FDI in the Banking Sector: Why borrowing costs fall while spread proxies increase

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Abstract

We construct a general equilibrium model of foreign direct investment (FDI) in the banking sector with heterogeneous banks to analyze the welfare consequences of liberalization. Using heterogeneous, imperfectly competitive lenders, the model explains why 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 actually fall, especially in less developed countries where it can be harder to implement the parent's technology or where there are more limitations on entry by domestic banks. In the model, borrowing costs fall on average under liberalization due to improved efficiency among lenders, increasing consumption and welfare in both countries. We find empirical support for the predictions using a sample of bank-level data from 80 countries between 2000 and 2006. In accordance with the theory, the distribution of average costs before a surge of FDI inflows is likely to first-order stochastically dominate the distribution emerging after a surge. Surges are also likely to shift the distribution of markups as proxied by net interest earnings, but in either direction, meaning that the average markup may increase or decrease while average costs are falling.

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1 Introduction

When it comes to the question of whether a country should open or "liberalize" its banking sector to allow foreign participation, a tension arises between the hope that foreign participation will reduce lending rates through competition and the concern that entry by large banks could concentrate market power and actually increase lending rates. Brock and 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 that banks charge lenders and the rate that they pay depositors, analogous to a markup in international trade models.[1] They 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. We model both. We find that growth-inducing impacts of financial openness can arise from increased efficiency among active banks, even when foreign entry increases the markups banks charge borrowers over the rates they pay depositors. These theoretical predictions are supported empirically by analyzing the distributions of net interest margins and average cost in the banking sectors of 80 countries. We further demonstrate that the effects of foreign participation through

[1] To be precise, the log of the markup is the net interest margin, which is commonly used as a measure of interest rate spreads.

takeovers of domestic banks are quite different from those of allowing domestic firms to receive loans directly from banks located abroad when technology transfer is not seemless.

In our model, liberalization policies always reduce average lending rates, but can actually increase the average net interest margin. The mechanism that generates this result is a model of endogenous markups by Bernard, Eaton, Jensen and Kortum (2003, hereafter BEJK) 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. This BEJK framework has also been applied to questions of pricing behavior and purchasing power parity in international macroeconomics by Atkeson and Burstein (2007 and 2008). The theoretical model here contributes to several literatures examining financial and trade liberalization. It complements empirical work by Dages, Goldberg, and Kinney (2000), Kaminsky and Tokatlidis (2001), Buch, Cartensen, and Schertler (2005), Arena, Reinhart, and Vasquez (2006), Stebunovs (2006), Ghironi and Stebunovs (2007), and Cetorelli and Goldberg (2008) linking foreign participation in the banking sector to macroeconomic outcomes. Whereas those papers (with the exception of Dages, Goldberg, and Kinney (2000)) 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 another strand of empirical literature that considers the impact of foreign participation on these three variables. This strand includes Buch (2001), 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.

Finally, the model expands the trade literature by generalizing the BEJK model to include foreign direct investment[2] and exploring the importance of the number of potential entrants, called "contestability" in the context of the banking sector by Claessens and Laeven (2004). In doing so, we find a new conceptualization of contestibility. Specifically, we find that with a lower number of potential entrants, the probability density of markups is quite flat, closer to uniform than to Pareto or Weibull in shape.[3] A large spike can also emerge at the upper end of the distribution of markups in markets with low contestability because some active banks are able to exploit the lax competitive environment by charging

[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]A low dispersion parameter can also make parts of the markup density flatter, but can be distinguished by its somewhat different impact on the probability density for non-interest average costs.

the maximum markup possible, subject to the elasticity of substitution between sources of credit. Contestability–the number of potential entrants in a particular sector of the credit market– is akin to the mass of potential entrants (M) in Melitz (2003), except that here it is (1) an exogenous policy parameter and (2) impacts the shape of the entire distribution of efficiency parameters and markups among active market participants. A market with few potential entrants into the banking system is much more likely to see reduced average markups after opening itself to either foreign loans (loan liberalization) or foreign direct investment in the banking sector (FDI). Using these distributions, we also take a step toward disentangling the effects of changing market structure from technological spillovers when analyzing the financial sector before and after liberalization, a challenge discussed in Goldberg (2007).

In sum, the paper models FDI in the financial sector in a general equilibrium framework with heterogeneity and imperfect competition. By using a framework with endogenous markups, it captures the main stylized fact from existing empirical studies– that bank mergers often increase markups– while demonstrating that this type of financial liberalization can still be likely to reduce the average lending rate. It also compares the impact of allowing financial sector FDI versus liberalization toward inflows of foreign loans. Although it abstracts from the exchange rate exposure that can accompany foreign loans, it does explain why allowing foreign loans is much more likely to reduce markups and somewhat more likely than FDI to reduce the average lending rate due to an interesting twist in the BEJK endogenous markup mechanism. We explore issues of contestability among creditors for the first time in a model of foreign direct investment and offer a framework to differentiate between the effects of increasing competition from those of technological spillover following either type of liberalization. Finally, we illustrate our theory of FDI liberalization using empirical evidence showing that average non-interest costs are likely to fall after FDI liberalization, while the movement of the distribution of markups proxied by net interest earnings is more ambiguous. Using a sample of bank-level data from 80 countries between 2000 and 2006, we show that in accordance with the theory, the distribution of average costs before a surge of FDI inflows is likely to first-order stochastically dominate the distribution emerging after a surge. Surges are also likely to shift the distribution of markups as proxied by net interest earnings, but in either direction, meaning that the average markup may increase or decrease while average costs are falling.

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 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 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.[4] 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. Both the high measures of spreads (the net interest margins) among foreign-owned banks and the split between the behavior of spreads in foreign-owned banks in industrialized versus developing countries can be explained by the model of FDI in the banking sector below if one supposes that it is easier for foreign banks to transfer their know-how over time and in industrialized countries, or that pre-liberalization entry by domestic banks is more restricted (generating low contestibility, defined below) in developing countries.

Several additional stylized facts also emerge from the empirical literature. First, it is 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 (2001) interprets evidence from aggregate variables as indicating that parent banks are more efficient than the banks they acquire overseas. Goldberg (2007) reports evidence

[4]Campa and Hernando (2006) present additional evidence that bank mergers increase market power in the European Union.

from multiple studies that foreign-owned banks operating in developing countries are more efficient than those that are domestically owned. Efficiency also correlates with bank size in the same way that one sees 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 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.

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 manufacturing industries 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. Only one author has introduced heterogeneity among many competitors' efficiency levels in a Salop model in general equilibrium, Vogel (2007a and b). Croft and Spencer (2004, revision forthcoming) also succeed in introducing heterogeneous Salop-type transaction costs in a study of ATM charges. Both are ground breaking contributions. Here, we would like to 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. 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 CES[5] desire for variety. We justify our use of the variety effect to bound market share by noting that firms have been observed to maintain lines of credit with between 4 and 30 banks on average, depending on the country.[6]

[5]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.

[6]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.

Heterogeneity is important to explain efficiency gains often found in banks after takeovers and the fact that foreign-owned banks tend to be more efficient than their domestically owned counterparts. 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, but is one of only two studies in this survey that uses data on actual deposit rates paid to borrowers, rather than the margin between interest revenues and interest expenses (the net interest margin). They argue that the long-run efficiency gains, which match the efficiency gains from liberalization in our model below, eventually generate more favorable deposit rates, outweighing the short-run impact of increases in market power, which are also quantified by Hannan and Prager (1998). For simplicity, banks take deposit rates as given in our model, but the efficiency gains are reflected in an increased demand for deposits and supply of credit. Interestingly, Claessens, Demirgüç-Kunt, and Huizinga (2001) find some evidence suggesting that domestically owned banks appear to have slightly lower costs and lower pre-tax profits in countries with more foreign-owned banks. We do not capture cost-cutting behavior by domestic banks, but foreign entry does select out the higher-cost domestic banks in the model. The only study besides Focarelli and Panetta (2003) in this survey that uses bank-level data on lending and deposit rates, Brock and Franken (2003), finds that net interest margins, are positively correlated with bank concentration,[7] whereas actual spreads are negatively correlated with concentration. This suprising finding is explained in our model because efficient banks charge lower spreads, giving them a larger market share, but can also potentially charge larger markups (analogous to the net interest margin) over their next-best competitor.

Claessens and Laeven (2004) measure the degree of competition using the Panzar and Rosse index, which measures the elasticities of bank's total revenue with respect to their input prices (Claessens and Laeven 2004, p.569). Working with a panel of 50 countries, they find that foreign entry increases the degree of competition in the banking industry, but that domestic restrictions on bank participation in various niches of the credit market were up to ten times more influential on the overall competitiveness of the environment. They call the ease of domestic participation in various credit niches "contestibility" 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. Beck, Demirgüç-Kunt,

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

and Maksimovic (2004) also determine that reduced contestibility (increased restrictions on banks' activities in particular sectors) tends to make credit less accessible to firms, which is a natural implication of the results for low contestibility in this model.

Finally, several papers indicate that increasing distance between countries–whether geographic, linguistic, or cultural–reduces both cross-border mergers and acquisisions in the banking sector and banks' holdings of net foreign assets, which include loans made directly to foreign agents in addition to activities in foreign bank branches (Buch 2005 and Buch, Driscoll and Ostergaard 2005). Hannan and Pilloff (2006) present some evidence of "cherry-picking" for takeovers of US banks by out-of-state acquirors. In particular, out-of-state acquirors tend to chose targets with larger market share and better efficiency, while in-state acquirors appear to care less about the pre-merger efficiency of the target. The authors interpret this as evidence that it is easier to transfer management practices in within-market mergers than in cross-border mergers, even between US states. In the model below, the distance variable plays a big role in differentiating between the impact of FDI versus liberalization toward foreign loans. If parent banks can seemlessly transfer their technology to their overseas targets, then the two types of liberalization have exactly the same impact on the distribution of markups and interest rates, yielding identical welfare effects.

