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FDI in the banking sector

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FDI in the Banking Sector

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Paper # 10-8

It is a well known quandry that when countries open their financial sectors, foreign-owned banks appear to bring superior efficiency to their host markets but also charge higher markups on borrowed funds than their domestically owned rivals, with unknown impacts on interest rates and welfare. Using heterogeneous, imperfectly competitive lenders, the model illustrates that FDI can cause markups (the net interest margins commonly used to proxy lending-to-deposit rate spreads) to increase at the same time efficiency gains and local competition keep the interest rates that banks charge borrowers from rising. Competition from arms-length foreign loans, however, both squeezes markups and lowers interest rates. We show that allowing foreign participation is not always a welfare-improving substitute for increasing competition and technical efficiency among domestic banks.

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FDI in the Banking Sector

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Abstract

It is a well known quandry that when countries open their financial sectors, foreign-owned banks appear to bring superior efficiency to their host markets but also charge higher markups on borrowed funds than their domestically owned rivals, with unknown impacts on interest rates and welfare. Using heterogeneous, imperfectly competitive lenders, the model illustrates that FDI can cause markups (the net interest margins commonly used to proxy lending-to-deposit rate spreads) to increase at the same time efficiency gains and local competition keep the interest rates that banks charge borrowers from rising. Competition from arms-length foreign loans, however, both squeezes markups and lowers interest rates. Both scenarios yield large welfare gains compared with financial autarky, except in countries with inferior domestic technologies or restricted entry by domestic banks.

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1 Introduction

The financial industry is highly concentrated: the largest 15 multinational banks supply more than 20% of the world's private lending.[1] When countries contemplate liberalizing their banking sector to allow foreign participation, a natural tension therefore arises. There is the hope that foreign participation will reduce interest rates charged to borrowers through superior technical efficiency or increased competition, tempered by the concern that large foreign banks will amass enormous market power in their host country and end up increasing interest rates. Brock and Rojas-Suarez (2000) put it most succinctly when discussing liberalization, including entry by foreign banks, in Latin America:

> " ...while the process of financial market liberalization is fully supported by policymakers in the region, there is a certain degree of disappointment with the results. In particular, policymakers expected that interest rate spreads would converge to international levels... high spreads are usually interpreted as an indicator of inefficiency, which adversely affects domestic real savings and investment (p.114)."

A number of studies have sought an empirical resolution to this question by testing the impact of foreign mergers and acquisitions on the net interest margin, the virtually universal proxy for the spread between the interest rate charged on loans and the one paid on deposits. The authors have formed a well known puzzle: Though foreign entry generally seems to improve loan quality and reduce costs among active banks– two characteristics of increased competitive pressures– it is often associated with increased net interest margins. Several of these studies also demonstrate the importance of imperfect competition and heterogeneity among banks when considering the impacts of opening the banking sector to foreign entry, a combination missing from current theories of financial liberalization.

In this paper, we study foreign direct investment (FDI) in the financial sector and arms-length lending by foreign banks in a model with imperfect competition and heterogeneous banks, so that we can capture these stylized facts. The model generalizes the

[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.

framework of Bernard, Eaton, Jensen and Kortum (2003, hereafter BEJK) to include foreign direct investment[2] and pinpoints the importance of the number of potential entrants, called "contestability" in the context of the banking sector by Claessens and Laeven (2004). Our model contributes to several literatures examining financial and trade liberalization[3] linking foreign participation in the banking sector to macroeconomic outcomes. Whereas most of these papers focus principally on output volatility and the transmission of shocks after liberalization, we focus on the distribution of markups, costs, and lending rates to bridge the macroeconomic analysis with a branch of empirical literature that considers the impact of foreign participation on these three variables.[4]

In our model, heterogeneity in bank efficiency causes liberalization toward foreign participation to generate efficiency gains, reducing costs and consequently either bearing no net effect on or actually *reducing* the average interest rate for borrowers. Liberalization policies never increase the mean interest rate but, in the case of cross-border takeovers by foreign banks, can increase net interest margins. An endogenous markup mechanism in our framework replicates the main stylized fact shown here and in existing micro-level empirical studies– that bank mergers often increase markups. The mechanism is based on the BEJK model, which allows for heterogeneity among industry participants while still incorporating a type of duopolistic competition akin to that embodied in the Salop model often used for analyses of the banking sector. The intuition is straightforward: A bank can charge a higher markup if it is more efficient than its next best domestic rival. If it is taken over by a foreign parent with superior technology, the bank becomes even more efficient than its next best rival. We also find a new conceptualization of contestability: A market with strong restrictions limiting domestic entry into the banking system is much more likely to see lower average markups after opening itself to foreign loans (loan liberalization) and will see an increase in markups from cross-border bank takeovers. Finally, we are able to demonstrate that the effects of foreign participation through takeovers are quite different from those of loan liberalization.

[2]Though quite different, our approach was inspired in part by Ramondo's (2007) expansion of the Ricardian framework with *perfect competition* in Eaton and Kortum (2002) to analyze bilateral flows of FDI in manufacturing industries.

[3]It complements empirical work by Dages, Goldberg, and Kinney (2000), Reinhardt and Tokatlidis (2001), Buch, Cartensen, and Schertler (2005), Arena, Reinhart, and Vasquez (2006), Stebunovs (2006), Ghironi and Stebunovs (2007), and Cetorelli and Goldberg (2008), for example.

[4]This branch includes Buch (2000), Claessens, Demirgüç-Kunt, and Huizinga (2001), Demirgüç-Kunt, Laeven, and Levine (2003), Claessens and Laeven (2004), and Martinez-Peria and Mody (2004), as well as others discussed in Section 2 below.

The paper is structured as follows. Section 2 describes the empirical evidence on banks and international takeovers. The model, distributions and equilibrium are analyzed in Section 3. Section 4 discusses the effects of financial liberalization on markups, the cost of funds, and welfare. The paper concludes with Section 5.

2 Banks and Foreign Takeovers: Empirical evidence

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 rise after the merger, in part due to an increase in market power. Using a large panel dataset, Claessens, Demirgüç-Kunt, and Huizinga (2001) find that foreign owned banks have higher net interest margins and profits than domestic banks in developing countries but not in industrialized countries. Similar facts are reported by a number of other studies. 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 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.[5]

Several additional stylized facts also emerge from the empirical literature. Heterogeneity is important in a model of mergers and acquisitions in the banking sector (Vennet,

[5]Similar facts are reported by a number of other studies. 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 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.

2002; Buch, 2000; and Goldberg, 2007). The role of heterogeneity in lending behavior and in determining which banks become acquirors or targets has not yet been inculcated into theoretical models of the banking sector. However, it corresponds well with the empirical analysis (Arnold and Javorcik, 2005) and theoretical modelling of foreign direct investment in the trade and open economy macroeconomic literature (Helpman, Melitz, and Yeaple, 2003; Nocke and Yeaple, 2007; and Russ, 2007). The disconnect is likely because competition between banks is often modelled using the Salop framework.[6] Salop's (1979) seminal work features monopolistic competition among firms located symmetrically along a circle, which derives in duopolistic competition between the two closest firms. Banks charge an endogenous markup over the deposit rate. The equilibrium solution depends on the assumption that banks are identical, so that they charge identical interest rates to borrowers.

Only one author has successfully introduced heterogeneity among many competitors' efficiency levels in a Salop model in general equilibrium, Vogel (2007a and b).[7] Here, we focus on heterogeneous efficiency levels– expanding the degree of heterogeneity beyond that allowed in Vogel's work, while preserving the endogenous markups that emerge from Salop's duopolistic competition between neighboring banks, via the BEJK setup. If there is "too much" disparity between competitors' efficiency levels in a Salop model, the more efficient competitor may absorb the entire market. The BEJK framework allows a full continuum of heterogeneity between competitors and preserves the duopolistic competition by limiting market share through a Dixit-Stiglitz (1977)[8] desire for variety.[9] We show that log of the markup in this model equals the log of the net interest margin, which is commonly used as a measure of interest rate spreads.

Second, efficiency correlates with bank size in the same way as in studies of manufacturing firms by Bernard and Jensen (1999) and Bernard, Redding and Schott (2007). In particular, Demirgüç-Kunt, Laeven, and Levine (2003) find using individual bank balance

[6]See for example Andrés and Arce (2009) and Cordella and Yeyati (2002).

[7]Croft and Spencer (2004, revision forthcoming) also succeed in introducing heterogeneous Salop-type transaction costs in a study of ATM charges.

[8]Constant elasticity of substitution–in BEJK this is the bundling of goods in the utility function. Below, it is the need for different types of credit bundled into the representative firm's credit constraint.

[9]Mandelman (2006) endogenizes this upperbound of the market share in a model of heterogeneous banks using an elegant mechanism design technique motivated by geographic segmentation of the credit market within a closed economy. Since our focus is on the impact of foreign participation, we turn to the BEJK framework where the market shares are limited by customers' need for a variety of types of different kinds of credit, but duopolistic competition still generates an endogenous markup.

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.

Third, despite the potentially positive effect on market power and markups, Focarelli and Panetta (2003) find long-run efficiency gains following domestic bank mergers. Their study focuses on the market for bank deposits rather than the net interest margin, using data on actual deposit rates paid to borrowers. They argue that the long-run efficiency gains from mergers eventually generate more favorable deposit rates, outweighing the short-run impact of increases in market power.[10] We do not capture cost-cutting behavior by domestic banks, but foreign entry does select out the higher-cost domestic banks in the model, as well as lower costs in the target banks after takeover.

