lost in recovery efforts, $0 < \mu \leq 1$. The firm does not know in advance if it is going to default or not, but the bank can imperfectly detect defaulters. As in Dell'Arriccia and Marquez (2008), neither the firm nor the bank can credibly transmit any information about the firm's creditworthiness to another bank. We reinterpret the cost parameter as a function of the bank's screening ability,

$$c = \bar{r} + \frac{\gamma\mu}{z},$$

where the fraction $\frac{1}{z}$ is now the likelihood that a bank misses a defaulter when screening and suffers a loss on the loan, with $0 < \frac{1}{z} \leq 1$. The screening parameter is distributed inverse Weibull, bounded from below by 1, so that the cost parameter is still distributed Weibull, but now as $\hat{G}(c) = 1 - e^{-T(\gamma\mu)^{\theta}(c-\bar{r})^{-\theta}}$. A bank can win a borrower anytime that it has the lowest cost within the pool of rival banks where the firm applied. Since costs are still distributed Weibull, all of the results with respect to markups in the closed and open economy remain intact if there are no information externalities. However, anytime the superior bank has a screening process that is better than a coin flip ($z > 2$), then its next best rivals for any borrower's business will confront a pool of applicants with a fraction of defaulters greater than γ and increasing in the superior bank's screening level z.[18] Banks thus experience a negative information externality when competing with better screeners.

A cross-border takeover may introduce technology that helps local banks use their existing information to screen more rigorously, increasing z and intensifying the information externality for incumbent rivals. The cherry picking reduces the lending cost of a merged bank and simultaneously increases the marginal cost of its next best rival for any client. Thus, with information externalities a merger should bring about both increased markups and increased interest rates. Do merged banks exploit this additional cost advantage from the information externality in a way that outweighs the efficiency effects driving the core results in our model?

If the information externality dominates the efficiency mechanism driving our results, we would see increased interest rates, as merged banks would exploit the adverse spillover effects of their improved screening on their rivals' marginal costs. Though there is considerable evidence that foreign banks cherrypick reducing their exposure to the riskiest borrowers relative to domestic banks (for borrower-level evidence, see Sapienza (2002), Montoriol-Garriga (2008), Hetland and Mjos (2010), Gormley (2010), and Erel (2011)), the only study we are aware of which tracks loans for borrowers who discontinue borrowing from a recently merged bank finds no effect on the interest rates that they pay when turning to other lenders (Montoriol-Garriga 2008). Of the studies mentioned here that measure actual interest rates charged to borrowers and control for borrowers' risk profile, all show that on average mergers (particularly cross-border mergers) are associated with downward or no movement in interest rates to specific borrowers. Gormley (2010) also shows that lending to continuing borrowers in India expands after a foreign takeover, which in our model is consistent with lower rates.[19]

[18] In particular, the next best rivals of a lender with screening ability $z > 2$ will receive a pool of rivals with a fraction of defaulters equal to

$$\frac{\left(\frac{z-1}{z}\right)\gamma}{\left(\frac{z-1}{z}\right)\gamma + \frac{1}{z}(1-\gamma)} > \gamma,$$

where $\left(\frac{z-1}{z}\right)\gamma$ is the probability that the superior bank gets an application from and rejects a defaulter and $\frac{1}{z}(1-\gamma)$ is the probability that it gets an application from and rejects a non-defaulter.

[19] In addition, Claessens, Demirgüç-Kunt, and Huizinga (2001) offer evidence that domestic banks appear to increase their efficiency following entry by foreign banks. Goldberg (2007) suggests that increased efficiency among unmerged local banks could occur due to technological spillover from foreign entrants to these locally owned competitors, or induced cost-cutting behavior, including efforts to step up screening to counteract cherry picking by foreign banks. In the case of technological spillover or cost-cutting, the technology parameter, T, would presumably be higher for the

We believe that information externalities, including the related changes in the composition of banks' clients, are very important to understand how banks respond to changes in relative marginal costs after a merger. Yet here we ask a different question, which is independent of the composition effect from information externalities– whether the increased market power stemming from mergers documented in empirical studies of net interest margins can derive from technological improvements that also lower interest rates for continuing borrowers, or at least prevent the increased market power from resulting in increased rates, as documented in empirical studies. Our model reconciles this dichotomy in a framework with a large number of heterogeneous banks charging endogenous markups.

3.3 Closing the open economy model

Since the impact of financial openness on the aggregate interest rate is computable using only data from the simulated cost parameters, it is possible to solve for all variables in terms of the aggregate interest rate using the open economy version of the steady state equations in Table 2. We transform the consumer's budget constraint (3) and the goods clearing condition (11) into two new equations,

$$\begin{aligned} q &= q_h + q_f \\ q &= wh + \pi_h^F + \pi_h^B + (\frac{1}{\delta_{fdi}})\pi_h^{B*} + (1 - \frac{1}{\delta_{fdi}})\pi_f^B + \bar{r}d \qquad ((3')) \\ y &= q + d + nx, \qquad ((11')) \end{aligned}$$

where q_h and q_f denote the quantity of the manufactured good that is produced in the home and foreign country, respectively, and consumed in the home country. Profits earned by home and foreign banks, respectively, in the home country are represented by π_h^B and π_f^B. Variables representing consumption, production, or payments taking place in the foreign country are denoted by asterices. For instance, π_h^{B*} represents profits earned by home-owned banks in the foreign country. The balance of payments equation is given by

$$nx = q_h^* - q_f \equiv \frac{1}{\delta_{fdi}} \left(\pi_f^B - \pi_h^{B*}\right) \tag{13}$$

where q_h^* is foreign consumption of goods imported from the home country. Put simply, a positive home net exports must be financed by the positive net profits of foreign banks operating in the home country. Analogous equations apply to the foreign country in equilibrium. The open economy differs from autarky because bank profits now include activity from making loans abroad, be it at arms-length under loan liberalization or in local branches with FDI. Trade does not have to be balanced if bank profits, net of takeover fees, are greater for one country than another. With the

foreign-owned banking industry than for the indigenous banks, or $T^* > T$, at the time of liberalization. One should then observe a leftward shift in the distribution of cost parameters for surviving indigenous banks over and above the selection effect involved in liberalization, an empirically testable implication that we leave for future research.

interest rates already known from computations above, we reduce the model into two equations (the aggregate budget constraints) and two unknowns, w and w^*, then solve using a nonlinear equation solver.

3.4 Aggregate impact

We simulate the model for five different scenarios. Results are presented in Table 3 for foreign takeovers and Table 4 for loan liberalization as percentage changes relative to autarkic levels. The first two cases (Models 1 and 2) are for symmetric countries with a technology (T) and shape (θ) parameter similar to an industrialized country like Denmark, Italy, the Netherlands, or the U.S. The first case assumes that contestability is high and in the second case it is low. The last three have settings where the home country has inferior financial technology reflected in one or both parameters in the Weibull distribution of cost parameters, which we match to the estimates for Argentina. In all cases, we set δ equal to 1.1, a 10 percent distance friction involved in cross-border lending, and δ_{fdi} equal to 3 so that foreign-owned banks capture one-third of the profit of target banks and pay the rest as dividends in a stock swap to buy out the target.[20] We hold the number of banks in the economy J constant ($J = 100$) in all cases. Overall, we find that liberalization has the potential to increase output, consumption, and employment when countries with inferior financial technologies or low contestability liberalize toward arms-length cross-border lending. Liberalization toward foreign takeovers yield less impact on aggregate outcomes in all cases due to the ability of foreign-owned banks to offset efficiency gains with increased markups after mergers.