3 Firms and Banks

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. However, they do not have funds to pay workers until after the goods are sold. They must borrow this working capital. 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 the firm decides how much to borrow and to produce. Thus, for simplicity we omit discussion of time subscripts until describing the consumer's savings behavior below. Define l^d as the total amount borrowed from financial intermediaries, with aggregate interest rate r.

Let the aggregate price level be the numeraire. Technology is given by $y = Ah^{1-\alpha}$. In autarky the aggregate price level is simply the price of the homogeneous domestically

produced final good ($p \equiv 1$). The representative firm maximizes profits

$$\max_{h} \pi^F$$

subject to

$$\pi^F = Ah^{1-\alpha} - wh - rl^d$$

and

$$l^d = wh \ ,$$

where w is the unit input cost, taken as given by firms and A is an aggregate productivity parameter. The first order condition with respect to labor input, h, is

$$(1-\alpha)\, Ah^{-\alpha} - (1+r)w = 0,$$

so that

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

The level of employment and output are inversely related to the wage and aggregate interest rate.

3.1 Banks: Financial autarky

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 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, $\sigma > 1$. 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). 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. 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. 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. Within each credit niche, there is duopolistic competition between banks reminiscent of a Salop framework, so that the spread between deposit rates and lending rates is ultimately endogenous.

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

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

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

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

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

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

The formula for loan demand implies that the demand for loans in a particular niche j is

higher when the interest rate, $r(j)$, is low.

Banks each draw an individual cost parameter that characterizes the calibre of its management and technology.[8] Let $C_k(j)$ denote the overhead cost parameter of the kth most efficient bank in sector j of a particular country. The overhead cost parameter represents per-unit non-interest expenditures (for instance, on personnel and facilities), or expenditures on deposits that are not immediately converted to loans due to inefficiency. 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 that emerges from the consumer's problem below. 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 $\bar{m} = \frac{\sigma}{\sigma-1}$. It can only do this if the cost of its next-best competitor exceeds its own unit cost times the maximum markup, or $C_2(j) > \bar{m}C_1(j)$. Thus, we have the interest rate on loans in niche j given by

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

with variable profits for the niche-j supplier equal to

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

where $d(j)$ represents the amount of deposits the bank collects to make the loans and cover non-interest expenses incurred before loans are repaid.[9] The amount the bank loans out, $l(j)$, must equal the amount of deposits it holds, less the amount it must use to cover its noninterest expenses (or interest on deposits stuck as "net inventory" as an inefficient bank

[8] 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. In this stylized framework, we are not able to integrate economies of scope that may arise from having a database of information on the creditworthiness of borrowers taking out different types of loan.

[9] 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.

takes extra time to transform incoming deposits into loan contracts), $\frac{d(j)}{C_1(j)}$, with $C_n(j) > 1$ for all n and j by an assumption built into the cumulative distribution underlying $C_n(j)$.

This differential cost parameter can be specified in similar forms to take account richer conceptualizations of the frictions involved in lending without changing the principal results below. For instance, it could be modeled as a costly state verification parameter. Supposing that some fraction $0 < \epsilon < 1$ of firms default on average, modelling $C_n(j)$ as a monitoring cost would result in the expected unit cost of lending for a particular bank as $\bar{r}\left[1 + \epsilon C_n(j)\right]$ in which case the intuition of the following analysis still holds. However, lending costs or efficiency could also be incorporated as a screening variable in a framework with *a priori* asymmetric information, which may alter the results in a way discussed in more detail in Section 7. We use the simplest specification possible both to nest the result within existing trade literature and to focus on the key idea that markups can increase while lending costs fall due to increased efficiency after a merger.

3.2 Distributions for cost parameters and the markup

Each bank 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 $[1, \infty)$.[10] The probability that a bank can loan out funds for less than the rate of interest it pays depositors (i.e., that it draws $c < 1$) is zero. Given n potential entrants in the niche, if c_1 represents 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 these lower record values, $g_{n,n-1}(c_1, c_2)$. Ahsanullah (2004, p.6-8) derives the formula for the lowest two record values as a function of the hazard rate and the density of the underlying distribution.

[10] This is akin to assuming that banks draw an efficiency parameter z from a Frechet distribution of the form $F(z) = 1 - e^{-Tz^{-\theta}}$ with support over $(0, 1]$, where unit cost is given by $c\bar{r} = \frac{\bar{r}}{z}$. The particular Weibull function used in this paper implies that the marginal cost of loaning one dollar is greater than or equal to the gross deposit rate ($c > 1$). Because it is not obvious how to formulate a Frechet distribution bounded from above (as opposed to a simply truncated Frechet, which would be simply $F(z)/1 - F(1)$), but it is straightforward to formulate a Weibull distribution bounded from below, we start discussion of the bank's problem with the Weibull-distributed cost function.

That is,[11]

$$\begin{aligned} g_{n,n-1}(c_1,c_2) &= \frac{[H(c_2)]^{(n-1)-1}}{(n-2)!}h(c_2)f(c_1) \\ &= \left(\frac{[-\ln(F(c_2))]^{n-2}}{(n-2)!}\right)\left(-\frac{d}{dc_2}\left[-\ln(F(c_2))\right]\right)\frac{d}{dc_1}\left[F(c_1)\right] \\ &= \left(\frac{\left[-\ln(1-e^{-T(c_2-1)^\theta})\right]^{n-2}}{(n-2)!}\right)* \\ &\quad \frac{d}{dc_2}\left\{-\ln\left(1-e^{-T(c_2-1)^\theta}\right)\right\}T\theta\left(c_1-1\right)^{\theta-1}e^{-T(c_1-1)^\theta} \\ &= \left(\frac{e^{-\left[T(c_2-1)^\theta\right](n-1)}}{(n-2)!}\right)\frac{1}{1-e^{-T(c_2-1)^\theta}}* \\ &\quad (T\theta)^2\left(c_2-1\right)^{\theta-1}\left(c_1-1\right)^{\theta-1}e^{-T(c_1-1)^\theta}, \end{aligned}$$

where $H(c_2) = -\ln(F(c_2))$ and $h(c_2)$ is $\frac{dH(c_2)}{dc_2}$. The last equality follows from using the approximation $\ln x \approx x-1$ on the expression $\ln(1-e^{-T(c_2-1)^\theta})$.

It is useful to note that this joint density yields a marginal density for c_2 that is influenced by the number of rivals in the niche n:

$$g_2(c_2) = \int_1^\infty g(c_1,c_2)dc_1 = \left(\frac{e^{-\left[T(c_2-1)^\theta\right](n-1)}}{(n-2)!}\right)\frac{T\theta\left(c_2-1\right)^{\theta-1}}{1-e^{-T(c_2-1)^\theta}}.$$

Eaton and Kortum 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

[11] Savvy readers may note that this density is a bit different than the joint density derived by Eaton and Kortum (2007) and BEJK, who present a joint density of the form $g(c_1,c_2) = h(c_1)f(c_2)$. This is because they start by deriving the joint density of the upper record values for firm efficiency, then substitute for efficiency using the unit cost function. The difference arises because we start by deriving the lower record values of the cost function, rather than starting with efficiency levels and substituting and because we do not integrate over n (see below). The results that follow are not qualitatively affected by this difference because we do simulations using only $F(c)$. N.B.: Line 3 in the derivation below uses the approximation $e^x \approx 1+x$.

potential entrants in each segment of the lending market. Thus, we use the 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 $M_t(j) = (r_t(j)/\bar{r}_t)$. Since the lowest-cost bank wants to charge the highest markup possible subject to the cost of its next most efficient competitor in the niche and the elasticity of firms' demand for loans, the markup it charges is given by

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

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

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

If there were no lower bound for the cost, 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 1. The simulation is done by first taking 100 draws (i.e.

$n \equiv 100$) from a transform of $F(c)$ based on a uniformly distributed variable y. To get the transform, one can simply invert the cumulative distribution function to solve for c as a function of y,

$$\begin{aligned} y &= 1 - e^{-T(c-1)^{\theta}} \\ 1-y &= e^{-T(c-1)^{\theta}} \\ c &= \left[-\frac{1}{T}\log(1-y)\right]^{\frac{1}{\theta}} + 1. \end{aligned}$$

We then take $C_1(j) = c_1$, the lowest c drawn from this sample of 100 and $C_2(j) = c_2$, the second lowest draw.[12] Then the markup is computed as $\min\{\frac{C_2(j)}{C_1(j)}, \bar{m}\}$. The process is repeated to calculate the markup for 100 niches. Finally, the entire distribution is simulated1000 times. The x-axis of Figure 1 is the markup value, and the y axis the probability that any of the markups (from the 1000 samples of 100 niches with 100 rival banks each) is within a particular interval (of width 0.002) of markup values.

It is important to note 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 2 shows the distribution of markups if the level of contestability 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 doubles to nearly 12 percent. Due to its impact on the distribution of markups, increasing contestibility (a drop in n) on average reduces the aggregate interest rate, as does an improvement in available technology– an increase in T. Using this result from simulated interest rates, we show below that an increased contestibility and technological growth in the banking sector are welfare improving under autarky. We also show in later sections that loan liberalization has a similar effect to increasing contestibility, whereas allowing FDI in the banking sector can induce an effect more like that of technological growth even if both countries have the same underlying cost distributions because only the best foreign banks enter and the matching in the merger market preserves much of the market power enjoyed by local banks before liberalization.

[12] We choose a technology parameter $T = 5$ and $\theta = \sigma = 6$, the last parameter reflecting a 20% markup on interest rates.