Fourth, using bank-level data on lending and deposit rates, Brock and Franken (2003) find that net interest margins are positively correlated with bank concentration,[11] whereas actual spreads are negatively correlated with concentration. This suprising finding is explained in our model because efficient banks charge lower actual spreads on average, giving them a larger market share, but can also potentially charge larger markups if they are much more efficient than their next-best competitor.

Fifth, Claessens and Laeven (2004), working with a panel of 50 countries, find that foreign entry increases the degree of competition in the banking industry, but that domestic restrictions on bank participation are up to ten times more influential on the overall competitiveness of the environment. They call the ease of domestic participation in various credit niches "contestability" and, generalizing the BEJK framework, we also find that it has a big influence over how likely foreign entry is to reduce markups and the average lending rate.

Finally, several papers indicate that increasing distance between countries–whether geographic, linguistic, or cultural–reduces both cross-border mergers and acquisitions in the banking sector and banks' holdings of net foreign assets (Buch, 2005; and Buch, Driscoll and Ostergaard, 2005). In the model below, distance plays a big role in differentiating between the impact of FDI versus liberalization toward foreign loans. When distance deters

[10] Hannan and Prager (1998) quantify increases in market power after mergers using U.S. deposit rate data.

[11] The positive correlation between net interest margins and concentration is also observed in the euro area by Corvoisier and Gropp (2002).

arms-length foreign lending to home firms, this type of financial liberalization naturally has little effect on markups or interest rates.

3 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 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 some general equilibrium implications.

Our objective is to analyze the general equilibrium effects of financial openness in three different scenarios: financial autarky (our benchmark); free access to foreign loans (what we call loan liberalization); and entry of foreign banks via mergers and acquisitions (foreign direct investment). We begin the description of the economy under financial autarky, with special emphasis on the banking sector.

3.1 Households

There is a continuum of households in the interval $[0, 1]$. Individuals in this economy consume a final good and work at the firms which produce it. They have funds each period that are deposited at the bank in return for some interest. 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:

$$d_{t+1} + q_t \leq \bar{r}_t d_t + w_t \mathbf{h}_t + \pi_t^F + \pi_t^B,$$

where d_t are one-period deposits at the banks, w_t are real wages, $\bar{r}_t$ is the gross market interest rate on deposits, and π_t^F and π_t^B are profits from firms and banks, respectively. Consumers are indifferent with regard to the banks where they deposit their funds, so they simply divide total deposits, d_t.

3.2 Firms

There is a continuum of perfectly competitive firms in the interval $[0, 1]$ that produce the final good devoted to consumption. They need to hire workers in order to start production, but do not have funds until after the goods are sold, so they must borrow this working capital.

Let the aggregate price level of the homogeneous domestically produced final good ($p \equiv 1$) be the numeraire. Technology is given by $y = Ah^{1-\alpha}$. The representative firm maximizes profits[12]

$$\pi^F = Ah^{1-\alpha} - wh - (r-1)l^d$$

and

$$l^d = wh \ ,$$

where l^d is the total amount of loans borrowed by the firm; h is labor demand; w is the unit input cost, taken as given by firms; r is the gross aggregate interest rate on the total of loans; and A is an aggregate productivity parameter. The first order condition with respect to labor gives the labor demand by the representative firm

$$h = \left(\frac{(1-\alpha)\, A}{rw} \right)^{\frac{1}{\alpha}} .$$

For simplicity and because firms often have a portfolio of loans with slightly different purposes and associated services (mortgages, car loans, small business loans, corporate

[12] We focus on steady-state analysis and thus omit time subscripts for the remainder of the discussion. 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.

credit, trade credit, etc.), we assume that the representative firm demands a portfolio of loans, with loans of different types combined using a constant elasticity of substitution, $\sigma > 1$.[13] Given that there are thousands of firms in any particular country, it is reasonable to assume that a representative firm assembles a basket of J different types of loans and may substitute between them based on the terms (interest rate charges) of each type.[14] Equivalently, we could assume that a representative firm chooses to borrow from only one bank at a time, where either the bank's expected variable transaction cost or the firm's understanding of the precise interest rate implied by the loan contract has a random component with a logit distribution.[15]

In either case, the representative firm chooses the optimal demand for loans from bank j, $l^d(j)$, by solving the following cost minimization problem:

$$\min_{l^d(j)} \; rl^d - \sum_1^J r(j)l^d(j)$$

subject to

$$l^d = \left[\sum_1^J l^d(j)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} .$$

The demand for loans in each market niche j by firms in a particular country is given by

$$l^d(j) = \left(\frac{r(j)}{r} \right)^{-\sigma} wh \ ,$$

[13]The CES specification employed here is not restrictive, since as shown by Head and Mayer (2001) it is equivalent to modelling "[...]a large number of heterogeneous consumers that each purchase only a single variety."

[14]The differences between each type of loan can arise due to geographic segmentation of the market, or to a demand for different types of credit services in which banks might specialize, or even due to preferences regarding superficial aspects of customer service like the training and behavior of the loan officers or the format of online services. In fact, there is quite a bit of empirical evidence documenting that firms typically take out loans from multiple banks (Udell, 2007; Bannier, 2005; Shikimi, 2005; and Escudero, 2003). At the upper end are firms in Italy, which have relationships with on average between 11 and 30 different banks, depending on firm size (D'Auria, Foglia, and Reedtz, 1998). A more typical average number of banks used by firms in industrialized countries would be closer to 6, as Bannier (2005) reports is found in several studies of Germany. Among small- and medium-sized firms in Japan, the average number of banking relationships is 4 (Shikimi 2005), which is closer to the number of recorded relationships per firm in Argentina. Streb, Bolzico, and Druck, Henke, Rutman, and Escudero (2003) report that 75 percent of Argentinian firms have relationships with between 3 and 15 banks, with the average number increasing in the size of total liabilities.

[15]See Anderson, de Palma, and Thisse (1988) or Verboven (1996) for derivations reconciling a representative consumer framework with the Dixit-Stiglitz preference specification.

where the aggregate market interest rate, r, comes from minimizing the cost of one bundle of loans to the representative firm:

$$r = \left[\frac{1}{J} \sum_{1}^{J} r(j)^{1-\sigma} \right]^{\frac{1}{1-\sigma}}.$$

3.3 The banking sector

Banks in this economy are distributed in niches indexed by j, with a total of J niches. Within each niche, banks draw an individual cost parameter that characterizes the calibre of their management and technology.[16] Let $C_k(j) \geq 1$ for all k denote the cost parameter of the kth most efficient bank in sector j of a particular country. The cost parameter can represent any per-unit non-interest expenditures (for instance, on personnel and facilities), or institutional lags that prevent deposits from immediately converted to loans due to inefficiency. If we were to include a uniform probability of default, or the firm's incentive to repudiate the debt, then the cost parameter is also analogous to a monitoring cost as in Carlstrom and Fuerst (2001), or a repudiation cost as in Kiyotaki and Moore (1997). 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. The bank's cost per dollar of loans supplied is then $\bar{r}C_k(j)$, with $\bar{r}$ being the risk-free rate paid to depositors.

Within each niche, banks compete by strategically setting their interest rates, so that only the bank charging the lowest interest rate– the bank with the lowest cost for a particular type of loan– supplies loans in that market segment. The unit cost function for the supplier in niche j is thus $\bar{r}C_1(j)$, with $C_1(j) = \min\{C_k(j)\}$. As described in BEJK, this low-cost supplier can not charge more than the marginal cost of the second-lowest cost firm. Otherwise it will be undersold by this next most efficient competitor. It would like to charge the maximum markup possible, the standard Dixit-Stiglitz markup, $\bar{m} = \frac{\sigma}{\sigma-1}$, but can only do this if the cost of its next-best competitor exceeds its own unit cost times the maximum markup, or $C_2(j) > \bar{m}C_1(j)$. This duopolistic competition between banks implies that the lending-to-deposit rate spread is ultimately endogenous. Thus, we have

[16] We can assume that each bank competes in only one niche or that all banks draw a separate i.i.d. cost parameter for each of the J niches, but with no economies of scope.

the interest rate on loans in niche j given by

$$r(j) = \min\left\{\frac{C_2(j)}{C_1(j)}, \bar{m}\right\}\left[\bar{r}C_1(j)\right],$$

with profits for the niche-j bank supplier equal to

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

where $l^s(j)$ is the supply of loans by bank j, and $d(j)$ represents the amount of deposits the bank collects to make the loans and cover non-interest expenses incurred before loans are repaid.[17] Since households are indifferent regarding where to deposit, the amount of deposits held in any particular bank, $d(j)$, differs across banks only due to differences in banks' requirements for deposits to make loans. We assume that the number of credit "niches," J, is large enough that each bank takes the aggregate interest rate and the aggregate demand for loans as given. Banks transform the deposits they receive into loans through the following technology:

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

that is, more efficient banks (lower $C_n(j)$) would be able to supply more loans out of deposits than less efficient ones.