Table 4 demonstrates that moving from autarky to loan liberalization when countries have high, symmetric levels of financial development (Models 1 and 2) generates a very small expansion in aggregate output and employment. Interest rates fall modestly in these cases, particularly when contestability is low ($n_h J = n_f^* J = 2$), as the additional competition from foreign banks puts downward pressure on markups. The drop in markups is small, implying that much of the fall in interest rates is due to some firms stumbling upon very efficient foreign banks when they search abroad. Allowing foreign takeovers in these symmetric cases (the analogous Models 1 and 2 in Table 3) has almost no impact at all on interest rates or the real economy. Cross-border takeovers do increase markups as expected, particularly when the countries have low search frictions so that markups were low before opening up to foreign takeovers. When domestic contestability is low, a higher proportion of target banks already charge the maximum markup under autarky, so there is little room to increase them further.

When countries are asymmetric with respect to the technology parameter T, as in Models 3 and 4, consumption also increases less than output under either policy, generating an equilibrium trade surplus.[21] The trade surplus arises because the home country pays interest on an excess of loans

[20] Qualitative results are robust to a wide range of δ_{fdi}, while quantitative results to not change much, since the influence of FDI is already rather small in our framework.

[21] When countries are identical, either country can run a small trade surplus or deficit, depending on the particular draws of cost parameters by individual banks.

from banks headquartered in its financially superior neighbor in terms of exported goods. Opening toward foreign arms-length lending increases equilibrium output by a whopping 4.55 percent when the home country has a technology parameter similar to that of Argentina and the foreign country has technology similar to that of Norway, given a similar dispersion parameter (θ) for both high and low contestability in the home market. Markups fall in both cases and the interest rate also falls dramatically– a 4.61 percentage point level change with high domestic contestability and a 17.58 percentage point level change with low contestability. (Note that the interest rate offered to borrowers begins at a higher level under low contestability and low technology.) Liberalization toward foreign takeovers in these cases, Models 3 and 4, have little impact on interest rates or aggregate outcomes.

The most interesting change occurs in Model 5, where we suppose that the country with the lower financial technology not only has a technology parameter equal to Argentina's, but also a more narrow range of bank technologies, so that the more financially developed country outpaces the home country both on average and in particular at the upper end of the efficiency spectrum. In this case, markups actually *increase* with loan liberalization, by 5 percent. Home firms pay lower interest rates, but the most efficient foreign banks are so far superior to the most efficient home banks that home firms can not easily use offers from home banks to negotiate better rates from foreigners, even when they have 10 domestic offers in hand. Markups increase more than 10 percent with liberalization toward foreign takeovers and efficiency gains within target banks are such that interest rates fall almost one half of a percentage point despite the gaping rise in markups. Thus, not only the mean but also the dispersion of bank costs matters for market structure. Equilibrium consumption actually falls slightly with openness to foreign lending and with foreign takeovers, as the home country pays extra interest to foreign banks in the form of a wider permanent trade surplus. Claessens and van Horen (2009) find that foreign-owned banks have higher profit margins in developing countries than in industrialized countries. They interpret their results as indicating that "technical and regulatory advances of foreign banks from high income countries make it easier for these banks to make profitable investments in developing countries (p.12)," a result we clearly find here.

Welfare is virtually unchanged in all cases. We have assumed that all domestic lending is financed using domestic deposits. The disutility of extra labor outweighs the increase in consumption, as consumption increases are dampened by the extra saving needed to finance working capital when firms expand. Building in capital financed through bank lending could mitigate this result, as lower financing costs would increase the level of the physical capital stock, increasing the marginal product of labor. A fully dynamic framework is likely to capture additional welfare gains, since risk sharing may be an important reason why funds flow across borders, particularly within multinational banks. Discerning how endogenous markups among heterogeneous lenders influences the allocation of funds flowing across borders due to risk sharing and differences in financial development is fertile ground for future research.

4 Conclusions

This study presents a stylized model for analyzing the implications of financial sector openness for consumption, welfare, and the components of the balance of payments. It focuses on the interaction of imperfect competition and bank heterogeneity with endogenous markups–the first to do so in a general equilibrium environment. We find that opening the financial sector to mergers and acquisitions by foreign acquirors can increase average net interest margins (markups), an ubiquitous proxy for lending-to-deposit rate spreads, while still generating efficiency gains that reduce the cost of borrowing overall. Information externalities can mitigate this result, but we survey recent studies and determine that they do not dominate it, but rather support our theoretical predictions.

Most importantly, we demonstrate that the choice of channels for allowing foreign participation in domestic financial intermediation is not trivial. While cross-border bank takeovers increase markups and have little effect on interest rates charged to borrowers, cross-border lending decreases both markups and interest rates. Although cross-border lending has exhibited considerable volatility during financial crises in developing countries, the potential benefits arising from lower markups under this mode of liberalization has gone largely explored in empirical studies. The results invite further exploration into supplemental policies to maximize the benefits from foreign participation in the financial sector. Given that dividends from a buyout could be an important source of gains from cross-border mergers for developing countries which exhibit low dispersion in bank cost ($\theta > 2$), joint venture requirements for foreign bank entry may be an optimal policy if the local ownership requirement is set low enough that it does not strongly discourage foreign entry. Similarly, a tax on interest earnings from arms-length cross-border loans may be analogous to an optimal "tariff" policy for countries with less developed financial sectors characterized by low dispersion in bank size. Our model underscores the importance of these questions and provides a new framework to examine them in future research.

References

[1] Agenor, Pierre-Richard and Joshua Aizenman. 2008. Capital Market Imperfections and the Theory of Optimum Currency Areas. NBER Working Paper No. 14088.

[2] Anderson, Simon P., Andre de Palma, and Jacques-Francois Thisse. 1992. Discrete Choice Theory of Product Differentiation. Cambridge, MA: MIT Press.

[3] Atkeson, Andrew and Ariel Burstein. 2007. Pricing to Market in a Ricardian Model of Trade. American Economic Review Papers and Proceedings (May).

[4] Bank for International Settlements. 2011. Detailed Tables on Provisional Locational and Consolidated Banking Statistics at End September 2010. Basel: Bank for International Settlements (January).

[5] Barajas, Adolfo, Roberto Steiner, and Natalia Salazar. 1999. Interest Spreads in Banking in Colombia, 1974-1996. IMF Staff Papers 46(2): 196-224.