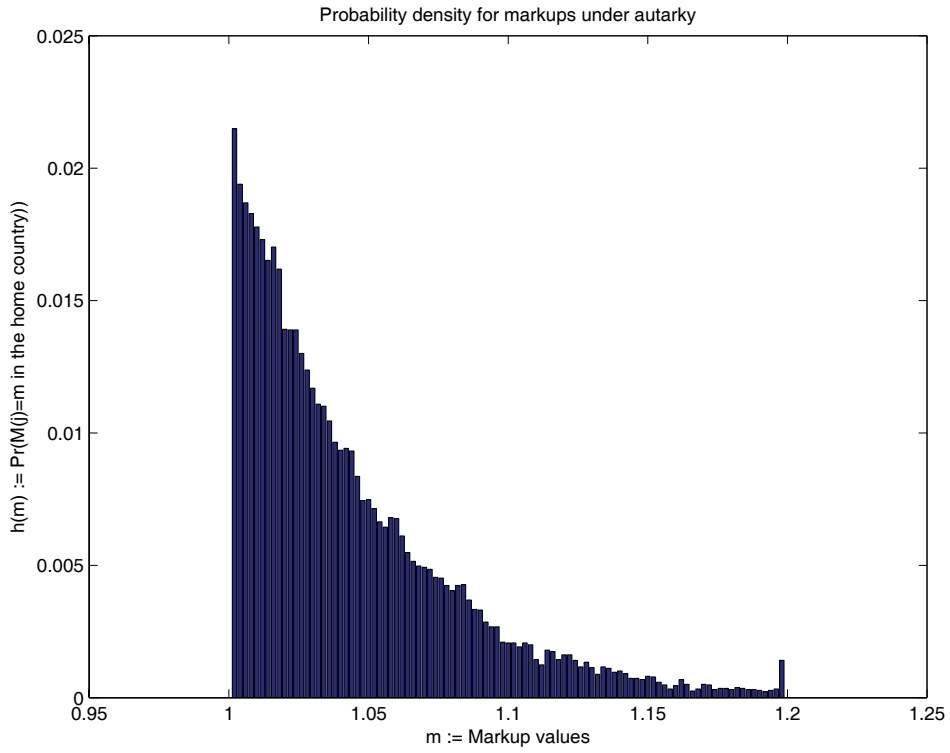

Figure 1: Probability density for markups in the Home country under autarky, with n=100 in each niche

4 Consumers and Equilibrium

There is a continuum of consumers in the interval $[0, 1]$. The utility function of the representative consumer is the following:

$$u(q_t, h_t^s) = \frac{q_t^{1-\rho}}{1-\rho} - \frac{h_t^{1+\frac{1}{\gamma}}}{1+\frac{1}{\gamma}},$$

where q_t is consumption 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

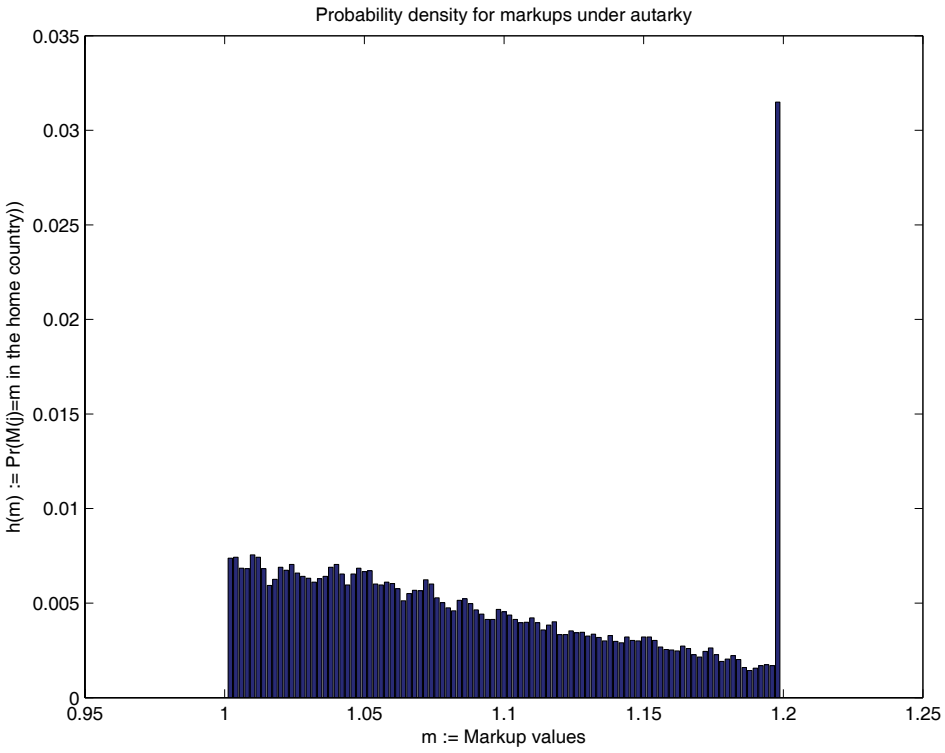

Figure 2: Probability density for markups in the Home country under autarky, with n=2 in each niche (low contestability)

maximizes utility by choosing consumption, labor and deposits

$$\max_{q_t, h_t^s, d_{t+1}^s} \sum_{t=0}^{\infty} \beta^t u\left[q_t, h_t\right]$$

subject to the following budget constraint

$$d_{t+1}^s + q_t \leq (1 + \bar{r}_t) d_t^s + w_t h_t^s + \pi_t^F + \pi_t^B,$$

where d_t are one-period deposits at the banks, q_t is consumption, w_t are real wages, $\bar{r}_t$ is the market interest rate on deposits, π_t^F and π_t^B are profits from firms and banks, respectively, which consumers receive as dividends at the end of the period. Due to the perfectly competitive goods market, in steady state, firm profits equal zero. Consumers are

indifferent with regard to the banks where they deposit their funds, so they simply divide total deposits, d_t. The implication is that the amount of deposits held in any particular bank, $d_t(j)$, differs across banks only due to differences in banks' demand for deposits to make loans. These differences arise entirely due to the particular cost parameters randomly drawn in period 0 by the first- and second- most efficient banks in each niche j.

The next step is to define equilibrium in this economy 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 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 B); 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. Closing the model requires one to specify the distribution of costs for banks, which allows one to calculate the distribution for markups and r. Given the duopolistic setup, the interest rate charged by any given bank will depend on the second most efficient competition in its niche. Due to the nonseparability issue described above, no closed-form solution for the distribution of markups or interest rates exists and we rely on simulations of the model to analyze the evolution of the spreads: one can only solve numerically for r due to the lowerbound on the cost parameter, as demonstrated in Section 3.2. All other aggregate variables depend on r, so we also obtain numerical solutions for them.

Thus, we rely on simulations of the model to analyze the distribution of the spreads and all associated macro outcomes. Below, we compare the steady-state distributions of bank-specific markups, costs and interest rates, as well as the level of the aggregate interest rate, consumption, employment, and supply of credit under autarky with the levels under loan liberalization and FDI in the financial sector using numerical solutions. Given the equations governing equilibrium, defining a steady state under autarky is straightforward. For simplicity, we assume in the steady state that $A = 1$. The productivity process in this model is used only to create a motive for saving. It is stationary and displays no growth. In the steady state, the deposit rate is given by

$$\bar{r}_t \equiv \bar{r} = \frac{1-\beta}{\beta}$$

Consumers		
Labor supply	$q^{\rho} = wh^{-\frac{1}{\gamma}}$	(1)
Euler condition	$\bar{r} = \frac{1-\beta}{\beta}$	(2)
Budget constraint	$q = wh + \pi^F + \pi^B + d\bar{r}$	(3)
Firms		
Technology	$y = Ah^{1-\alpha}$	(4)
Optimal labor demand	$h = \left(\frac{(1-\alpha)A}{(1+r)w}\right)^{\frac{1}{\alpha}}$	(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	$r = \left[\frac{1}{J}\sum_1^J r(j)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$	(12)

Table 1: Model specification under autarky

4.1 Welfare effects under autarky

Although the aggregate interest rate can not be derived analytically, it *can* be computed directly from the markups among the simulated banks, separately from all variables other than the deposit rate. Restricting bank competition to lending rates, rather than deposit rates, provides a very simple reduced form for the deposit rate in steady state, $\frac{1-\beta}{\beta}$. With this simplifying assumption, it is straightforward to numerically compute r using the steady-state forms of Equations (7) and (12) without knowing the reduced forms for any other variables in the model. Thus, solving for all variables in terms of the aggregate interest rate allows a discussion of welfare effects given different states of technology and contestability in the banking sector–a useful context for the discussion of financial openness below.

Using the steady state forms of Equations (1), (4), (5), and (11), we see that the wage is an inverse function of the interest rate,[13]

$$w = \left(\frac{1-\alpha}{r}\right)^{\frac{\frac{1}{\gamma}+\rho(1-\alpha)}{\alpha+\frac{1}{\gamma}+\rho(1-\alpha)}}.$$

Substituting this into the labor demand equation, it is clear that employment is also inversely related to the interest rate,

$$h = \left(\frac{1-\alpha}{r}\right)^{\frac{1}{\alpha+\frac{1}{\gamma}+\rho(1-\alpha)}},$$

as are output and consumption,

$$q = y = \left[\frac{(1-\alpha)}{r}\right]^{\frac{1-\alpha}{\alpha+\frac{1}{\gamma}+\rho(1-\alpha)}}$$

Given the standard assumption that $0 < \beta \leq 1$, a reduction in the interest rate increases consumer welfare.[14]

[13] See Appendix D.1 for derivation.

[14] See Appendix D.2 for proof.