Many studies have used net interest rate margins as a proxy for markups when analyzing the impact of financial sector liberalization on borrowing costs due to data constraints. Few authors have had access to actual data on lending and deposit rates and instead rely on measures of the net interest margin, as we do here. However, using the model we can still map the distribution of markups into the distribution of net interest margins. In particular, it is simple to show that the log of the markup is approximately equal to the net interest

[17] We assume for simplicity that bank working capital is thus drawn from deposits, but the same cost structure would result even if working capital was derived from the funds of bank owners, since the opportunity cost of putting up the funds would be the rate of interest on deposits.

margin. The log markup is given by

$$\begin{aligned}\log m(j) &= \log r(j) - \log \bar{r}C_1(j) \\ &\approx [r(j) - 1] - [\bar{r}C_1(j) - 1] \\ &= r(j) - \bar{r}C_1(j).\end{aligned}$$

The "wide" net interest margin,[18] equal to total interest revenues minus total interest expenditures divided by assets equals

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

where we have used $d(j) = C_1(j)l^s(j)$. Thus, the model's depiction of markups is easily reconciled with existing empirical research.

3.4 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 and r. We assume that each rival competing in niche j draws its cost parameter from an identical, independent Weibull function,

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

with positive support over $[1, \infty)$,[19] that is, the probability that a bank can loan out funds for less than the rate of interest on deposits (i.e., $c < 1$) is zero. Given n potential entrants in the niche, let c_1 represent the efficiency level of the most efficient (n^{th} lowest-cost) lender and c_2 the efficiency level of the second most efficient ($(n-1)^{th}$ lowest-cost) lender. Then, one can derive the joint density for the two lowest record values, $g_{n,n-1}(c_1, c_2)$ using a

[18] 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.

[19] This is akin to assuming that banks draw an efficiency parameter z from a Fréchet distribution of the form $F(z) = 1 - e^{-Tz^{-\theta}}$ with support over $(0, 1]$, 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."

simple formula from order statistics (Rinne 2009, p.224)

$$\begin{aligned} g_{1,2}(c_1, c_2) &= \frac{n!}{(n-2)!}\left[1 - F(y)\right]^{n-s} f(x)f(y) \\ &= n(n-1)\left(T\theta\right)^2 \left(c_1 - 1\right)^{\theta-1} \left(c_2 - 1\right)^{\theta-1} e^{-T(c_1-1)^\theta} e^{-T(c_2-1)^\theta(n-1)}. \end{aligned}$$

Notice that the implied marginal density for c_2 is influenced by the number of rivals in the niche n:

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

Eaton and Kortum (2007) assume that this number of potential suppliers is Poisson distributed, a very realistic assumption for their examination of trade in goods across many different industries. With the special functional forms in their study, the number of rivals elegantly averages out into a function of the parameters governing the distribution of unit cost parameters (Eaton and Kortum 2007, Chapter 4 Appendix). In the specific case of the banking industry, government policy could bear an enormous impact on the number of potential entrants in each segment of the lending market. Thus, we use an exogenous parameter n to embody the concept of contestability examined empirically in the cross-country banking study by Claessens and Laeven (2004).

The markup charged by any particular supplier is $M(j) = \frac{r(j)}{\bar{r}C_1(j)}$. Since the lowest-cost bank ($C_1(j)$) wants to charge the highest markup possible subject to the cost of its next most efficient competitor in the niche ($C_2(j)$), and the elasticity of firms' demand for loans ($\overline{m}$), the markup it charges is given by

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

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. Following BEJK, one

can compute the cumulative distribution for the markup as

$$\begin{aligned}
\Pr\left[\frac{C_2(j)}{C_1(j)} \leq m' | C_2(j) = c_2\right] &= \Pr\left[\frac{C_2(j)}{m'} \leq C_1(j) \leq c_2 | C_2(j) = c_2\right] \\
&= \frac{\int_{(\frac{c_2}{m'})}^{c_2} g_{1,2}(c_1, c_2) dc_1}{\int_1^{c_2} g_{1,2}(c_1, c_2) dc_1} \\
&= \frac{\left[-e^{-T(c-1)^\theta}\right]_{\frac{c_2}{m'}}^{c_2}}{\left[-e^{-T(c-1)^\theta}\right]_1^{c_2}} \\
&= 1 - \left(\frac{\frac{c_2}{m'} - 1}{c_2 - 1}\right)^\theta
\end{aligned}$$

If there were no lower bound for the cost parameter, then the cumulative distribution would reduce to the expression in BEJK, which is entirely independent of c_2, $H(m) = 1 - m^{-\theta}$. A simple simulation demonstrates that we obtain a distribution with a pdf of roughly Pareto shape, shown in Figure 1a. The simulation is done by first taking 11 draws (i.e. $n \equiv 11$)[20] from a transform of $F(c)$ based on a uniformly distributed variable y. We find $C_1(j) = c_1$, the lowest c drawn from this sample of 100 and $C_2(j) = c_2$, the second lowest draw. Then 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 in the Bankscope sample described above implies $\sigma = 5.87$,[21] so we choose $\sigma = 6$. Following the suggestion in Eaton and Kortum (2002), we then set θ equal to σ and set T equal to 1 to correspond with the normalization used in our presentation of the empirical estimation of T below. The process is repeated to calculate the markup for 100 niches. Finally, the entire distribution is simulated 1000 times. The x-axis of Figure 1a is the markup value, and the y axis the probability that any of the markups is within a narrow interval (0.004) of markup values.

Notice that we have set the number of potential rivals equal to 100 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 in the market (as seen in the formula for $g(c_2)$ above). To illustrate, Figure 1b shows the distribution of markups when the level of contestability

[20] We calibrate the number of rivals based on the value of n for the United States found in de Blas and Russ (2009), which we estimate based on the ratio between the number of banks in the data and the population size.

[21] Specifically, Bankscope reports a maximum net interest margin of approximately 21 percent. Having shown above that the net interest margin is the log of the markup, we impute the maximum markup from the maximum net interest margin and back out a $\sigma = 5.87$.

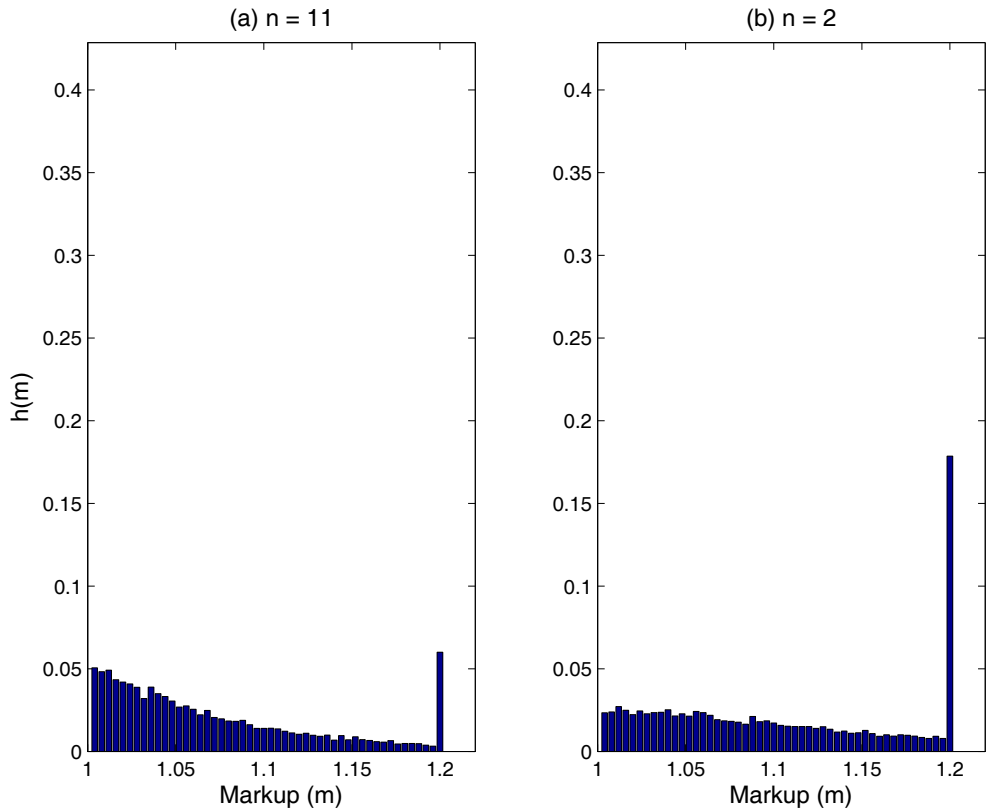

Figure 1: Probability density of markups with high versus low contestability in the banking sector

in each niche is extremely low, so that $n = 2$. The number of banks in the entire banking industry charging very low markups (near 1) is dramatically curtailed, while the fraction of all banks charging the upperbound, $\bar{m} = \frac{\sigma}{\sigma-1}$, more than triples, exceeding 15 percent. Due to its impact on the distribution of markups, increasing contestability (an increase in n) on average reduces the aggregate interest rate.

In a related study (de Blas and Russ (2009)), we estimate the parameters of the Weibull distribution employed in this paper to match the distribution of costs in a panel of countries, using the ratio of deposits to loans to measure the cost parameter, exactly as modelled here. An application of the Ansari-Bradley test indicates that there is little variation across countries in the estimates for the technology parameter, T, while the number of competitors (our measure of contestability) does vary considerably more. The results imply

that bank competition within niches (n) is a more important factor driving differences in the distribution of markups across countries than differences in available technology. This finding is consistent with those of Claessens and Laeven (2004) regarding the importance of contestability– the degree of domestic entry– in driving the competitiveness of bank pricing behavior.