[6] Berger, Allen N., Robert DeYoung, Gregory F. Udell and Hesna Genay. 2000. Globalization of Financial Institutions: Evidence from Cross-Border Banking Performance. Brookings-Wharton Papers 3: 23-120.

[7] Bernard, Andrew, Jonathan Eaton, J. Bradford Jensen, and Samuel Kortum. 2003. Plants and Productivity in International Trade. American Economic Review 93(4): 1268-1290.

[8] Brock, Philip and Liliana Rojas-Suarez. 2000. Understanding the Behavior of Bank Spreads in Latin America. Journal of Development Economics 63: 113-134.

[9] Buch, Claudia M. 2003. Information or Regulation: What Drives the International Activities of Commercial Banks? Journal of Money, Credit and Banking 35(6): 851-69,

[10] Buch, Claudia M. 2005. Distance and International Banking. Review of International Economics 13(4): 787-804.

[11] Buch, Claudia M. John C. Driscoll and Charlotte Ostergaard. 2010. Cross-Border Diversification in Bank Asset Portfolios. International Finance 13(1): 79-108.

[12] Cetorelli, Nicola and Linda S. Goldberg. 2010. Banking Globalization and Monetary Transmission. Forthcoming, Journal of Finance.

[13] Claessens, Stijn, Asli Demirguc-Kunt, and Harry Huizinga. 2001. How Does Foreign Entry Affect Domestic Banking Markets? Journal of Banking and Finance 25: 891-911.

[14] Claessens, Stijn and Luc Laeven. 2004. What drives bank competition? Journal of Money, Credit, and Banking 36(3): 563-583.

[15] Claessens, Stijn and Neeltje van Horen. 2009. Being a Foreigner among Domestic Banks: Asset or Liability? International Monetary Fund Working Paper 09/273.

[16] de Blas, Beatriz and Katheryn N. Russ. 2010. Teams of Rivals: Endogenous Markups in a Ricardian World. National Bureau of Economic Research Working Paper No. 16587.

[17] DeAngelo, Harry, Linda DeAngelo, and Rene Stulz. 2006. Dividend policy and the earned/contributed capital mix: a test of the life-cycle theory. Journal of Financial Economics 81(2):227-254.

[18] Degryse, Hans and Steven Ongena. 2005. Distance, Lending Relationships, and Competition. Journal of Finance 60(1): 231-266.

[19] dell'Arriccia, Giovanni, Ezra Friedman, and Robert Marquez. 1999. Adverse Selection as a Barrier to Entry in the Banking Industry. RAND Journal of Economics 30(3): 515-534.

[20] dell'Arriccia, Giovanni and Robert Marquez. 2004. Information and Bank Credit Allocation. Journal of Financial Economics 72: 185-214.

[21] —-. 2008. Can Cost Increases Increase Competition? Asymmetric Information and Equilibrium Prices. RAND Journal of Economics 39(1): 144-162.

[22] Demirguc-Kunt, Asli, Luc Laeven and Ross Levine. 2004. Regulations, Market Structure, Institutions, and the Cost of Financial Intermediation. Journal of Money, Credit and Banking 36(3): 593-622.

[23] Denis, David J. and Igor Osobov. 2008. Why Do Firms Pay Dividends? International Evidence on the Determinants of Dividend Policy. Journal of Financial Economics 89(1): 62-82.

[24] Detragiache, Enrica, Thierry Tressel, and Poonam Gupta. 2008. Foreign Banks in Poor Countries: Theory and Evidence." Journal of Finance 63(5): 2123-2160, October.

[25] Eden, Maya (2010). Financial Distortions and the Distribution of Global Volatility. Massachusetts Institute for Technology (MIT). Cambridge, MA. Mimeo.

[26] Erel, Isil. 2011. The Effect of Bank Mergers on Loan Prices: Evidence from the U.S. Review of Financial Studies, Forthcoming.

[27] Eaton, Jonathan and Samuel Kortum. 2002. Technology, Geography, and Trade. Econometrica 70: 1741-1779.

[28] Freixas, Xavier; Hurkens, Sjaak; Morrison, Alan D.; and Vulkan, Nir. 2007. "Interbank Competition with Costly Screening," The B.E. Journal of Theoretical Economics 7(1, Topics): Article 15.

[29] Freixas, Xavier and Jean-Charles Rochet. 1997. Microeconomics of Banking. Cambridge, MA: The MIT Press.

[30] Gerali, A., S. Neri, L. Sessa, and F.M. Signoretti. 2010. Credit and Banking in a DSGE Model of the Euro Area. Journal of Money, Credit and Banking 42(1): 107-141.

[31] Ghironi, Fabio and Viktors Stebunovs. 2010. The Domestic and International Effects of Interstate Banking. National Bureau of Economic Research Working Paper No.16613.

[32] Goldberg, Linda. 2007. Financial Sector FDI and Host Countries: New and old lessons. FRBNY Economic Policy Review (March): 1-17.

[33] Gormley, Todd A. 2010. Banking Competition in Developing Countries: Does Foreign Bank Entry Improve Credit Access? Working Paper, John M. Olin School of Business, Washington University in St. Louis.

[34] Hetland, Ove Rein and Aksel Mjos. 2010. Using Bank Mergers and Acquisitions to Understand Lending Relationships. Working Paper, Norwegian School of Economics and Business Administration.

[35] Kiyotaki, Nobuhiro and Thomas Moore. 1997. Credit Cycles. The Journal of Political Economy, 105(2): 211-248.

[36] Lehner, Maria, and Monika Schnitzer. 2008. Entry of Foreign Banks and their Impact on Host Countries. Journal of Comparative Economics 36: 430-452.

[37] Mandelman, Federico S. 2010. Business Cycles: A Role for Monopolistic Competition in the Banking Sector. Journal of International Economics 81(1): 122-138.

[38] Mandelman, Federico S. 2006. Business Cycles and Monetary Regimes in Emerging Economies: A Role for a Monopolistic Banking Sector. Federal Reserve Banks of Atlanta Working Paper No. 2006-17.

[39] Manzano, George and Emilio Neri. 2001. Foreign Bank Entry, Bank Spreads, and the Macroeconomic Policy Stance. Philippine APEC Study Center Network Working Paper No. 2001-07.

[40] Martinez-Peria, Maria Soledad and Ashoka Mody. 2004. How Foreign Participation and Market Concentration Impact Bank Spreads: Evidence from Latin America. Journal of Money, Credit and Banking 36(3): 511-544.

[41] Montoriol-Garriga, Judit. 2008. Bank Mergers and Lending Relationships. European Central Bank Working Paper No. 934.

[42] Nocke, Volker and Stephen R. Yeaple. 2007. Cross-border Mergers and Acquisitions vs. Greenfield Foreign Direct Investment: The Role of Firm Heterogeneity. Journal of International Economics 72(2): 336-365.

[43] Olivero, Maria Pia. 2010. Market Power in Banking, Countercyclical Margins and the International Transmission of Business Cycles. Journal of International Economics 80: 292-301.