5 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–which here are the spread between the rates that banks charge borrowers and the rate that they pay depositors– retains a roughly Pareto-like shape. Using data from the simulation technique above repeated for two identical countries, Figure 3 shows that under this type of loan liberalization, the distribution of markups is quite similar to that under autarky in Figure 1. We will

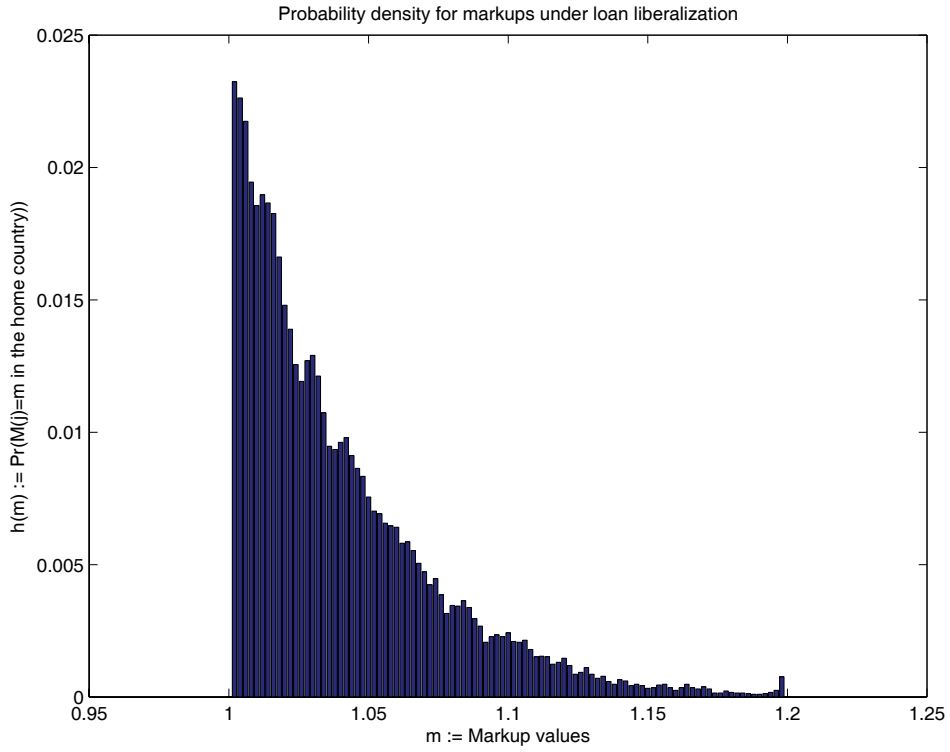

Figure 3: Distribution of markups in the Home country under loan liberalization

show below that in this benchmark setup with no geographic frictions, the distribution of markups (the lending-to-deposit rate spread) 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. Recall that the parameter J represents the number of market niches, which in each iteration is set equal to 100. 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, $\left[\frac{1}{J}\sum_{j=1}^{J} m(j)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$. In the simulation exercise here, both measures of the average markup fall under loan liberalization for 87 percent of the trials. 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 contestibility. 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 contestibility (n) or a lower technology parameter (the scale parameter, T), it will naturally experience higher rates of foreign participation.

Buch (2001) finds that the foreign asset holdings of banks fall with geographic distance. The loan liberalization in Figure 3 presumes that there is no extra cost involved in supplying loans to overseas firms. Suppose that the unit cost to foreign banks supplying loans to firms in the home country is not $C_1(j)$, but $\delta C_1(j)$, with $\delta > 1$. This distance factor could represent all sorts of factors, from added costs involved in locating and advertising to 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. The small friction used here ($\delta = 1.05$) causes very little change in the shape of the probability density in Figure 3. Further, Figure 4 shows that the cdf under liberalization still does not cross the cdf under autarky. Indeed, as the distance factor increases, 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.

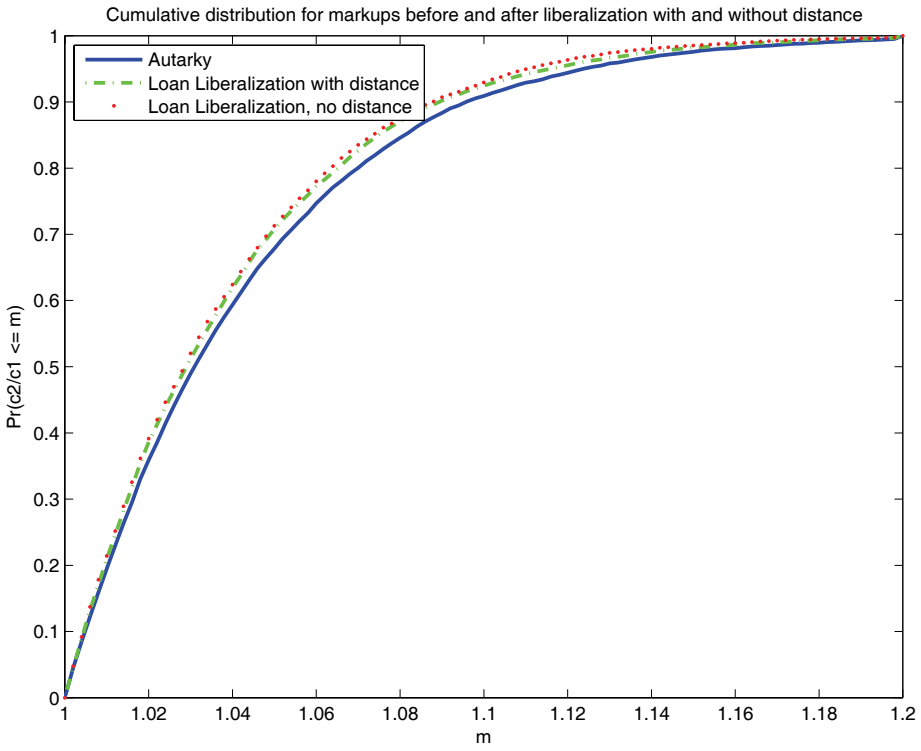

Figure 4: Loan liberalization and geographic frictions

5.1 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 has been 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 (2001) reports evidence suggesting that parent banks are more efficient than the banks they acquire. If the parent bank can fully apply its management and technology after the merger, so that the target bank's lesser techniques do not influence costs at all, then the resulting distribution of markups is exactly the same as under the loan liberalization scenario (without any cross-border takeovers) discussed above. However, suppose that the foreign bank in niche j 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

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

with $\delta_{fdi} \geq 1$.[15] 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.[16]

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. The parent bank buys out the target by paying a dividend equal to the maximum of either (1) 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 (2) whatever profits the target would have made had it not been bought out at all but prices its loans according to the threat that its next-best domestic competitor might be bought out. The pricing of the takeover is specified in detail in Appendix A. 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, a merged bank is most profitable when it employs the most efficient technology available.

What is the impact of the mergers on markups? Given that the most efficient foreign bank buys out the most efficient home bank, if the second-lowest cost foreign bank in niche j wanted to enter the home market, it would then have to purchase the second-lowest cost

[15]The parameter δ can be thought of as a distance factor. If it equals its lowerbound of 1, then the foreign bank can seemlessly transfer its own techniques to the target bank. If δ equals zero, then it is impossible for an acquiror to transfer any of its methods to the target. The experiments below yield the same qualitative results if we instead use an arithmetic average, $C_1^M(j) = 0.5\left[C_1^*(j) + C_1(j)\right]$.

[16]In a more elaborate framework with asymmetric information, the acquired bank might have important information about the creditworthiness of local borrowers.

home bank in niche j, giving it a cost of

$$C_2^M(j) = \left(C_2^*(j)\right)^{\frac{1}{\delta_{fdi}}} \left(C_2(j)\right)^{1-\frac{1}{\delta_{fdi}}}.$$

This matching process generates a distribution of markups under direct investment liberalization that may or may not first-order stochastically dominate the distribution of the markup under either autarky or loan liberalization. For the case where $C_1^*(j) < C_1(j)$ and $C_2^*(j) < C_2(j)$, one might expect an increase in the markup (a widening of the spread). However, under special circumstances the markup may fall in some niches. Suppose that $C_1(j) < C_1^*(j) < C_2(j)$. Then, although the low-cost home bank will not choose to merge, the threat of entry by the low-cost foreign competitor merging with the second-lowest cost home competitor will compel the low-cost home bank to lower its markup. Thus, direct investment liberalization can increase or decrease the average markup–the result is ambiguous, depending entirely on parameterization and the set of productivity draws in the two countries.[17]

To show this, we use the same data from the simulation above. FDI liberalization–opening the home country banking sector to FDI while prohibiting any direct borrowing from foreign banks located abroad–results in a reduced average markup in only 16 percent of cases for the arithmetic average and 34 percent of cases for the market-share-weighted average. That is to say, the distribution of markups under FDI liberalization is not stochastically dominated by the distribution under autarky (Figure 5). The CDF for markups under FDI liberalization crosses the CDF under autarky, meaning FDI can increase markups in some niches and reduce them in others, with no certainty as to the impact on the average markup.

In contrast, the CDF for loan liberalization will not generally fall below 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, so that

[17]It is only certain that 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, even though only some of them actually do so, while others may have a markup that is reduced or unchanged from its pre-liberalization level.

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 reduce or have no effect the markup. Only one of the three conditions is always necessary to generate an increased markup in niche j following FDI liberalization: $C_1^*(j) < C_1(j)$. The second condition, $C_2^*(j) < C_2(j)$, is never necessary and the third, $\frac{C_2^*(j)}{C_1^*(j)} > \frac{C_2(j)}{C_1(j)}$, is only necessary if $C_2^*(j) < C_2(j)$. The matching process involved in foreign takeovers thus makes an increased spread much more likely than loan liberalization.