3.5 Equilibrium

The next step is to define equilibrium and the properties of the steady state. An equilibrium under autarky in this economy is defined by a set of quantities and prices such that households, firms, and banks solve their maximization problems and that markets clear, $\{q, p, w, h, y, r, \bar{r}, l, d, l(j), d(j), r(j)\}$. The equilibrium conditions emerge from the consumer's intertemporal optimization (derived Appendix C); the firm's demand for labor and loans; banks' price setting; the goods, deposit, and loan market clearing conditions; and the definition of the aggregate interest rate. These are shown for the steady state in Table 1.

4 The markup, financial sector liberalization, 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. If liberalization is defined as the ability to borrow from banks located overseas, "importing" bank loans from abroad, then it can be shown numerically that the distribution of markups retains a roughly Pareto-like shape. Using data from the simulation technique above repeated for two identical countries, Figure 2b shows that under this type of loan liberalization, the distribution of markups is quite similar to that under autarky in Figure 1, which is presented here for ease of comparison in panel 2a. We will show below that in this benchmark setup with no geographic frictions, the distribution of markups and interest rates charged to borrowers under loan liberalization is, on average, stochastically dominated by the distribution under autarky: the average markup and interest rate fall under cross-border loan liberalization. One might define the average markup in the home country as an arithmetic mean, $\frac{1}{J}\sum_{j=1}^{J} m(j)$, or a market-share-weighted mean, $\left[\frac{1}{J}\sum_{j=1}^{J} m(j)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$, where J represents the number of market niches, equal to 100 in each iteration. In the simulation exercise here, both measures of

Consumers		
Labor supply	$q^{\rho} = w\mathtt{h}^{-\frac{1}{\gamma}}$	(1)
Euler condition	$\bar{r} = \frac{1}{\beta}$	(2)
Budget constraint	$q = w\mathtt{h} + \pi^F + \pi^B + d\bar{r}$	(3)
Firms		
Technology	$y = Ah^{1-\alpha}$	(4)
Optimal labor demand	$h = \left(\frac{(1-\alpha)A}{rw}\right)^{\frac{1}{\alpha}}$	(5)
Demand for loans	$l(j) = \left(\frac{r(j)}{r}\right)^{-\sigma} wh$	(6)
Banks		
Lending rate	$r(j) = \min\left\{\bar{r}C_2(j), \bar{m}\left[\bar{r}C_1(j)\right]\right\}$	(7)
Loan supply	$l(j) = \frac{d(j)}{C_1(j)}$	(8)
Market Clearing and Aggregation		
Loan market clearing	$l \equiv \sum_1^J l(j)$	(9)
Deposit market clearing	$d \equiv \sum_1^J d(j)$	(10)
Goods market clearing	$y \equiv q$	(11)
Aggregate interest rate	$r = \left[\lvert frac1J \sum_1^J r(j)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$	(12)
Labor market clearing	$\mathtt{h} \equiv h$	(13)

Table 1: Model specification under autarky

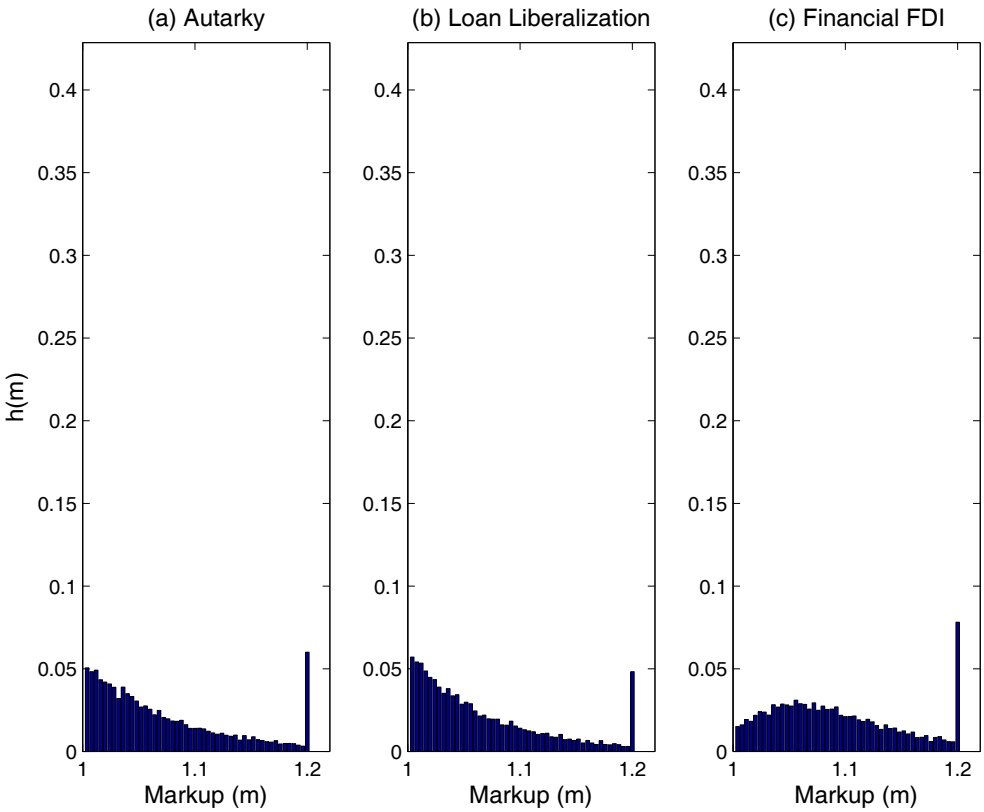

Figure 2: Probability density of markups: Autarky versus openness

the average markup fall. This is largely because the expected markup is not separable from the cost parameter of the second-lowest-cost supplier and allowing firms to borrow from foreign banks has an effect similar to increasing contestability. Futher, the average interest rate, r, falls in all 1000 trials.

We can also compute the fraction of niches that will be supplied by foreign loans. When both countries are identical, the fraction is one half on average. If one country has lower contestability (n) or a lower technology parameter (the scale parameter, T), it will naturally experience higher rates of foreign participation.

Buch (2000) finds that the foreign asset holdings of banks fall with geographic distance. The loan liberalization in Figure 2b presumes that there is an extra cost involved in supplying loans to overseas firms, so that the marginal cost of lending is $\delta_{loan} C_1(j)\bar{r}$,

with $\delta_{loan} > 1$. This distance factor could represent all sorts of frictions, from added costs involved in locating and advertising for potential borrowers overseas to the cost of hedging exchange rate risk. As δ increases, fewer and fewer foreign banks supply credit to home firms and the distribution of markups under liberalization converges to the home distribution under autarky. Figure 3 shows that the cdfs under liberalization (with and

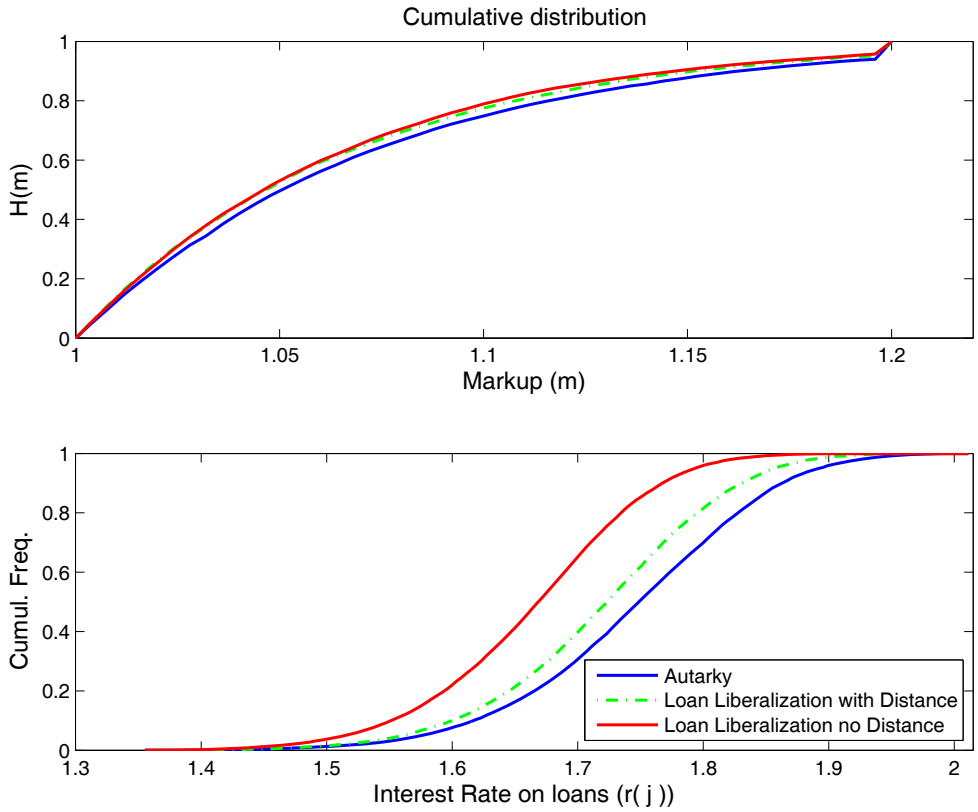

Figure 3: Markups are lower under loan liberalization compared to autarky

without distance) still do not cross the cdf under autarky. Indeed, as the distance factor increases (in Figure 3, we present $d_{loan} = 1$ in the case with no distance, $d_{loan} = 1.1$ in the case with distance), limiting the number of foreign sources of credit, the cdf under liberalization simply converges to the distribution seen under autarky. Thus, the autarkic distribution of markups always first-order stochastically dominates or closely overlaps with the distribution after loan liberalization–i.e., loan liberalization almost always reduces the

average markup and is most likely to do so when costs arising from distance are small. Below, we elaborate on this result and contrast it with openness to FDI in the financial sector.