[44] Martinez Peria, Maria Soledad and Ashoka Mody. 2004. How Foreign Participation and Market Concentration Impact Bank Spreads: Evidence from Latin America. Journal of Money, Credit and Banking 36(3): 511-544.

[45] Sapienza, Paola. 2002. The Effects of Banking Mergers on Loan Contracts. Journal of Finance 57(1): 329-367.

[46] Stebunovs, Viktors. 2006. Finance as a Barrier to Entry: US Bank Deregulation and Volatility. Mimeo, Boston College.

[47] Vennet, Rudi Vander. 2002. in Herrmann H. and Lipsey R. (eds.), Foreign direct investment in the real and financial sector of industrial countries, Springer Verlag, 295-315.

[48] Vera, Leonardo, Luis Zambrano-Sequin, and Andreas Faust. 2007. The Efficiency-Stability Trade-Off: The case of high interest rate spreads in Venezuela. The Developing Economies 45(1): 1-26.

[49] von Thadden, Ernst-Ludvig. 2004. Asymmetric Information, Bank Lending, and Implicit Contracts: The Winner's Curse. Finance Research Letters 1(1): 11-23.

[50] World Bank. 2010. World Development Indicators. Washington, DC: International Bank for Reconstruction and Development.

5

A Consumer First-Order Conditions

Given the following utility function:

$$u(q_t, \mathtt{h}_t) = \frac{q_t^{1-\rho}}{1-\rho} - \frac{\mathtt{h}_t^{1+\frac{1}{\gamma}}}{1+\frac{1}{\gamma}},$$

the FOC are given by

$$q_t^{\rho} = w_t \mathtt{h}_t^{-\frac{1}{\gamma}},$$

$$q_t^{-\rho} = \beta \bar{r}_t q_{t+1}^{-\rho},$$

$$d_t \bar{r}_t + w_t \mathtt{h}_t + \pi_t^F + \pi_t^B = d_{t+1} + q_t.$$

B Markups and Entry

B.1 The maximum markup

The maximum markup is the markup the bank would charge if it were maximizing profit– setting marginal revenue equal to marginal cost and taking into account the fact that firms respond to a higher interest rate by reducing the amount they borrow. Specifically, in the absence of competition from rivals, a bank with cost parameter c would set its interest rate to maximize profit when lending to each firm i,

$$\max_{r(i)}\{\pi^B(i)\} = \max_{r(i)}\{r(i)l(i) - cl(i)\}.$$

The first-order condition with respect to the interest rate is

$$\frac{\partial \pi^B(i)}{\partial r(i)} = l(i) + r\frac{\partial l(i)}{\partial r(i)} - c\frac{\partial l(i)}{\partial r(i)} = wh + rw\frac{\partial h(i)}{\partial r(i)} - c\frac{\partial h(i)}{\partial r(i)} \equiv 0.$$

Using the labor demand equation (2), the condition reduces to the interest rate $r(i) = \frac{1}{1-\alpha}c$, implying a maximum markup over marginal cost equal to $\frac{1}{1-\alpha}$.

B.2 Free entry condition

The total number of banks in the economy, J, does not influence our discussion of markups in an qualitatively important way, so for simplicity we take it as an exogenous policy decision. However, one can easily endogenize this parameter. Suppose there is a cost to enter, such that banks must set aside an amount κ, $0 < \kappa$ in their initial period of operation. This cost could be considered a type of capital requirement or cost of regulatory compliance. Let "entry" into the banking industry by an entrepreneur be the act of drawing a lending cost parameter from the Weibull distribution. Suppose also there is some probability δ, $0 < \delta < 1$ that a bank will be forced to exit in any period due to an errant manager or a change in regulatory policy. Then, if entrepreneurs enter the industry one at a time, entry will take place until the expected profit from entry equals the fixed cost of entry:

$$E_t\left[\sum_{s=0}^{\infty}\delta^{t+s}\int_0^1 \left(r_{t+s}(i)l_{t+s}(i) - C_1 l_{t+s}(i)\right)di\right] \equiv \kappa.$$

In steady state this condition is given by

$$E_t\left[\int_0^1 \Big(r(i)l^d(i) - C_1 l^d(i)\Big)\,di\right] \equiv \delta\kappa$$

The definition of market share ($s(c)$) in Section 2.4 in the main text shows that market share for any bank is decreasing in J. Assuming that when deciding whether to enter the banking industry, each entrepreneur takes the degree of search n by any firm as given, then expected profit is monotonically decreasing in the number of entrants from the level of bank profit in the case where there is only one entrant, $\frac{\alpha}{1-\alpha}E[C]\left[(1-\alpha)A\right]^{\frac{1}{\alpha}} w^{\frac{\alpha-1}{\alpha}}(1+\frac{1}{1-\alpha}E[C])^{-\frac{1}{\alpha}}$, to zero as $J \to \infty$. Thus, there must be some unique J such that expected profit equals $\delta\kappa > 0$.

C Estimation of Key Parameters

We estimate the parameters of the Weibull distribution on banking costs for a sample of countries for the year 2000. We use data from Bankscope for 80 countries and fit a Weibull distribution for costs to match the distribution of the ratio of deposits to loans observed for each country. The estimation method is maximum likelihood. To this end, we use a transformed version of the Weibull distribution,

$$G(c) = 1 - e^{-\left(\frac{\tilde{c}}{\chi_1}\right)^{\chi_2}},$$

which corresponds to $T = \left(\frac{1}{\chi_1}\right)^{\chi_2}$, $\theta = \chi_2$, and $\tilde{c} = c - \tau$. We set τ equal to 1 in the main text to minimize notation, but verify here that this is a reasonable simplification. We estimate χ_1 and χ_2

by maximum likelihood. The parameter $\hat{\tau}$ is then obtained from the median of the distribution for each country. The parameter θ corresponds to the shape parameter in the Weibull function, which governs the dispersion of bank costs and thus bank size. Eaton and Kortum (2002) find estimates of θ between 3.6 and 8.32. With endogenous markups, BEJK find $\theta = 3.29$. In our case, $\hat{\theta}$ is the maximum likelihood estimator based on the distribution of costs (the ratio of deposits to loans) across all banks in each country. Our findings show values for $\hat{\theta}$ between 0.521 and 11.6, a range which encompasses values reported in these previous studies for manufacturing firms. We use the standard bootstrap method to obtain 95% confidence intervals.