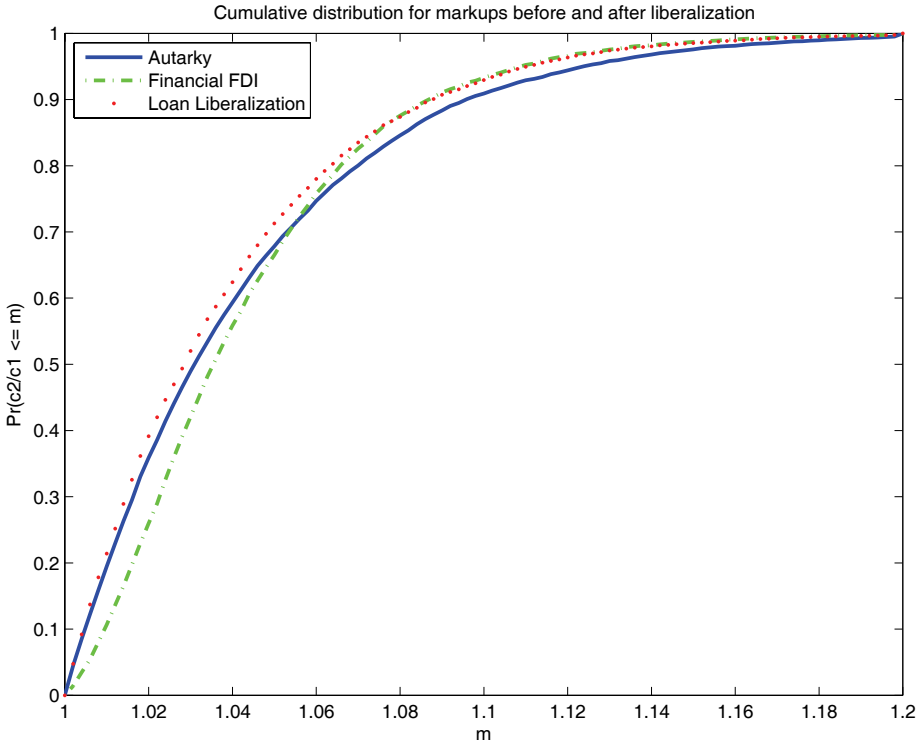

Figure 5: Loan liberalization vs. FDI in the financial sector

In the majority of cases, the duopolistic competition combined with imperfect transferability of bank efficiency results in an increased average markup as compared with autarky. Nonetheless, the average interest rate charged falls in all 1000 cases: the mergers increase banking sector efficiency to a degree that supercedes the impact of increased market power arising within a few sectors. Frictions impeding the full transfer of parent bank efficiency could very plausibly be higher in developing than industrialized countries and diminish

with age. Thus, our model offers one explanation for why Claessens, Demirgüç-Kunt, and Huizinga (2001) find that markups are higher after foreign entry in developing countries, but not in industrialized ones. It also explains why Martinez Peria and Mody (2004) find that the increased markup after foreign takeovers disappears when conditioning on the age of the merger. Increasing age may dissipate the technological transfer frictions, bringing the banks closer to the loan liberalization result.

5.2 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 interest rates under autarky stochastically dominate the distributions for either loan or FDI liberalization (Figures 6 and 7). Thus, we can say unequivocally that either type of liberalization increases average bank efficiency and reduces the average lending rate. Numerical computations confirm that this is true in 100 percent of the simulated cases.

Theoretically, we can show why. Although the markup (net interest margin) 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

$$\begin{aligned} r^M(j) &= \min\{\frac{\min\{C_2(j), C_2^M(j)\}}{C_1^M(j)} * C_1^M(j)\bar{r}, \bar{m}C_1^M(j)\} \\ &= \min\{\min\{C_2(j), C_2^M(j)\}\bar{r}, \bar{m}C_1^M(j)\}. \end{aligned}$$

The cost parameter of the second-best supplier of credit to niche j in the domestic market will either stay the same or fall after FDI liberalization, meaning the interest rate in niche j will never increase due to a takeover or the threat of a takeover. With a constant deposit rate, $\bar{r}$, that means that the actual spread ($r(j) - \bar{r}$, before the merger)can decrease even while the markup increases or stays the same due to the increased efficiency of the merged bank and possibly its potential rivals.

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 could observe what 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

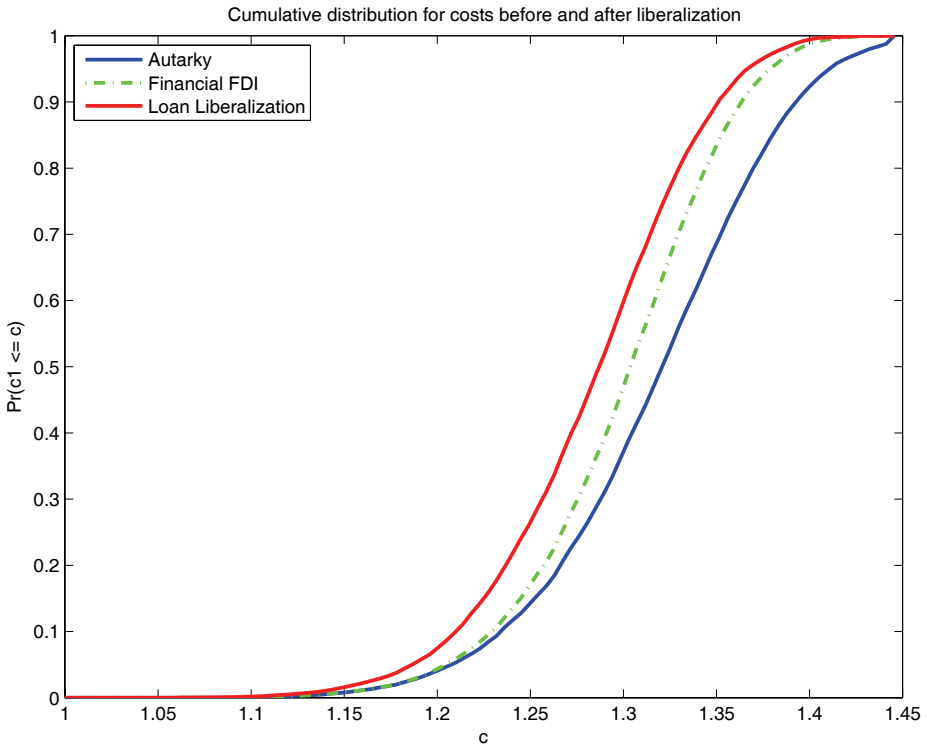

Figure 6: Loan liberalization and FDI in the financial sector reduce average costs

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 rightward shift in the distribution of cost parameters for surviving indigenous banks over and above the selection effect involved in liberalization, an empirically testable implication we leave for future research.

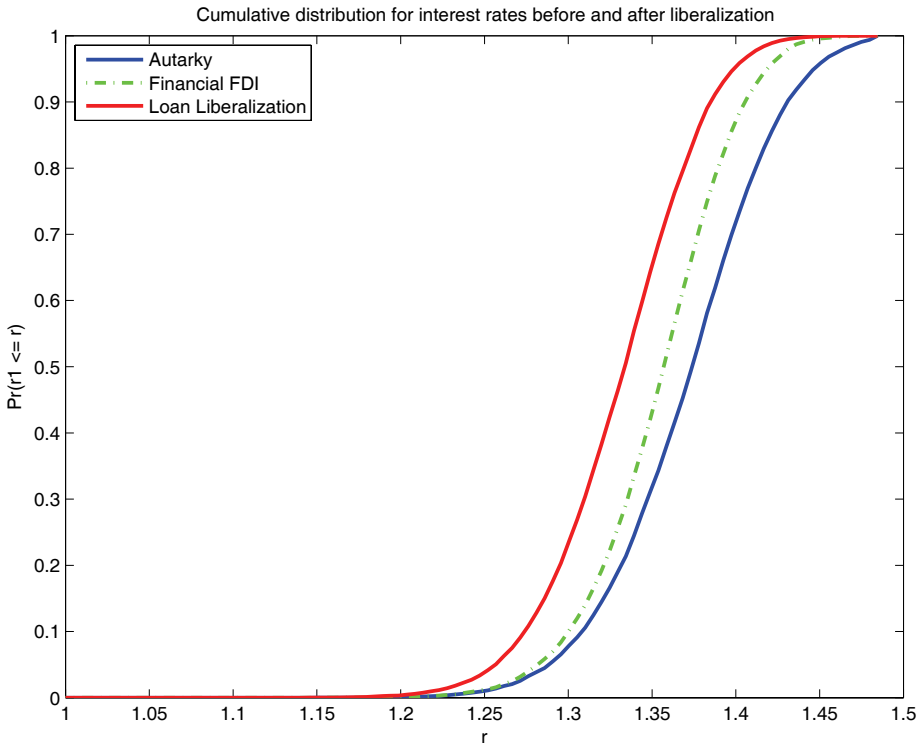

Figure 7: Loan liberalization and FDI in the financial sector reduce the average interest rate

5.3 Technology vs. contestibility

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 contestibility (n_f). However, entry by foreign banks with superior technology through M&As has little effect on the size of the "spike" at the far end of the markup distribution when the country opening up has high levels of contestability, while the new entrants do shift the markup distribution to the right, as in Figure 8 (compared to Figure 1). Recall that, as in Figure 2, countries with low contestability have a flat pdf with a large "spike" at the upper end of the probability density for markups. When foreign banks enter a market with low contestability, the spike falls dramatically and the distribution becomes more hump-shaped (Figure 9). Fewer banks now charge the maximum markup. Measuring changes in the relative flatness (via

second-order stochastic dominance) and size of the spike at the upper end of the markup distribution before and after liberalization, which can actually be observed in distributions of net interest margins constructed from Bankscope data, could help disentangle whether it is technological spillovers or increased competition that generates the reduced profitability among domestic banks following foreign entry noted in the empirical literature. We leave this decomposition for future research.