4.1 FDI in the banking sector

Expanding the model to allow foreign takeovers of home banks provides a theoretical reason for why spreads may actually increase among banks taken over by a foreign parent, as documented in developing countries by Claessens, Demirgüç-Kunt, and Huizinga (2001). The intuition is straightforward and hinges on heterogeneous levels of efficiency among banks. First, consider a world where banks can buyout overseas banks only in their own niche through a bidding process. Buch (2000) reports evidence suggesting that parent banks are more efficient than the banks they acquire. Suppose that the foreign bank in niche j is more efficient than the lowest cost home bank, $C_1^*(j) < C_1(j)$, 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 following the buyout, where a low-cost bank from niche j in the foreign country buys the low-cost bank from niche j in the home country, be given by

$$C_1^M(j) = (C_1^*(j))^{\frac{1}{\delta_{fdi}}} (C_1(j))^{1-\frac{1}{\delta_{fdi}}},$$

with $\delta_{fdi} \geq 1$.[22]

Because the lowest-cost foreign bank will be able to run a more efficient home branch after a merger, it can charge lower lending rates, lend out more money, and reap more profits from the venture than the second-lowest-cost foreign bank could possibly do, given its inferior technology. Thus, it is immediately obvious that the most efficient foreign bank will be able to outbid the second-most efficient foreign bank for any potential target in the host country. We also assume that parent banks can only acquire active banks, so only the best bank in each niche is a potential target.[23] The parent bank buys out the target

[22] 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.

[23] We relaxed this assumption in previous versions of the paper with qualitatively similar results. We adopt the simplifying assumption here to preclude domestic mergers and to keep the focus on the effects of foreign participation. (Costly domestic mergers undertaken to increase potential markups by buying out the next-best competitor would simply shift the mass toward the upper end of the distribution of markups

by paying a dividend equal to the maximum of either (i) whatever profits the target would have made if it had been bought out by the second-highest foreign bidder in exchange for all operating profits, or (ii) whatever profits the target would make if it does not sell out. The pricing of the takeover is specified in detail in Appendix B. The cherry-picking of the most efficient local bank in the niche is a result, rather than an assumption– taking all other banks' behavior as given, the Dixit-Stiglitz bundling of loans guarantees that a merged bank is most profitable and thus affords the target the most advantageous buyout when the most efficient foreign rival in its niche is the acquiror.

What is the impact of the mergers on markups? Given that the most efficient foreign bank buys out the most efficient home bank, 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 will increase in all merged banks that were not already charging $\bar{m}$. The markup will never increase for local banks that are not bought out by foreigners. Therefore, merged banks in any sample will display a higher propensity to increase markups, while each surviving domestically owned bank will have a markup that remains unchanged from its pre-liberalization level. Surviving domestically owned banks will on average be more efficient than the pre-liberalization sample, since less efficient domestic banks are more likely to be merged. To show the overall effect on the distributions, we use the same data from the simulation above. The distribution of markups under FDI liberalization stochastically dominates the distribution under autarky (Figure 4). The cdf for markups under FDI liberalization crosses the cdf under autarky, meaning FDI increases the average markup.

In contrast, the cdf for markups under loan liberalization will generally billow to the left, above the cdf under autarky when the home and foreign country have the same level of technology, T. Loan liberalization will increase the markup in a particular niche only when three conditions hold: $C_1^*(j) < C_1(j)$, $C_2^*(j) < C_2(j)$, and $\frac{C_2^*(j)}{C_1^*(j)} > \frac{C_2(j)}{C_1(j)}$. Put another way, these three conditions imply that inflows of foreign loans will only increase the spread in the home country's niche j if both low-cost foreign banks have superior efficiency to the low-cost home banks *and* there is already a larger spread in the foreign country's niche j. When these conditions jointly occur, the home country effectively "imports" a higher markup from the foreign country in that particular niche. In the absence of any one of these conditions, loan liberalization will either reduce or have no effect the on markup. Only the

with no important qualitative implications for our analysis of FDI.)

first condition is necessary for a cross-border merger to increase a target bank's markup and this is the same necessary condition for a merger to take place. Therefore, whereas the distribution of markups under FDI stochastically *dominates* the distribution under autarky, the distribution of markups under loan liberalization is stochastically *dominated by* the autarkic distribution.

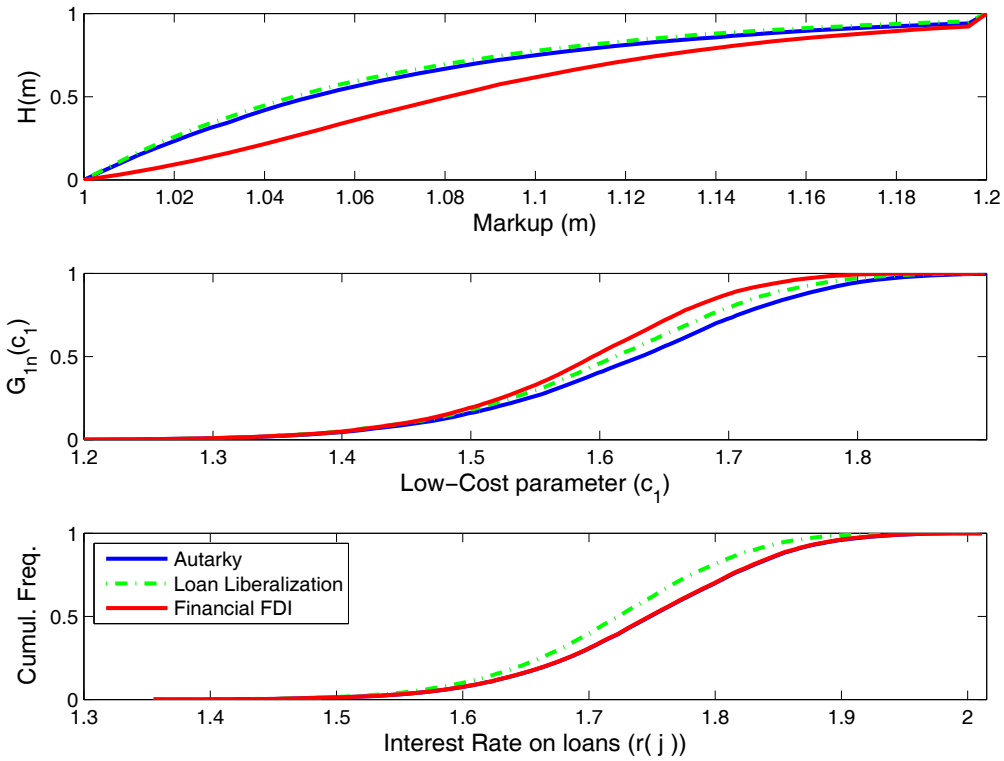

Figure 4: Effects of liberalization on the distribution of markups, costs, and interest rates

Table A.1 shows summary statistics for net interest margins, the ratio of overhead expenses to total interest earning assets, and the ratio of personnel expenses to total interest earning assets for a panel of 80 countries. The data are split by whether there was a surge in foreign takeovers in the financial sector between 2000 and 2006 for any length of time.[24] All countries saw both net interest margins and costs drop by more than 10%

[24]We run break tests, described in the Appendix, to identify a surge in foreign takeovers in the financial industry recorded in the Thomson SDC database. In the table we split the data by whether there is at least one test indicating the existence of a surge.

between 2000 and 2006. However, in countries for which there is some evidence of a surge during the sample period, the drop in the mean of average costs was between 40 and 180 percent bigger than the drop for net interest margins. This is in contrast to countries exhibiting no evidence of a surge, where the mean for the net interest margin and for costs dropped at about the same rate. In our model, an increase in arms-length foreign loans would reduce net interest margins across most banks, while FDI occurring at the same time would dampen the fall, just as we see in the data.

4.2 Bank efficiency and interest rates

What do increased markups mean for firms? Efficiency gains prevent these increased average markups from translating into higher borrowing costs. The distribution of costs and under autarky stochastically dominates the distributions for either loan or FDI liberalization (Figure 4, middle panel). Increased markups from foreign takeovers are completely offset by the fall in costs: the average interest rate under financial FDI is virtually unchanged from autarky and actualy falls a miniscule amount. Mergers therefore increase banking sector efficiency to a degree that supercedes the impact of increased market power arising within a few sectors. This is evident in the bottom panel of Figure 4– the cumulative distribution of interest rates for financial FDI is almost identical to that for autarky. The autarkic distribution of interest rates stochastically dominates the one for loan liberalization. Thus, we can say unequivocally that neither type of liberalization increases lending rates, even though FDI increases markups. Numerical computations confirm that this is true in 100 percent of the simulated cases.