D Equilibrium

The set of equations governing the steady state open economy equilibrium is given in the table below. It is similar to the closed economy version in Table 1, plus four new equations, which include an augmented budget constraint (3') and market-clearing equation (11'). In Table 5, $C'_k(i)$ represents the k^{th} lowest-cost bank applied to by firm i in the home country under financial liberalization. Under loan liberalization, this could be either a home or foreign bank. If it is a foreign bank, then $C'_k(i) = \delta C^*_k(i)$, where $C^*_k(i)$ is the k^{th} lowest-cost foreign bank to which home firm i sends an application. With FDI, this could be either a fully domestically owned home bank or a merged bank. If the bank that supplies loans to firm i is acquired by a foreign bank, then its

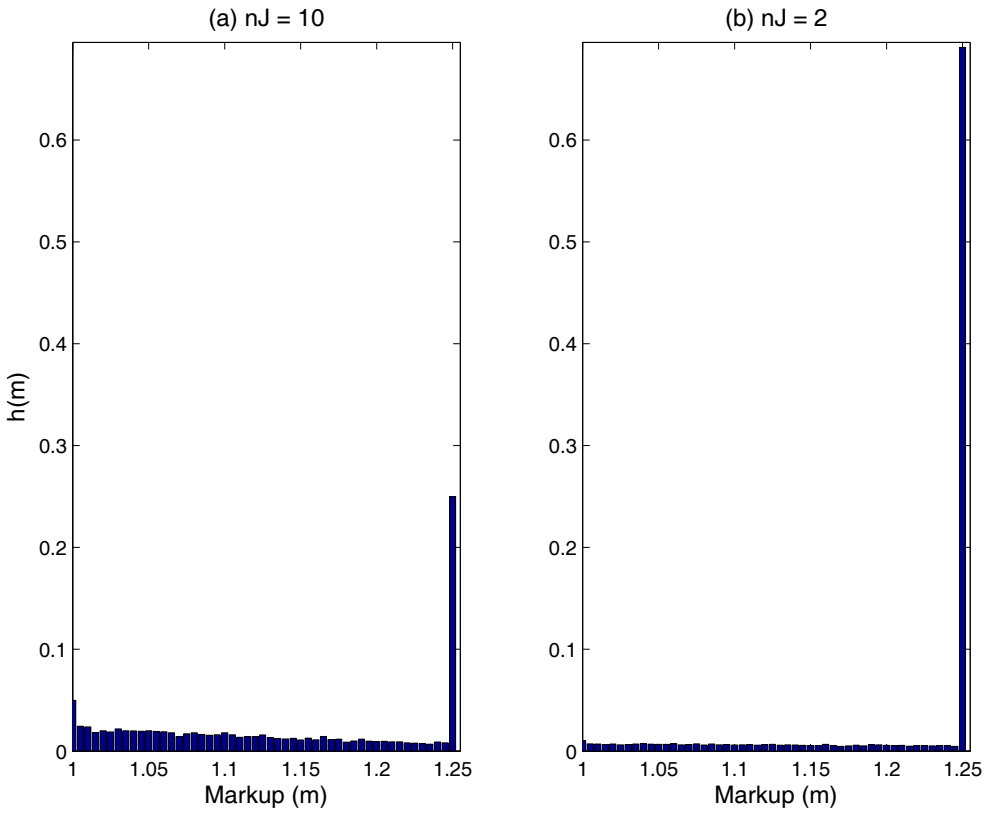

Figure 1: Less search moves mass of the probability density for markups to the right

cost of lending and markups changed as described in the text.