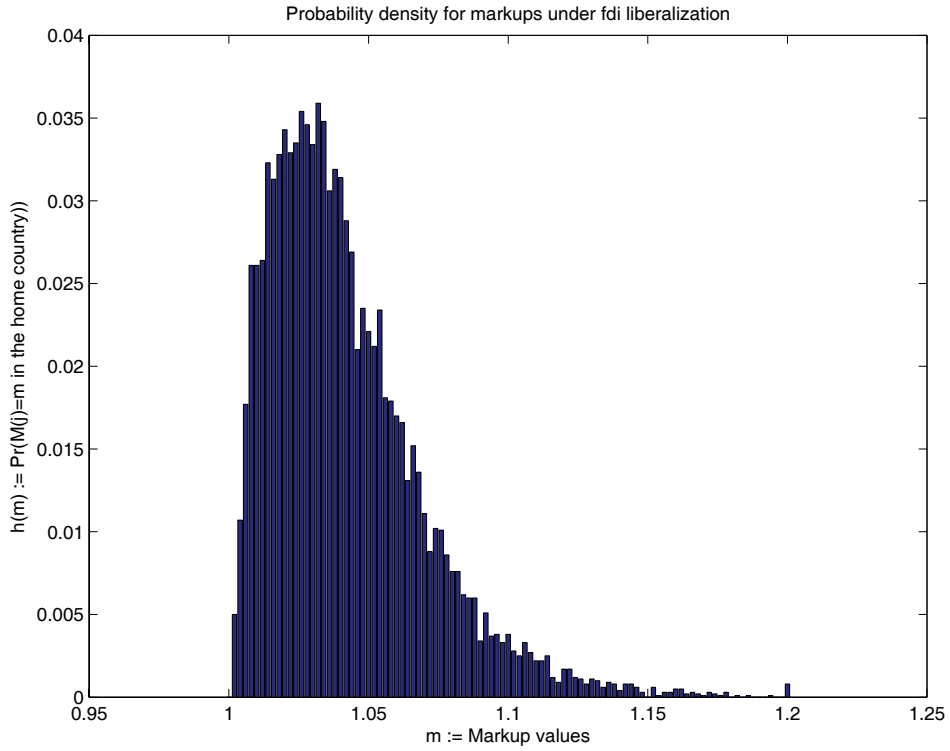

Figure 8: Foreign country has superior technology ($T_f > T_h$) and both countries have high contestability ($n_f = n_h = 100$).

5.4 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

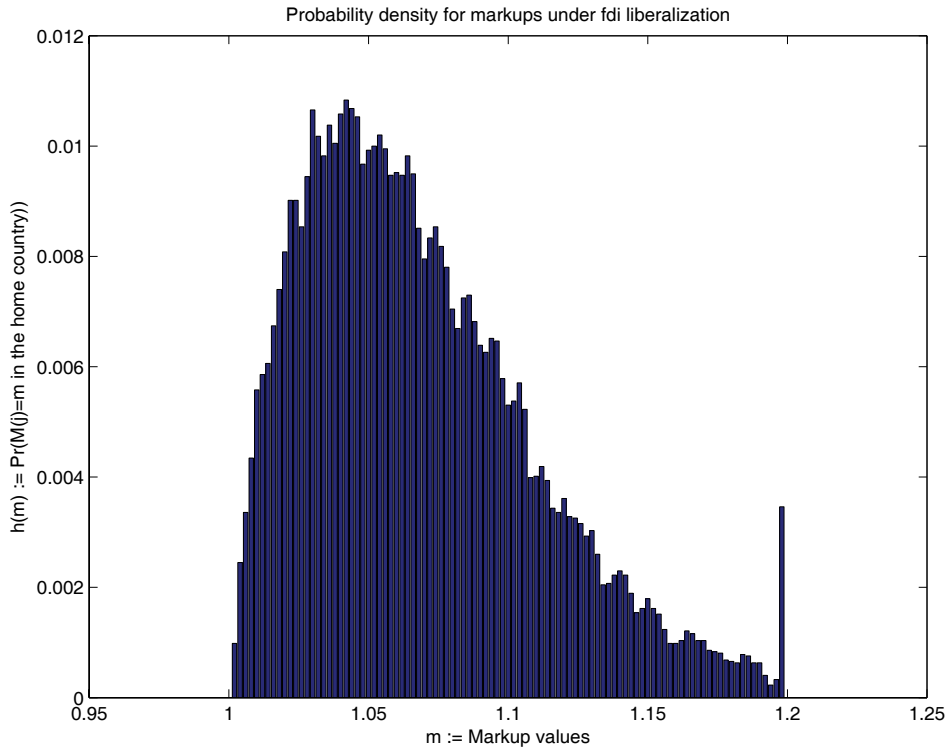

Figure 9: Host and foreign country have equal technology ($T_f = T_h$), but host country has low contestability ($n_f = 100, n_h = 2$)

clearing condition (11) into two new equations,

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

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. 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 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 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.[18]

The overall effect of liberalization is to reduce the average interest rate, which increases consumption and utility. Computations using data from the simulations above[19] show an increase in utility of just over 50 percent moving from autarky to liberalization. Whether FDI or loan liberalization improves welfare more depends on the relative size of δ and δ_{fdi}. Interestingly, liberalization increases the welfare in both countries even when their respective T or n parameters are not identical. However, a country with a more efficient banking sector will have a persistent trade deficit unless the distance parameters are equal to zero. Under FDI, for instance, a country with lower overall available technology (lower T) will run a persistent trade surplus, paid for by the net profits of resident foreign banks. 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.

6 Empirical application

We use the model to analyze data from a number of developing countries which experienced an influx of foreign direct investment into their financial sector after 1999. We do this using measures of net interest rate margins and two measures of costs for individual banks

[18] Code available upon request.

[19] We report results for calibration with standard values $\alpha = 0.7$, $\rho = 1$ (logarithmic utility), and $\gamma = 1$ (unit elasticity of labor supply), and choose $\delta_{loan} = 0$ and $\delta_{fdi} = .5$. Results are robust for $\alpha \geq .2$, $1 \leq \rho < 6$, and $\gamma \geq 0.01$.

reporting consolidated balance sheets in 2000 and 2006 from the Bankscope databases. 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. That is, few authors have had access to actual data on lending and deposit rates and instead rely on measures of the net interest margin, which we do here. However, using the model we can still map the distribution of markups into the distribution of net interest margins to analyze the effect of foreign direct investment in the financial sector. In particular, it is simple show that the log of the markup is approximately equal to the net interest margin. The log markup is given by

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

The "wide" net interest margin,[20] equal to total interest revenues minus total interest expenditures divided by assets equals

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

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, this study focuses on whether the distributions shift in the way the model would predict following cross-border merger waves in the financial sector. We find that the behavior of observed distributions in countries experiencing surges in cross-border mergers in the financial sector is quite similar to the simulated distributions. Since the analysis focuses on country-specific distributions for the variables of interest, rather than the behavior of individual banks, the sample is narrowed 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.

[20] 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.

6.1 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),[21] 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 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

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

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.[22] Table A.1 contains the complete results for the break testing.[23] Table 2 lists countries experiencing surges. 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." Figure 10 depicts cross-border financial M&As in China as an illustration of a surge.

6.2 The distribution of net interest margins and costs

Table 3 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. All countries saw both net interest margins and costs drop by more than 10% between 2000 and 2006. However, in countries for which there is some evidence of a surge during the sample period, the drop in average costs was between 40 and 180 percent bigger than the drop in net interest margins. This is in contrast to countries exhibiting no evidence of an in-sample surge, where the net interest margin and costs dropped at about the same rate.

The distributions of these variables change considerably for some countries between 2000 and 2006. As an opportunistic visual example, we note the obvious upswing in foreign takeovers beginning in 2000 in China, shown in Figure 10. Our break test identifies the surge as beginning in 2003. Figure 11 shows the evolution of markups during that period. The distribution for markups transforms from a rather flat form to one notably more hump-shaped, similar to the case of increasing contestibility discussed in Section 3.2. A look at the cumulative distribution functions for markups and costs in 2000 and 2006 shows that

[22] 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.

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

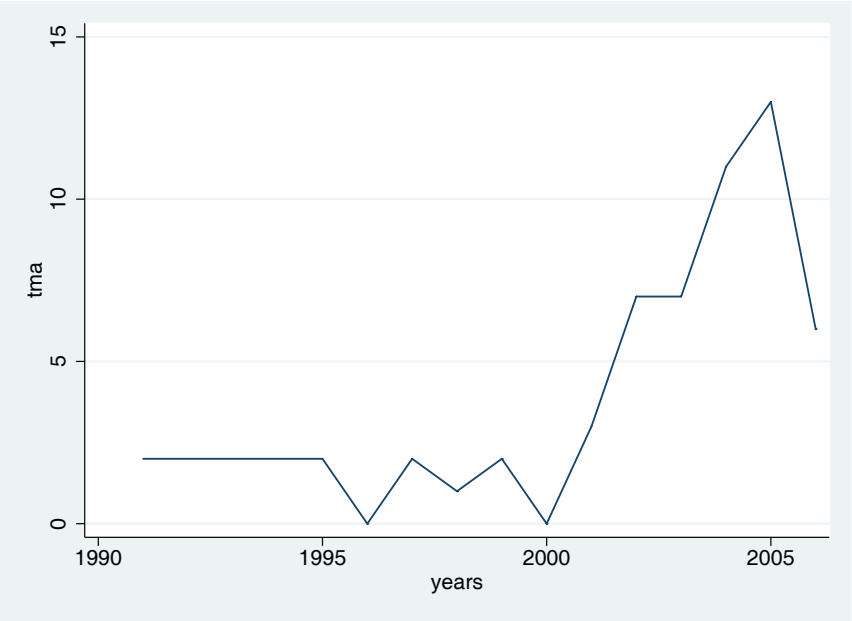

Figure 10: Cross-border M&As in China's Financial Sector

the CDF for our markup proxy rotates counterclockwise in 2006, crossing the 2000 CDF just as for the simulated data in Figure 5. The CDF for average overhead costs in Figure 12 has shifted almost horizontally left in 2006, just as we see for post-liberalization simulated data in Figure 6. The pre-FDI-surge distribution in 2000 clearly stochastically dominates that for 2006. Not all CDFs for markups in surge countries rotate counterclockwise–most shift left. All CDFs for cost distributions in surge countries tend to shift left, except for one, discussed below.