Theoretically, we can show why. Although the markup may increase, the actual spread always falls after a merger. Recall that the acquiring bank is always more efficient than the target, or $C_1^M(j) < C_1(j)$. Then, the interest rate for the merged bank will be

$$r^M(j) = \min\left\{C_2(j)\bar{r}, \bar{m}C_1^M(j)\bar{r}\right\}.$$

The cost parameter of the second-best supplier of credit to niche j in the domestic market will either stay the same ($C_2(j)\bar{r}$) after FDI liberalization, meaning the interest rate in niche j will never increase and may fall if the targeted domestic bank was already charging $\bar{m}$ before merging. With a constant deposit rate, $\bar{r}$, that means that the actual spread ($r(j) - \bar{r}$, before the merger) can stay the same or decrease while the markup increases or stays the same due to the increased efficiency of the merged bank.

Claessens, Demirgüç-Kunt, and Huizinga (2001) offer evidence that domestic banks appear to increase their efficiency following entry by foreign banks. In our model, we can observe what empirically looks like increased efficiency in the domestic banking sector simply because the domestic banks that still supply loans after liberalization are some of the most efficient banks in the domestic market. The appearance of increased efficiency may also simply be evidence of unmerged local banks having to lower their markups. However, as suggested by Goldberg (2007), increased efficiency among unmerged local banks could also occur due to technological spillover from foreign entrants to these locally owned competitors, or induced cost-cutting behavior. In the case of technological spillover or cost-cutting, the technology parameter, T, would presumably be higher for the foreign-owned banking industry than for the indigenous banks, or $T_f > T_h$, 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.

4.3 Technology vs. contestability

The impact of either type of liberalization on the distribution of markups and lending rates in the home country is similar whether the home market opens up to a country with higher mean technology (T_f) or higher contestability (n_f). Recall that, as in Figure 1b, countries with low contestability have a flat pdf with a large "spike" at the upper end of the probability density for markups. Comparing Figures 2a and 2c, we see that allowing foreign takeovers moves the mass of the distribution of markups to the right, and increases the number of banks charging the maximum markup.

When foreign banks enter a market with low contestability, the spike increases even more. Figure 5b shows a case where a country with low contestability opens up to a world with similar banking technology but higher contestability. The number of banks charging the maximum markup is more than 4 times larger than in the case of FDI with high contestability, and more than twice as large as in the case of low contestability under autarky, as shown in 1b. The same holds true if a country with low technology opens to a world with similar contestability but higher technology.

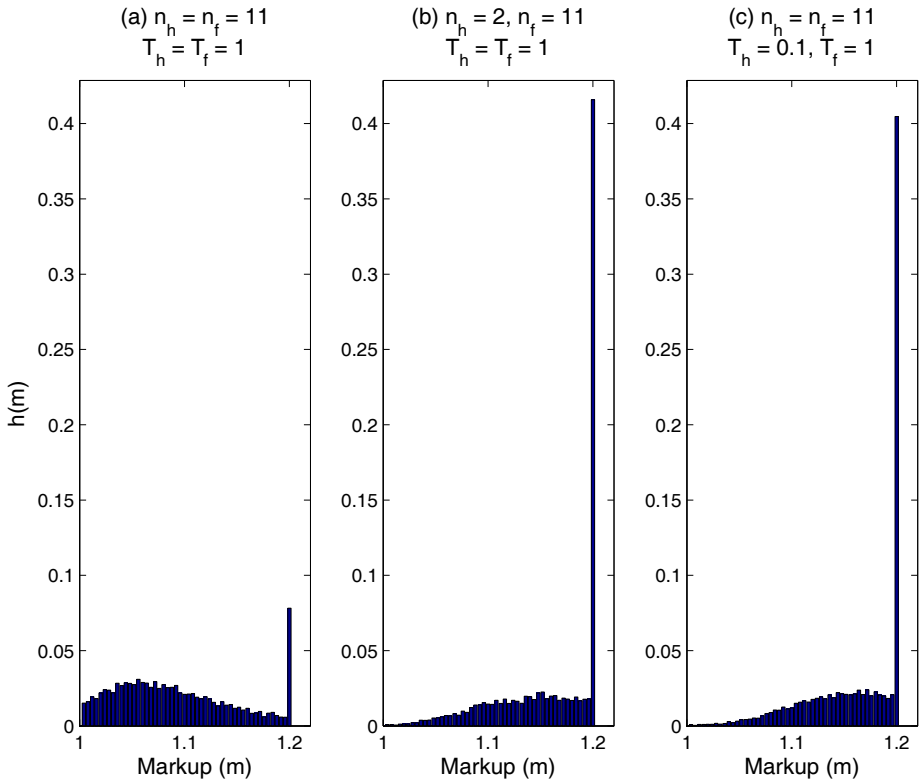

Figure 5: Financial FDI when contestability or technology are lower in the host country

4.4 Welfare effects

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 1. We transform the consumer's budget constraint (3) and the goods clearing condition (11) into two new equations,

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

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. V is the total of all takeover fees paid to owners of native home-country banks acquired by foreign-owned banks. 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. That is, π_h^{B*} represents profits earned by home-owned banks in the foreign country, and V^* is the total of all takeover fees paid by home acquirors to the owners of targeted foreign banks.

The balance of payments equation is given by

$$nx = q_h^* - q_f \equiv (\pi_f^B - V) - (\pi_h^{B*} - V^*) \tag{13}$$

where q_h^* is consumption of goods produced by home firms in the foreign country. That is, a home export surplus 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 in goods does not have to be balanced if bank profits, net of takeover fees, are greater for one country than another. With the interest rates already given by 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.

The overall effect of loan liberalization is to reduce the average interest rate, which increases consumption and utility. Computations using data from the simulations above[25] are reported in Table 2 and show that moving from autarky to loan liberalization implies an increase of consumption of around 28.2% in terms of consumption under autarky. Furthermore, going from autarky to FDI in the financial sector improves welfare even more, implying an increase in consumption by more than 200% compared to consumption under autarky. In both cases, the result stems from the increased efficiency with which banks are serving their borrowers.

However, the channels through which the increased efficiency translates into welfare gains are completely different. Loan liberalization transforms increased efficiency into lower financing costs for borrowers. Bank profits may increase due to new overseas lend-

[25] We report results for calibration with standard values $\alpha = 0.36$, $\rho = 1$ (logarithmic utility), and $\gamma = 1$ (unit elasticity of labor supply), and choose $\delta_{loan} = 1.10$ and $\delta_{fdi} = 2$.

Compensated variation: Required increase in autarkic consumption to reach post-lib. welfare levels		
	Autarky → Loan Lib.	Autarky → Financial FDI
Baseline $d_{loan}= 1.1, d_{fdi}= 2, T_h= T_f, n_h= n_f$	0.282	2.333
High arms-length friction $d_{loan}= 1.5$	0.281	—
High technological hangup for FDI $d_{fdi}= 10$	—	2.058
Lower home technology $T_h= 1 < T_f= 2$	-0.004	0.749
Lower home contestability $n_h= 2 < n_f= 11$	—	-0.342

Table 2: Welfare effects of liberalization

ing, but only because a particular bank can offer a lower interest rate to overseas firms than their local bank. Financial FDI transforms increased efficiency into higher markups and therefore profits for banks, with little or no change in interest rates charged to borrowers. In addition, for a merger to occur, the foreign bank must buy out the local one, so the increased profits are split between the foreign bank and the local one due to the takeover payments. It follows that when a country with inferior technology or contestability opens to FDI, the welfare gains are dramatically reduced or even reversed, in the case of very low contestability ($n_h= 2 < n_f= 11$). The implication is clear: the most important thing a country can do to reap welfare gains from financial openness is to encourage competition and improvements in technical efficiency among domestic banks at the same time it liberalizes toward foreign participation.

A country with a less efficient banking sector will also run a trade surplus, paid for with the excess profits of foreign banks. Under FDI, for instance, a country with lower overall technology (lower T) will run a persistent trade surplus, paid for by the net profits of resident foreign banks. Under loan liberalization, the surplus is paid for with profits from arms-length loans made in the home country by foreign banks in excess of the profits made from arms-length loans made by home country banks to foreign firms. When both countries are identical, either country can run a trade surplus or deficit, depending on the particular draws of cost parameters by individual banks.

5 Conclusions

This study draws on well known stylized facts from the empirical banking literature to analyze the implications of financial sector openness for consumption, welfare, and the components of the balance of payments. It abstracts from issues such as currency and maturity mismatches that are discussed in depth in the international finance literature, but focuses on the interaction of imperfect competition and bank heterogeneity–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 never increase rates and may reduce the costs of borrowing. It is the first model to explain why widening measures of interest rate spreads under liberalization do not imply increased interest rates for borrowers and that increases in net interest margins are less likely to occur when opening to foreign loans as opposed to FDI in the banking sector..

With regard to less financially developed nations, we show that opening to foreign takeovers in the banking sector is not a substitute for improving domestic banking institutions. Our findings suggest that to get the most benefit from foreign entry, a country should promote increased competition and technical efficiency among domestic banks. For financially advanced countries, the analysis provides an argument for liberalizing a country's banking sector to foreign entry even if its banking sector is already technically efficient relative to the rest of the world, since only competitors that are superior in a particular niche buy out local banks. In addition, profits earned from overseas lending yield a big domestic consumption boost and may even end up financing a persistent trade deficit.