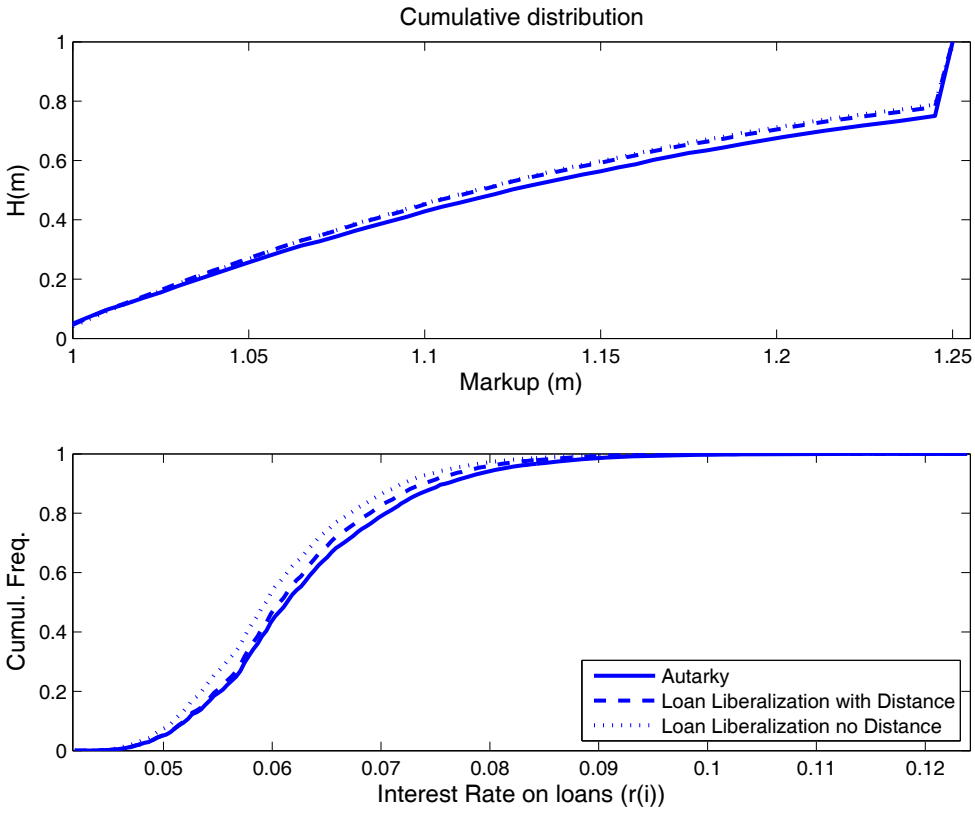

Figure 2: Arms-length cross-border lending reduces markups and interest rates

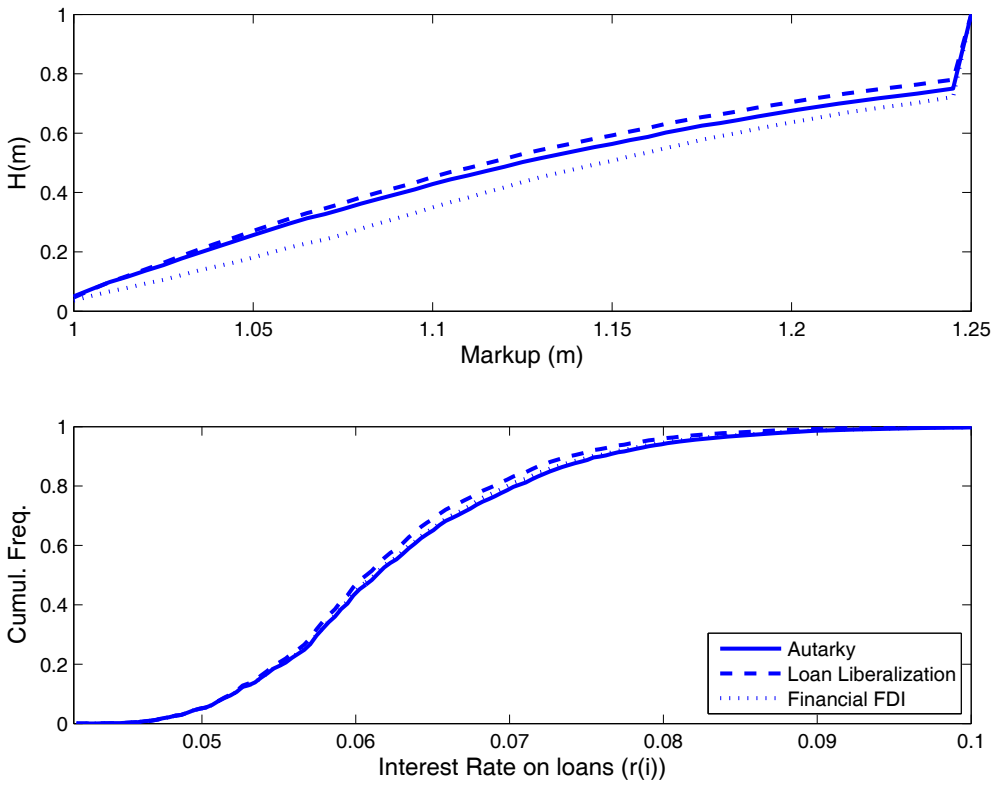

Figure 3: Cross-border lending and cross-border takeovers affect markups and interest rates differently

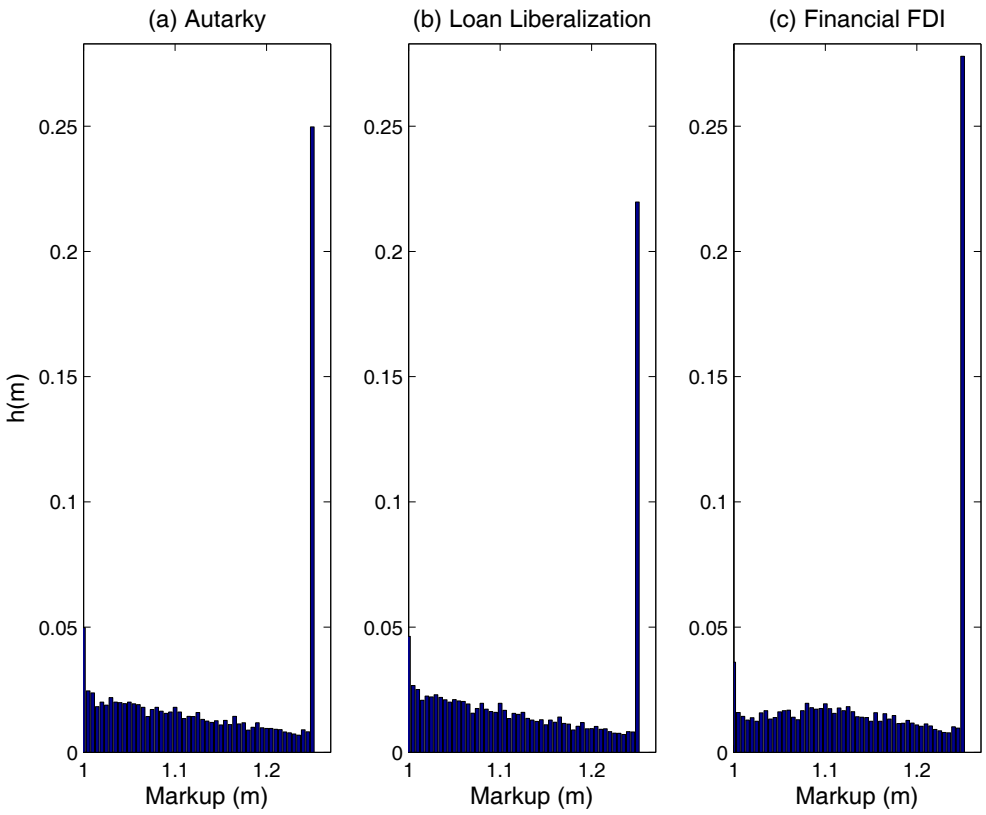

Figure 4: Probability densities for markups under autarky, cross-border lending, and cross-border takeovers

Country	$\hat{T}$	$(\hat{T}_{low}, \hat{T}_{up})$	$\hat{\theta}$	$(\hat{\theta}_{low}, \hat{\theta}_{up})$	$\hat{\tau}$
Andorra	0.00	(0.00 , 0.00)	5.65	(2.55 , 12.50)	0.90
Argentina	0.05	(0.00 , 0.18)	4.40	(3.04 , 6.38)	0.97
Australia	0.62	(0.39 , 0.88)	0.53	(0.44 , 0.64)	0.80
Austria	0.59	(0.34 , 0.89)	0.61	(0.50 , 0.74)	0.86
Bahamas	0.17	(0.01 , 0.53)	0.85	(0.55 , 1.33)	-1.19
Bahrain	0.16	(0.03 , 0.45)	0.83	(0.51 , 1.34)	-2.76
Belarus	0.03	(0.00 , 0.27)	4.94	(2.38 , 10.30)	1.18
Belgium	0.37	(0.19 , 0.62)	0.58	(0.46 , 0.73)	-0.07
Bermuda	0.38	(0.12 , 0.75)	0.70	(0.45 , 1.07)	0.00
Brazil	0.33	(0.19 , 0.55)	1.15	(0.97 , 1.35)	0.77
Canada	0.54	(0.32 , 0.80)	1.31	(1.06 , 1.62)	0.98
CaymanIsl	0.23	(0.01 , 0.76)	0.49	(0.30 , 0.80)	-6.00
Chile	0.25	(0.04 , 0.58)	6.78	(4.51 , 10.20)	0.99
China	0.06	(0.00 , 0.17)	4.71	(3.25 , 6.81)	0.86
CostaRica	0.28	(0.07 , 0.60)	3.61	(2.63 , 4.97)	0.92
Croatia	0.03	(0.00 , 0.28)	5.07	(2.74 , 9.37)	1.04
Cuba	–	–	–	–	–
Cyprus	0.28	(0.01 , 0.75)	1.31	(0.83 , 2.05)	0.56
CZRepublic	0.07	(0.00 , 0.41)	2.43	(1.32 , 4.47)	1.01
Denmark	0.78	(0.45 , 1.19)	1.54	(1.12 , 2.12)	1.19
ElSalvador	0.03	(0.00 , 0.31)	15.90	(9.44 , 26.60)	0.96
Estonia	0.21	(0.01 , 0.91)	2.13	(1.19 , 3.82)	0.54
Finland	0.73	(0.27 , 1.45)	1.46	(0.91 , 2.33)	1.18
France	0.49	(0.38 , 0.63)	0.58	(0.53 , 0.64)	0.38
Germany	0.47	(0.32 , 0.66)	0.61	(0.53 , 0.70)	0.68
Ghana	0.30	(0.03 , 1.22)	0.83	(0.50 , 1.39)	0.78
Greece	0.34	(0.14 , 0.61)	0.99	(0.73 , 1.34)	0.75
HongKong	0.35	(0.19 , 0.56)	1.92	(1.51 , 2.45)	1.04
Hungary	0.25	(0.04 , 0.57)	1.90	(1.45 , 2.49)	0.91
Iceland	0.31	(0.06 , 0.77)	1.57	(0.87 , 2.83)	0.54
India	–	–	–	–	–
Indonesia	0.20	(0.03 , 0.45)	1.16	(0.77 , 1.74)	0.76
Ireland	0.49	(0.25 , 0.74)	0.46	(0.35 , 0.61)	0.13
Israel	0.29	(0.03 , 0.84)	3.31	(2.37 , 4.63)	0.92
Italy	0.51	(0.36 , 0.70)	1.21	(1.03 , 1.42)	0.78
Jamaica	0.16	(0.02 , 0.49)	1.48	(0.91 , 2.41)	0.68
Japan	0.55	(0.40 , 0.69)	0.65	(0.60 , 0.70)	0.90
Jordan	0.04	(0.00 , 0.24)	3.68	(2.22 , 6.10)	1.13
Kazakhstan	0.43	(0.11 , 1.05)	0.41	(0.29 , 0.60)	-0.47