We formalize the analysis of distributional shifts between 2000 and 2006 using the test for first-order stochastic dominance discussed by Barrett and Donald (2003).[24] The tests are based on a null hypothesis of "reject stochastic dominance." Thus, following their methodology, we test for stochastic dominance of a particular variables distribution in a particular country in 2000 over the corresponding distribution for 2006. If we fail to reject stochastic dominance of the 2000 over the 2006 distribution but reject stochastic dominance of the 2006 over the 2000 distribution, then we consider the 2000 distribution to

[24]Please see the Appendix (to be completed) for country-specific test results for first-, second- and third-order dominance.

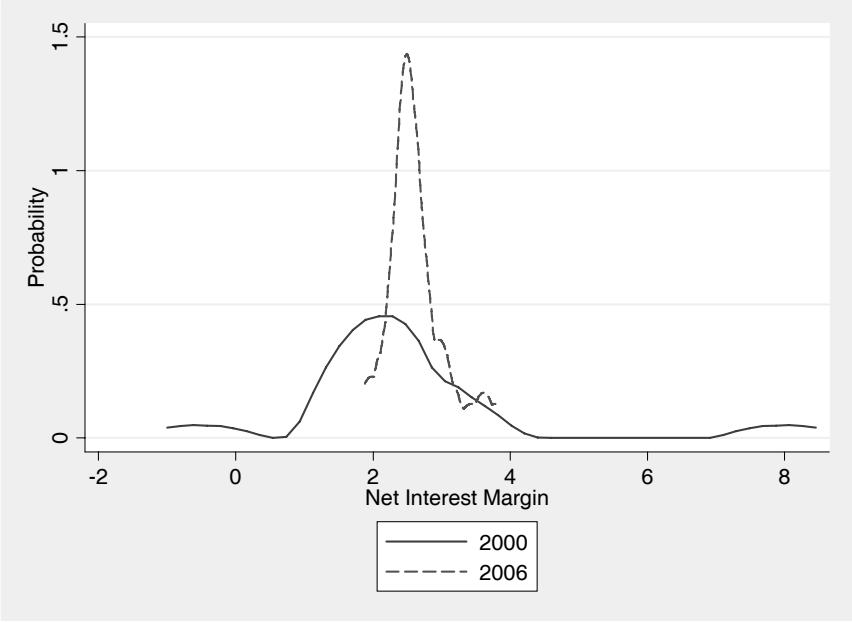

Figure 11: Probability Density Functions for Net Interest Margins in China in 2000 and 2006

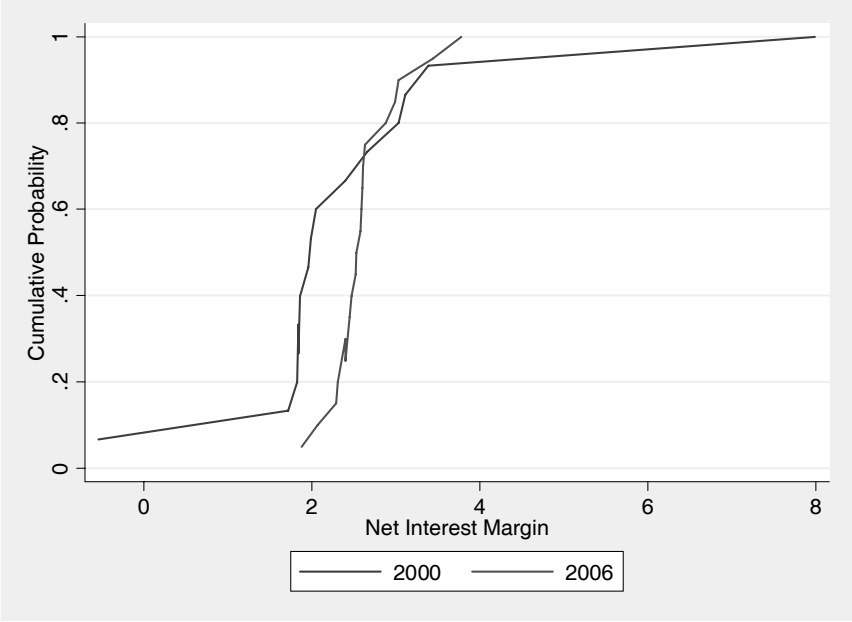

Figure 12: Cumulative Distribution Functions for Net Interest Margins in China, 2000 and 2006

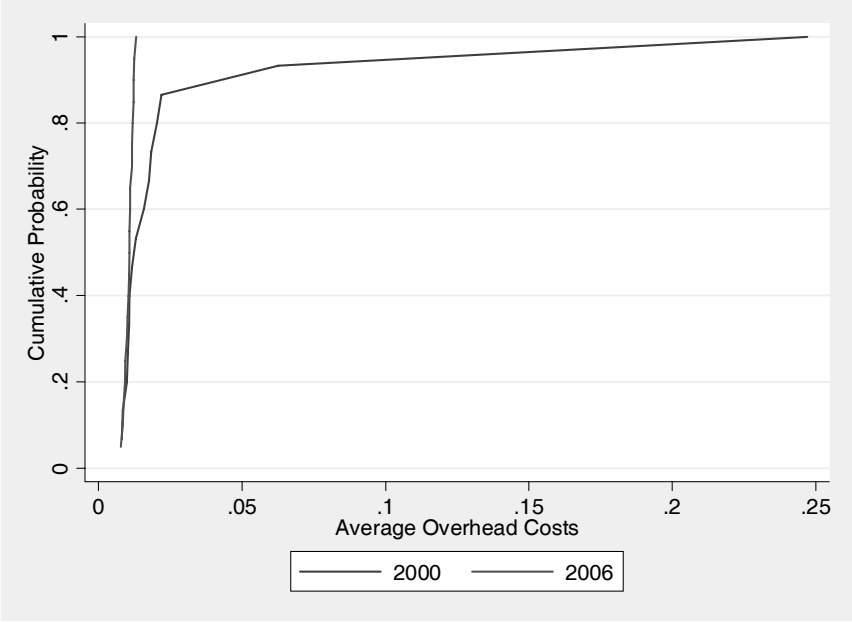

Figure 13: Cumulative Distribution Functions for Average Overhead Costs in China, 2000 and 2006

be stochastically dominant. Table 4 contains a tabulation of the outcomes for net interest margin using the sample of all 12 countries identified as having a surge in 2000 or afterward by the BIC minimization described above. A majority (7 of 12) surge countries experienced a significant change in the distribution of net interest margins, while the majority of non-surge countries (47 of 68) did not. Surge countries were about 17 percentage points more likely to have the 2000 distribution of net interest margins be stochastically dominant (a reduction in the average margin) and 10 percentage points more likely to have 2006 stochastically dominate (an increase in the average margin). Note that these results describe the overall distribution of net interest margins. For any given bank, the spread could have increased or decreased. The results are similar if we also include the four countries with surges beginning in 1999 (Denmark, Japan, Poland, and Singapore). The results are even stronger if we restrict surge countries to be only the 7 identified by all break tests as having a positive break (an increasing mean number of M&As) during the sample.

Table 5 contains the tabulation for average overhead costs. In this case, the 2000 distribution of overhead costs stochastically dominates for exactly half (6 of 12) of surge countries, while this is the case for only a quarter of non-surge countries (17 of 68). It is remarkable that for almost three-quarters of non-surge countries, there is no statistically significant shift in the distribution of average overhead costs. For one surge country, the 2006 distribution is stochastically dominant, revealing a general increase in average overhead costs that conflicts with the predictions of the theory. This country is Indonesia. A similar but somewhat weaker pattern emerges from the analysis of distributions of average personnel costs in Table 6. Here again, the 2006 distribution of costs in Indonesia stochastically dominates that from 2000, conflicting with the theory above. Nonetheless, consistent with the theory, surge countries are 16 percentage points more likely than non-surge countries to have an overall drop in average personnel costs demonstrated by the stochastic dominance of the distribution from 2000. Again, results are strongest if we restrict the surge sample to the 7 countries most likely to have a break. Results are similar, but weaker for overhead costs if the countries with surges beginning in 1999 are added to the baseline 12, but the results for personnel costs when adding these early surgers no longer hold.

7 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 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 reduce the cost of borrowing overall. Differences in the efficiency or competitive environment across countries can lead to persistent trade imbalances, while still generating large welfare gains for both countries when allowing foreign participation in the form of loans or FDI. It is the first model to explain how widening measures of interest rate spreads under liberalization can be compatible with lower lending costs, increased efficiency, and lower actual spreads. It further demonstrates that increases in net interest margins are less likely to occur when opening to foreign loans as opposed to FDI in the banking sector. We provide empirical support for the theory's predictions of distributional shifts in interest rate spreads and average costs after the banking sector is opened to FDI using bank-level data.