The stylized facts upon which we base our analysis come with several caveats. First, do actual net interest margins increase as a result of the takeover, as in the model, or are foreign banks good at choosing targets for whom market conditions are about to cause margins to increase? The model here does not resolve this problem, which permeates the entire literature on spreads and foreign takeovers. We simply offer an explanation whereby one might observe increased measures of spreads following foreign entry but still see improvements in lending rates and welfare. Second, we do not model default or problems associated with asymmetric information, which naturally can also increase spreads. However, to the degree that local banks have information about local borrowers, the main engines driving the results– the cherry-picking of the best targets in the model and the

inability of foreign banks to transfer their own technology seemlessly – are even more plausible.

The omission most likely to alter the results is the potential consolidation or elimination of branches that might arise due to economies of scope. This effect could occur either due to foreign or to domestic merger activity, which we do not explore here. The Ricardian framework in the model above leaves the number of credit niches fixed (though the number of banks is not necessarily fixed if we assume that banks can take draws of cost parameters in any niche without economies of scope.) There is some evidence in recent literature that consolidation occurring after liberalization may cause reductions in the availability of credit to small firms, an important credit niche for innovation and growth in an economy. This might occur if the profit margins of some local banks who do not sell out are squeezed so that they are less likely to take on riskier loans, or if the superior efficiency of foreign acquirors involves being less willing to take on risk than their targets. Empirical studies are already addressing these questions, but theory has lagged behind. The interaction of an endogenous number of heterogeneous borrowers (or niches) and heterogeneous banks could further enrich our understanding of changes in market power that occur due to foreign entry and their implications for actual and proxied interest rate spreads.

References

[1] Ahsanullah, Mohammad. 2004. Record Values–Theory and Applications. Lanham, MD: University Press of America.

[2] Andrés, Javier and Óscar Arce. 2009. Banking Competition, Housing Prices and Macroeconomic Stability. Banco de España Working Papers 0830.

[3] Arena, Marco, Carmen Reinhart, and Francisco Vasquez. 2006. The Lending Channel in Emerging Economies: Are Foreign Banks Different? NBER Working Paper No. 12340 (June).

[4] Arnold, Jens Matthias and Beata Smarzynska Javorcik. 2005. Gifted Kids or Pushy Parents? Foreign Acquisitions and Plant Performance in Indonesia. CEPR Discussion Paper No. 5065.

[5] Bai, Jushan and Pierre Perron. 2003. Computation and Analysis of Multiple Structural Change Models. Journal of Applied Econometrics 18(1): 1-22.

[6] Bannier, Christina. 2005. Heterogeneous Multiple Bank Financing under Uncertainty: Does it Reduce Inefficient Credit Decisions? Goethe University Frankfurt am Main Finance and Accounting Working Paper Series No. 149.

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

[8] Barrett, Garry F. and Stephen G. Donald. 2003. Consistent Tests for Stochastic Dominance. Econometrica 71(1): 71-104 (January).

[9] Bernard, Andrew, and J. Bradford Jensen. 1999. Exceptional Exporter Performance: Cause, Effect, or both? Journal of International Economics 47(1): 1-25.

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

[11] Bernard, Andrew, Stephen J. Redding, and Peter K. Schott. 2007. Comparative Advantage and Heterogeneous Firms. Review of Economic Studies 74: 31-66.

[12] Brock, Philip and Helmut Franken. 2003. Measuring the Difference between Average and Marginal Interest Rate Spreads in Chile, 1994-2001. Working Paper, University of Washington.

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

[14] Buch, Claudia M. 2000. Information or Regulation: What is Driving the International Activities of Commercial Banks? Kiel Working Paper No. 1011 (November).

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

[16] Buch, Claudia M., K. Carstensen and Andrea Schertler. 2005. Macroeconomic Shocks and Banks' Foreign Assets. Kiel Working Paper 1254.

[17] Buch, Claudia M. John C. Driscoll and Charlotte Ostergaard. 2005. Cross-Border Diversification in Bank Asset Portfolios. European Central Bank Working Paper No. 429 (January).

[18] Carlstrom, C.T. and T.S. Fuerst. 1997. "Agency Costs, Net Worth, and Business Fluctuations: A Computable General Equilibrium Analysis," The American Economic Review, 87(5): 893–910.

[19] Cetorelli, Nicola and Linda S. Goldberg. 2008. Banking Globalization, Monetary Transmission, and the Lending Channel. Working Paper, Federal Reserve Bank of New York.

[20] 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.

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

[22] Cordella, Tito and Eduardo Levy Yeyati. 2002. Financial Opening, Deposit Insurance, and Risk in a Model of Banking Competition. European Economic Review 46(3): 471-485.

[23] Corvoisier, Sandrine & Gropp, Reint, 2002. "Bank concentration and retail interest rates," Journal of Banking & Finance, Elsevier, vol. 26(11): 2155-2189.

[24] Croft, Elizabeth W. and Barbara J. Spencer. 2004. Fees and Surcharging in ATM Networks: The Role of Nonbanks and Depositor Base. NBER Working Papers 9883.

[25] Dages, B. Gerard, Linda Goldberg, and Daniel Kinney. 2000. Foreign and Domestic Bank Participation in Emerging Markets: Lessons from Mexico and Argentina. Economic Policy Review, September: 17-36.

[26] de Blas, Beatriz and Katheryn N. Russ. 2009. Technology versus Contestability in the Banking Sector. Manuscript, University of California, Davis. August.

[27] Demirguc-Kunt, Asli, Luc Laeven and Ross Levine. 2003. Regulations, Market Structure, Institutions, and the Cost of Financial Intermediation. NBER Working Papers 9890.

[28] Dixit, Avinash and Joseph Stiglitz. 1977. Monopolistic Competition and Optimum Product Variety. American Economic Review 67(3): 297-308.

[29] Focarelli, Dario and Fabio Panetta. 2003. Are Mergers Benficial to Consumers? Evidence from the Market for Bank Deposits. American Economic Review 93(4): 1152-1172.

[30] Ghironi, Fabio and Viktors Stebunovs. 2007. The Domestic and International Effects of Financial Integration. Boston College Working Paper.

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

[32] Hannan, Timoth H. and Robin A. Prager. 1998. Do Substantial Horizontal Mergers Generate Significant Price Effects? Evidence from the Banking Industry. The Journal of Industrial Economics 46(4): 433-452.

[33] Helpman, Elhanan, Marc J. Melitz, and Stephen R. Yeaple. 2003. Exports versus FDI. NBER Working Papers 9439.

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

[35] 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.

[36] 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.

[37] 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.

[38] Melitz, Marc J. 2003. The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. Econometrica 71(6): 1695-1725.

[39] 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.

[40] Reinhart, Carmen and Ioannis Tokatlidis. 2001. Berfore and After Financial Liberalization. Mimeo, University of Maryland.

[41] Russ, Katheryn N. 2007. The Endogeneity of the Exchange Rate as a Determinant of FDI: A Model of Entry and Multinational Firms. Journal of International Economics 71(2): 344-372.

[42] Shikimi, Masako. 2005. Do Firms Benefit from Multiple Banking Relationships? Evidence from Small- and Medium-Sized Firms in Japan. Hi-Stat Discussion Paper Series No. 70 (January).

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

[44] Streb, Jorge M., Javier Bolzico, Pablo Druck, Alejandro Henke, Jose Rutman, and Walter Sosa Escudero. 2003. Bank Relationships: Effect on the Availability and Marginal Cost of Credit for Firms in Argentina. In Credit Constraints and Investments in Latin America, ed. by Arturo Galindo and Fabio Schiantarelli. Washington, DC: Inter-American Development Bank. (Also CEMA Working Paper (Serie de Documentos de Trabajo) No. 216).

[45] 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.

[46] 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.

A Summary Statistics

We present here net interest rate margins and two measures of costs for individual banks reporting consolidated balance sheets in 2000 and 2006 from the Bankscope databases. Since a number of studies have already documented the fact that foreign-owned banks tend to have higher net interest margins and lower costs using regression analysis, here

we examine whether the distributions shift in the way the model would predict following cross-border merger waves in the financial sector, given that there may also be cross-border arms-length lending. We narrow the sample to the 80 countries for which there were at least five observations for net interest margins in 2000 (or 2001, for India and Pakistan) and 2006.

A.1 Identifying surges in financial FDI

Liberalization with respect to the entry of foreign banks can take place legally without being followed by actual entry. Thus, we use a *de facto* indicator for liberalization, identifying countries which have experienced a surge in foreign takeovers of domestic banks within the sample period (2000-2006). For this task, we use data on cross border M&As from the Thomson SDC Platinum database involving lending or depository institutions as acquirors or targets from 1984-2005. There are many ways to identify a surge. A very simple rule would be to select countries for whom the annual number of cross-border M&As is twice as high for any year within the sample period as it had been in any year preceding the sample period. Using this method, we identify four countries: China, Indonesia, Taiwan, and Turkey.