Table 1: Parameter estimates for Weibull distribution

Country	$\hat{T}$	$(\hat{T}_{low}, \hat{T}_{up})$	$\hat{\theta}$	$(\hat{\theta}_{low}, \hat{\theta}_{up})$	$\hat{\tau}$
Kenya	0.17	(0.01 , 0.45)	3.21	(2.3 , 4.47)	0.94
Kuwait	0.08	(0.00 , 0.32)	1.86	(1.06 , 3.25)	0.34
Latvia	0.10	(0.01 , 0.35)	1.42	(0.78 , 2.60)	0.23
Lebanon	0.01	(0.00 , 0.06)	3.95	(2.74 , 5.69)	1.02
Lesotho	–	–	–	–	–
Lithuania	0.08	(0.00 , 0.39)	3.93	(2.14 , 7.22)	0.93
Luxembourg	0.28	(0.10 , 0.70)	0.59	(0.44 , 0.80)	-0.63
Malaysia	0.30	(0.13 , 0.53)	2.19	(1.74 , 2.76)	0.90
Mexico	0.34	(0.14 , 0.62)	1.47	(1.15 , 1.87)	0.75
Netherlands	0.48	(0.31 , 0.71)	1.27	(1.04 , 1.56)	0.83
NewZealand	0.66	(0.28 , 1.47)	14.50	(7.17 , 29.4)	0.91
Nigeria	0.15	(0.01 , 0.44)	1.83	(1.20 , 2.79)	0.68
Norway	1.64	(1.20 , 2.56)	3.02	(2.09 , 4.36)	1.11
Pakistan	0.01	(0.00 , 0.05)	4.98	(1.82 , 13.70)	1.28
Panama	0.38	(0.18 , 0.66)	1.35	(1.01 , 1.79)	0.72
Peru	0.00	(0.00 , 0.22)	10.80	(5.41 , 21.80)	0.87
Phillipines	0.02	(0.00 , 0.06)	5.90	(3.93 , 8.84)	0.90
Poland	0.01	(0.00 , 0.07)	6.57	(4.06 , 10.6)	0.99
Portugal	0.40	(0.22 , 0.63)	0.70	(0.60 , 0.88)	0.15
Qatar	0.09	(0.00 , 1.01)	6.55	(2.44 , 17.6)	1.08
Romania	0.00	(0.00 , 0.06)	8.23	(3.44 , 19.7)	0.84
Russia	0.38	(0.25 , 0.55)	0.97	(0.83 , 1.14)	0.77
SaudiArabia	0.02	(0.00 , 0.27)	5.21	(2.66 , 10.20)	1.03
Singapore	0.59	(0.34 , 0.95)	0.93	(0.69 , 1.25)	0.81
Slovakia	0.12	(0.00 , 0.50)	2.75	(1.57 , 4.79)	0.58
Slovenia	0.04	(0.00 , 0.25)	7.17	(4.69 , 11.00)	1.00
SAfrica	0.51	(0.30 , 0.75)	1.27	(1.01 , 1.60)	0.79
SouthKorea	0.11	(0.02 , 0.31)	4.73	(3.12 , 7.17)	1.12
Spain	0.48	(0.32 , 0.64)	0.71	(0.62 , 0.82)	0.64
Sweden	0.88	(0.51 , 1.59)	0.96	(0.73 , 1.27)	1.11
Switzerland	0.43	(0.22 , 0.63)	0.41	(0.35 , 0.47)	-0.15
Taiwan	0.50	(0.25 , 0.80)	1.20	(0.79 , 1.84)	0.94
Thailand	0.33	(0.10 , 0.70)	3.20	(2.21 , 4.64)	1.00
TTobago	0.52	(0.07 , 1.74)	1.13	(0.60 , 2.15)	1.35
Turkey	0.18	(0.09 , 0.35)	1.74	(1.36 , 2.23)	0.92
Ukraine	0.18	(0.04 , 0.46)	3.07	(2.13 , 4.43)	0.954
UAEmirates	0.25	(0.04 , 0.64)	2.48	(1.68 , 3.67)	0.72
UKingdom	0.35	(0.27 , 0.45)	0.77	(0.70 , 0.86)	-0.17
USA	0.48	(0.45 , 0.52)	1.33	(1.28 , 1.39)	0.95
Venezuela	0.02	(0.00 , 0.14)	5.55	(3.13 , 9.85)	0.94
Vietnam	0.13	(0.00 , 0.72)	3.16	(1.64 , 6.08)	0.79

We bootstrap to obtain the 95% confidence intervals in parenthesis.

Table 1: Estimates of Weibull distribution parameters, continued

Consumers		
Labor supply	$q^{\rho} = w\mathtt{h}^{-\frac{1}{\gamma}}$	(1)
Euler condition	$\bar{r} = \frac{1}{\beta} - 1$	(2)
Budget constraint	$q = w\mathtt{h} + \pi^F + \pi^B + \bar{r}d$	(3)
Firms		
Technology	$y(i) = Ah(i)^{1-\alpha}$	(4)
Optimal labor demand	$h(i) = \left(\frac{(1-\alpha)A}{(1+r(i))w}\right)^{\frac{1}{\alpha}}$	(5)
Demand for loans by firm i	$l^d(i) = wh(i)$	(6)
Banks		
Lending rate	$r(i) = \min\{C_2(i), \bar{m}C_1(i)\}$	(7)
Loan supply to firm i	$l^s(i) = \frac{d(i)}{C_1(i)}$	(8)
Market Clearing and Aggregation		
Loan market clearing	$l^s(i) = l^d(i)$	(9)
Aggregate loans	$\int_0^1 l^s(i)di = \int_0^1 l^d(i)di$	
Deposit market clearing	$d \equiv \int_0^1 d(i)di$	(10)
Goods market clearing	$y \equiv q$	(11)
Labor market clearing	$\mathtt{h} \equiv h$	(12)