A more sophisticated method involves testing for structural breaks in the series, counting those countries for which a break to a *higher* mean (for any length of time) occurs between the beginning of 2000 and the end of 2005 as having a surge during the sample period. Using code from Bai and Perron (2003),[26] one can try to pinpoint such breaks using four different methods. The Bai-Perron method provides alternative ways of testing for the absence of a structural break (the null hypothesis) against the existence of a particular number of strucutral breaks (sup-F) or against an unknown number of breaks (UDmax and WDmax). Once the null has been rejected, the method tests for the number of structural breaks sequentially up to a maximum of 5 possible breaks (1 versus 2, 2 versus 3 ...), and also uses information criteria for the choice of structural breaks. To be conservative, we use the UDmax and WDmax and sup-F tests to determine whether the series shows structural breaks, and then the Bayesian Information Criterion (BIC) to test for the number of break points. This is what we refer to as "all tests." When there is disagreement between the tests (mainly because the sup-F sometimes fails to reject the null of no structural break when the UDmax, WDmax, and BIC tests do reject it), we follow the indications given

[26] Available on Pierre Perron's website in a very user-friendly format.

	Year	No.Obs.	Mean	St.Dev.	Skew	Min	Max
No M&A surge after 1999 (69 countries)							
Net Interest Margins							
	2000	2355	3.61	2.74	2.48	-1.33	23.21
	2006	2304	3.20	2.51	2.49	-1.28	21.65
	% change		-11.34	-8.61	0.44	-3.76	-6.72
$\frac{\text{Overhead Costs}}{\text{Total Earning Assets}}$							
	2000	2361	0.05	0.08	6.34	0.00	1.00
	2006	2306	0.04	0.08	6.67	0.00	0.87
	% change		-11.22	-4.05	5.13	4.85	-12.87
$\frac{\text{Personnel Costs}}{\text{Total Earning Assets}}$							
	2000	2210	0.02	0.04	6.79	0.00	0.48
	2006	2195	0.02	0.03	6.16	0.00	0.41
	%change		-12.01	-17.86	-0.09	16.78	-14.74
M&A surge after 1999 (11 countries)							
Net Interest Margins							
	2000	337	4.44	5.01	1.83	-1.31	22.99
	2006	425	3.52	3.14	2.32	-1.19	20.48
	% change		-20.79	-37.24	27.23	-9.16	-10.92
$\frac{\text{Overhead Costs}}{\text{Total Earning Assets}}$							
	2000	346	0.05	0.06	2.77	0.00	0.42
	2006	436	0.04	0.04	5.89	0.00	0.53
	% change		-28.37	-25.26	112.41	-12.40	27.82
$\frac{\text{Personnel Costs}}{\text{Total Earning Assets}}$							
	2000	174	0.03	0.03	2.52	0.00	0.20
	2006	276	0.02	0.02	4.07	0.00	0.21
	% change		-37.47	-36.96	61.66	-8.82	6.19

See App. A for description of data and methodology

Table 3: FDI Surges and the distribution of markups and costs

by the BIC. The Bai-Perron code conveniently estimates the mean of a series before and after each break point. We consider that a surge has occurred only if the mean increases after a break identified using the BIC.

We collapse the Thomson data into quarterly series and identify seven countries as having a surge during the sample period according to all tests– China, Indonesia, Lithuania, Pakistan, the Russian Federation, the Slovak Republic, and Turkey. We further identify five more surges using only the BIC which are not indicated by any other test results. These are the Cayman Islands, Croatia, Estonia, Japan, Lithuania, and Taiwan. Another group appears to have a surge that began before and ended after 2000 according to the BIC minimization. These are Argentina, Brazil, Chile, France, Greece, Hong Kong, Hungary, India, Norway, Peru, Poland, Singapore, South Korea, Thailand, and Venezuela.[27] [28] In the analysis below, we focus only on countries experiencing a surge during the sample period and ignore the countries in mid-surge at the beginning of 2000 except when specified. We use the 12 countries with surges during the sample identified using the BIC as our baseline list of "surge countries."

Table A.1 shows summary statistics for net interest margins, the ratio of overhead expenses to total interest earning assets, and the ratio of personnel expenses to total interest earning assets for the entire panel of 80 countries, split by whether there is at least one test indicating that there was a surge in foreign takeovers in the financial sector between 2000 and 2005 for any length of time.

A.2 Bank-level data in detail

The variables used for the empirical analysis are obtained from Bankscope database for the period 2000-2006 at an annual frequency. In particular, the variables employed are:

- Net interest margin: This ratio is the net interest income expressed as a percentage of earning assets. The higher this figure the cheaper the funding or the higher the margin the bank is commanding. Higher margins and profitability are desirable as long as the asset quality is being maintained.

- Ratio of overhead expenses to total interest earning assets: Non interest expenses or overheads plus provisions give a measure of the cost side of the banks performance relative

[27] Within this group of countries that were "mid-surge" in 2000, at the time our bank data sample begins, the results described below hold only for countries with surges beginning in 1999.

[28] The M&A series have at most 87 observations and in many cases less than half that number. In this Appendix we report results for countries experiencing surges that begin before and end after 2000.

to the assets invested.

- Ratio of personnel expenses to total interest earning assets

-Ratio of deposits to loans (for empirical estimation of T and n)

We eliminate the 1st and 99th percentile for each variable within each country's observations in each year.

B The Merger Market

Suppose that $C_1^*(j) < C_1(j)$. Any acquiror also must offer at least as much as the target bank would earn independently in the new liberalized environment. To calculate these amounts, both the acquiror and the target take as given that all potential buyouts in other niches will occur. Thus, the price offered for the takeover is

$$V(j) = wh \max\left\{ r^A(j)\left(\frac{r^A(j)}{r_{fdi}}\right)^{-\sigma} - \bar{r}C_1(j)\left(\frac{r^A(j)}{r_{fdi}}\right)^{-\sigma}, 0\right\},$$

where $r^A(j) = \min\left\{\frac{C_2(j)}{C_1(j)}, \bar{m}\right\}\bar{r}C_1(j)$ is the interest rate that the lowest cost home bank would charge in the absence of any takeover. The merger market participants take the aggregate interest rate as given and calculate r_{fdi} as the aggregate interest rate that would emerge if all possible takeovers (including their own) occurred in every case where $C_1^*(j) < C_1(j)$.

C 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

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

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

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

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 the table below, $C_{k,lib}(j)$ represents the kth lowest-cost bank supplying niche j in the home country. Under loan liberalization, this could be either a home or foreign bank. If it is a foreign bank, then $C_{k,lib}(j)$ would be calculated including the distance friction. With FDI, this could be either a fully domestically owned home bank or a merged bank.

Consumers		
Labor supply	$q^{\rho} = w\mathtt{h}^{-\frac{1}{\gamma}}$	(1)
	$q^{*\rho} = w^* \left(\mathtt{h}^*\right)^{-\frac{1}{\gamma}}$	
Euler condition	$\bar{r} = \bar{r}^* = \frac{1}{\beta}$	(2)
Budget constraint	$q = w\mathtt{h} + \pi_h^F + \pi_h^B + d(\bar{r} - 1)$	(3')
	$+\pi_h^{B*} - \pi_f^{F*} + V - V^*$	
	$q^* = w^*\mathtt{h}^* + \pi_f^{F*} + \pi_f^{B*} + d^*(\bar{r}^* - 1)$	
	$+\pi_f^B - \pi_h^{B*} + V^* - V$	
Aggregate consumption	$q = q_h + q_f$	
	$q^* = q_h^* + q_f^*$	
Firms		
Technology	$y = Ah^{1-\alpha}$	(4)
	$y^* = A^* \left(h^*\right)^{1-\alpha}$	
Optimal labor demand	$h = \left(\frac{(1-\alpha)A}{rw}\right)^{\frac{1}{\alpha}}$	(5)
	$h^* = \left(\frac{(1-\alpha)A^*}{r^*w^*}\right)^{\frac{1}{\alpha}}$	
Demand for loans	$l(j) = \left(\frac{r(j)}{r}\right)^{-\sigma} wh$	(6)
	$l^*(j) = \left(\frac{r^*(j)}{r^*}\right)^{-\sigma} w^*h^*$	
Banks		
Lending rate	$r(j) = \min\left\{\bar{r}C_{2,lib}(j), \bar{m}\left[\bar{r}C_{1,lib}(j)\right]\right\}$	(7')
	$r^*(j) = \min\left\{\bar{r}C_{2,lib}^*(j), \bar{m}\left[\bar{r}C_{1,lib}^*(j)\right]\right\}$	
Loan market clearing (I)	$l(j) = \frac{d(j)}{C_{1,lib}(j)}$	(8)
	$l^*(j) = \frac{d^*(j)}{C_{1,lib}^*(j)}$	
Market Clearing and Aggregation		
Loan market clearing (II)	$l = \sum_1^J l(j), \;\; l^* = \sum_1^J l^*(j)$	(9)
Deposit market clearing	$d = \sum_1^J d(j), \;\; d^* = \sum_1^J d^*(j)$	(10)
Goods market clearing	$y = q + nx = q_h + q_h^*, \; y^* = q^* + nx^* = q_h^* + q_f$	(11')
Aggregate interest rate	$r = \left[\frac{1}{J}\sum_1^J r(j)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}, \;\; r^* = \left[\frac{1}{J}\sum_1^J r^*(j)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$	(12)
Balance of Payments	$nx = \pi_f^B - \pi_h^{B*} - V + V^*$	(13)
	$nx^* = -\left(\pi_f^B - \pi_h^{B*} - V + V^*\right)$	
Labor market clearing	$\mathtt{h} = h, \; \mathtt{h}^* = h^*$	(14)

Table 4: The open economy