Table 2: Model specification under autarky

	$\%\Delta y$	$\%\Delta q$	$\%\Delta h$	$\%\Delta M(i)$	$\Delta r(i)$
(1) Symmetry, high domestic contestability	0.02	-0.01	0.02	0.98	-2 b.p.
$T = T^* = 0.48$, $n_h J = n_f^* J = 10$	(0.02)	(0.03)	(0.03)	(0.66)	(1)
(2) Symmetry, low domestic contestability	0.01	0.02	0.02	0.14	-5 b.p.
$T = T^* = 0.48$, $n_h J = n_f^* J = 2$	(0.01)	(0.01)	(0.02)	(0.08)	(3)
(3) Asymmetry, high domestic contestability	0.03	0.02	0.04	0.16	-9 b.p.
$T = 0.05$, $T^* = 1.52$, $n_h J = n_f^* J = 10$	(0.02)	(0.01)	(0.04)	(0.15)	(7)
(4) Asymmetry, low domestic contestability	0.08	0.03	0.12	0.08	-3 b.p.
$T = 0.05$, $T^* = 1.52$, $n_h J = n_f^* J = 2$	(0.03)	(0.03)	(0.04)	(0.06)	(1)
(5) Asymmetry, lower home dispersion	0.31	-0.20	0.48	10.48	-49 b.p.
$T = 0.05$, $T^* = 1.52$, $n_h J = n_f^* J = 10$, $\theta = 4.4$	(0.07)	(0.06)	(0.11)	(2.74)	(13)

Standard deviations are given in parenthesis. Changes in markups and interest rates are an average. All changes are relative to autarkic levels. Level changes in interest rates are expressed in basis points. $\theta = \theta^* = 1.54$ in Models (1)-(4). θ^* remains 1.54 in Model (5).

Table 3: Simulation Results for Liberalization toward Foreign Takeovers

	$\%\Delta y$	$\%\Delta q$	$\%\Delta h$	$\%\Delta M(i)$	$\Delta r(i)$
(1) Symmetry, high domestic contestability	0.06	0.01	0.10	-0.59	-15 b.p.
$T = T^* = 0.48$, $n_h J = n_f^* J = 10$	(0.03)	(0.02)	(0.04)	(0.21)	(4)
(2) Symmetry, low domestic contestability	0.51	0.25	0.81	-2.30	-153 b.p.
$T = T^* = 0.48$, $n_h J = n_f^* J = 2$	(0.11)	(0.03)	(0.16)	(0.34)	(25)
(3) Asymmetry, high domestic contestability	1.58	0.65	2.48	-1.44	-461 b.p.
$T = 0.05$, $T^* = 1.52$, $n_h J = n_f^* J = 10$	(0.33)	(0.23)	(0.53)	(1.02)	(105)
(4) Asymmetry, low domestic contestability	4.55	3.97	7.20	-3.16	-1758
$T = 0.05$, $T^* = 1.52$, $n_h J = n_f^* J = 2$	(0.30)	(0.31)	(0.47)	(0.39)	(151)
(5) Asymmetry, low domestic dispersion	1.00	-0.12	1.56	5.04	-215 b.p.
$T = 0.05$, $T^* = 1.52$, $n_h J = n_f^* J = 10$, $\theta = 4.4$	(0.07)	(0.04)	(0.11)	(1.41)	(0.17)

Standard deviations are given in parenthesis. Changes in markups and interest rates are an average. All changes are relative to autarkic levels. Level changes in interest rates are expressed in basis points. $\theta = \theta^* = 1.54$ in Models (1)-(4). θ^* remains 1.54 in Model (5). $n_h^* J = n_f J = 2$ in all five Models.

Table 4: Simulation Results for Liberalization toward Foreign Lending

Consumers		
Labor supply	$q^{\rho} = w\mathtt{h}^{-\frac{1}{\gamma}}$	(1)
	$q^{*\rho} = w^{*}\left(\mathtt{h}^{*}\right)^{-\frac{1}{\gamma}}$	
Euler condition	$\bar{r} = \bar{r}^{*} = \frac{1-\beta}{\beta}$	(2)
Budget constraint	$q = w\mathtt{h} + \pi_h^F + \pi_h^B + (\frac{1}{\delta_{fdi}})\pi_h^{B*} + (1 - \frac{1}{\delta_{fdi}})\pi_f^B + \bar{r}d$	(3)
	$q^{*} = w^{*}\mathtt{h}^{*} + \pi_f^{F*} + \pi_f^{B*} + (\frac{1}{\delta_{fdi}})\pi_f^B + (1 - \frac{1}{\delta_{fdi}})\pi_h^{B*} + d^{*}\bar{r}^{*}$	
Aggregate consumption	$q = q_h + q_f$	(4)
	$q^{*} = q_h^{*} + q_f^{*}$	
Firms		
Technology	$y(i) = Ah(i)^{1-\alpha}$	(5)
	$y^{*}(i) = A^{*}\left(h^{*}(i)\right)^{1-\alpha}$	
Optimal labor demand by a firm i	$h(i) = \left(\frac{(1-\alpha)A}{(1+r(i))w}\right)^{\frac{1}{\alpha}}$	(6)
	$h^{*}(i) = \left(\frac{(1-\alpha)A^{*}}{(1+r^{*}(i))w^{*}}\right)^{\frac{1}{\alpha}}$	
Demand for loans by a firm i	$l^{d}(i) = wh(i)$	(7)
	$l^{d*}(i) = w^{*}h^{*}(i)$	
Banks		
Lending rate	$r(i) = \min\left\{C_2'(i), \bar{m}\left[\bar{r}C_1'(i)\right]\right\}$	(8)
	$r^{*}(i) = \min\left\{C_2'^{*}(i), \bar{m}\left[\bar{r}C_1'^{*}(i)\right]\right\}$	
Loan supply to firm i	$l^{s}(i) = \frac{d(i)}{C_1'(i)}$	(9)
	$l^{s*}(i) = \frac{d^{*}(i)}{C_1'^{*}(i)}$	
Market Clearing and Aggregation		
Loan market clearing	$l^{s}(i) = l^{d}(i)$	(10)
	$l^{s*}(i) = l^{d*}(i)$	
Aggregate Loans	$l = \int_0^1 l(i)di$	(11)
	$l^{*} = \int_0^1 l^{*}(i)di$	
Deposit market clearing	$d = \int_0^1 d(i)di$	(12)
	$d^{*} = \int_0^1 d^{*}(i)di$	
Goods market clearing	$y = q + nx = q_h + q_h^{*}$	(13)
	$y^{*} = q^{*} + nx^{*} = q_h^{*} + q_f$	
Balance of Payments	$nx = \frac{1}{\delta_{fdi}}\left(\pi_f^B - \pi_h^{B*}\right)$	(14)
	$nx^{*} = -\frac{1}{\delta_{fdi}}\left(\pi_f^B - \pi_h^{B*}\right)$	
Labor market clearing	$\mathtt{h} = \int_0^1 h(i)di$	(15)
	$\mathtt{h}^{*} = \int_0^1 h^{*}(i)di$	

Table 5: Model specification for the open economy