There are several caveats involved in the use of this dataset and methodology. First, it is not possible to identify fees associated with loans, which may increase the effective interest rate that a borrower pays and such fees are entirely omitted from the model. Fees are relevant because an increase in the competitiveness of the market or the introduction of sophisticated foreign credit instruments may lead banks to hide the full costs of a loan by attaching fees to a contract with a low lending rate. In this case, we would still expect local banks taken over by foreign financial institutions to charge higher markups after the merger whenever possible, leaving the theoretical prediction regarding markups unchanged. Second, there is an endogeneity problem inherent in trying to identify a causal relationship between cross-border mergers and increasing measures of spreads, which is the stylized fact underlying this model. Do spreads 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 spreads to increase? The model here does not resolve this problem, which permeates the entire literature on spreads and foreign takeovers, but simply offers an explanation whereby one might observe increased measures of spreads following foreign

entry but still see improvements in lending rates and welfare. It also 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. Third, 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 seemlessly transfer their own technology (which presumably would include superior databases on the creditworthiness of borrowers in their own country)– 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 due to foreign and domestic merger activity, which we do not explore here. The Ricardian framework in the model above leaves the number of credit niches fixed (though not necessarily the number of banks, 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 with economies of scope, while outside the scope of this paper, 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.

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A The Merger Market

Suppose for a moment that $C_1^*(j) < C_2^*(j) < C_1(j)$. The second-lowest-cost foreign bank will bid for a target home bank, increasing its bid until it offers all potential profits from the takeover. If successful, the second-lowest-cost foreign bank could charge a markup of

$$m_2^M(j) = \min \left\{ \frac{(C_1^*(j))^{\frac{1}{\delta}} (C_2(j))^{1-\frac{1}{\delta}}}{(C_2^*(j))^{\frac{1}{\delta}} (C_1(j))^{1-\frac{1}{\delta}}}, \bar{m} \right\},$$

assuming that the lowest-cost foreign bank would threaten to enter by buying out the next-best home bank if it did not purchase the best one. The hypothetical merged bank

would then charge the interest rate

$$r_2^M(j) = \min\left\{\frac{(C_1^*(j))^{\frac{1}{\delta}}(C_2(j))^{1-\frac{1}{\delta}}}{(C_2^*(j))^{\frac{1}{\delta}}(C_1(j))^{1-\frac{1}{\delta}}}, \bar{m}\right\}(C_2^*(j))^{\frac{1}{\delta}}(C_1(j))^{1-\frac{1}{\delta}}\bar{r}$$

The rivalry forces the lowest-cost foreign bank to offer at least the amount of profits that could be earned under the second-best merger scenario to secure the takeover in the merger market. 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

$$V(j) = wh\max\left\{\begin{array}{c} r_2^M(j)\left(\frac{r_2^M(j)}{r_{fdi}}\right)^{-\sigma} - \bar{r}(C_2^*(j))^{\frac{1}{\delta}}(C_1(j))^{1-\frac{1}{\delta}}\left(\frac{r_2^M(j)}{r_{fdi}}\right)^{-\sigma}, \\ r^A(j)\left(\frac{r^A(j)}{r_{fdi}}\right)^{-\sigma} - \bar{r}C_1(j)\left(\frac{r^A(j)}{r_{fdi}}\right)^{-\sigma}, 0 \end{array}\right\},$$

where $r^A(j) = \min\left\{\frac{\min\left\{(C_1^*(j))^{\frac{1}{\delta}}(C_2(j))^{1-\frac{1}{\delta}}, C_2(j)\right\}}{C_1(j)}, \bar{m}\right\}C_1(j)\bar{r}$ is the interest rate that the lowest cost home bank would charge in the absence of any takeover. The merger market participants calculate r_{fdi} as the aggregate interest rate that would emerge if all possible takeovers occurred (anywhere where $C_1^*(j) < C_1(j)$).

B Consumer First-Order Conditions

The FOC from the maximization are

$$\frac{\partial u(q_t, h_t^s)}{\partial q_t} - \lambda_t = 0, \tag{1}$$

$$\frac{\partial u(q_t, h_t^s)}{\partial h_t^s} + w_t\lambda_t = 0, \tag{2}$$

$$-\lambda_t + \beta\lambda_{t+1}(1+\bar{r}_t) = 0, \tag{3}$$

$$(1+\bar{r}_t)d_t^s + w_t h_t^s + \pi_t^F + \pi_t^B - d_{t+1}^s - q_t = 0, \tag{4}$$

where λ_t is the Lagrange multiplier associated to the household's budget constraint.

We will assume the following utility function

$$u(q_t, h_t^s) = \frac{q_t^{1-\rho}}{1-\rho} - \frac{h_t^{1+\frac{1}{\gamma}}}{1+\frac{1}{\gamma}}, \tag{5}$$

then the FOC can be reduced to

$$q_t^{\rho} = w_t h_t^{-\frac{1}{\gamma}}, \tag{6}$$

$$q_t^{-\rho} = \beta(1+\bar{r}_t) q_{t+1}^{-\rho}, \tag{7}$$

$$d_t^s(1+\bar{r}_t) + w_t h_t^s + \pi_t^F + \pi_t^B = d_{t+1}^s + q_t. \tag{8}$$

C 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, four new equations, which include an augmented budget constraint and market-clearing equation,

$$\begin{aligned} q &= q_h + q_f \\ q &= wh + \pi^B + d\bar{r} + V - V^* \\ nx &= q_h^* - q_f = (\pi_f^B - V^*) - (\pi_h^{B*} - V) \\ y &= q + nx. \end{aligned}$$

Consumers		
Labor supply	$q^{\rho} = wh^{-\frac{1}{\gamma}}$	(1)
	$q^{*\rho} = w^* (h^*)^{-\frac{1}{\gamma}}$	
Euler condition	$\bar{r} = \bar{r}^* = \frac{1-\beta}{\beta}$	(2)
Budget constraint	$q = wh + \pi_h^F + \pi_h^B + d\bar{r} + \pi_h^{B*} + V - V^*$	(3')
	$q^* = w^* h^* + \pi_f^{F*} + \pi_f^{B*} + d^* \bar{r}^* + \pi_f^B + V^* - V$	
Aggregate consumption	$q = q_h + q_f$	
	$q^* = q_h^* + q_f^*$	
Firms		
Technology	$y = Ah^{1-\alpha}$	(4)
	$y^* = A^* (h^*)^{1-\alpha}$	
Optimal labor demand	$h = \left(\frac{(1-\alpha)A}{(1+r)w}\right)^{\frac{1}{\alpha}}$	(5)
	$h^* = \left(\frac{(1-\alpha)A^*}{(1+r^*)w^*}\right)^{\frac{1}{\alpha}}$	
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	$y = q + nx = q_h + q_h^*$	(11')
	$y^* = q^* + nx^* = q_h^* + q_f$	
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)
	$nx^* = -\left(\pi_f^B - \pi_h^{B*} - V + V^*\right)$	

Here, $C_{k,lib}(j)$ represents the k^{th} 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.

The set of equations defining dynamic equilibrium under autarky (not discussed in this paper) is given in the table below.

Consumers		
Labor supply	$q_t^{\rho} = w_t h_t^{-\frac{1}{\gamma}}$	(1)
Euler condition	$q_t^{-\rho} = \beta(1+\bar{r}_t) q_{t+1}^{-\rho}$	(2)
Budget constraint	$(1+\bar{r}_t)d_t + w_t h_t^s + \pi_t^B = d_{t+1} + q_t$	(3)
Firms		
Technology	$y_t = A_t h_t^{1-\alpha}$	(4)
Optimal labor demand	$h_t = \left(\frac{(1-\alpha)A_t}{(1+r_t)w_t}\right)^{\frac{1}{\alpha}}$	(5)
Demand for loans	$l_t(j) = \left(\frac{r_t(j)}{r_t}\right)^{-\sigma} w_t h_t$	(6)
Banks		
Lending rate	$r_t(j) = \min\left\{\bar{r}_t C_2(j), \bar{m}\left[\bar{r}_t C_1(j)\right]\right\}$	(7)
Loan market clearing (I)	$l_t(j) = d_t(j)$	(8)
Market Clearing and Aggregation		
Loan market clearing (II)	$l_t = \sum_1^J l_t(j)$	(9)
Deposit market clearing	$d_t = \sum_1^J d_t(j)$	(10)
Goods market clearing	$y_t = q_t$	(11)
Aggregate interest rate	$r_t = \left[\sum_1^J r_t(j)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$	(12)

D Steady-State Equilibrium

D.1 Autarky

Assuming $A = 1$, compute labor supply

$$\begin{aligned} y &\equiv q \\ Ah^{1-\alpha} &= w^{\frac{1}{\rho}} h^{-\frac{1}{\rho\gamma}} \\ h^s &= w^{\frac{1}{\frac{1}{\gamma}+\rho(1-\alpha)}}. \end{aligned}$$

Set labor supply equal to labor demand to find the equilibrium wage in terms of r :

$$\begin{aligned} h^d &\equiv h^s \\ \left[\frac{(1-\alpha)A}{(1+r)w}\right]^{\frac{1}{\alpha}} &= w^{\frac{1}{\frac{1}{\gamma}+\rho(1-\alpha)}} \\ w &= \left[\frac{(1-\alpha)}{(1+r)}\right]^{\frac{\frac{1}{\gamma}+\rho(1-\alpha)}{\alpha+\frac{1}{\gamma}+\rho(1-\alpha)}}. \end{aligned}$$

Substitute w back into h^s to find employment as a function of r :

$$h = \left[\frac{(1-\alpha)}{(1+r)}\right]^{\frac{1}{\alpha+\frac{1}{\gamma}+\rho(1-\alpha)}}.$$

substitute h^s into y to find $y = q$ as a function of r:

$$q = y = \left[\frac{(1-\alpha)}{(1+r)}\right]^{\frac{1-\alpha}{\alpha+\frac{1}{\gamma}+\rho(1-\alpha)}}.$$

D.2 Welfare effects

Welfare effects can be derived by noting that

$$\begin{aligned} \frac{\partial u}{\partial r} &= q^{-\rho}\frac{\partial q}{\partial r} - h^{\frac{1}{\gamma}}\frac{\partial h}{\partial r} \\ &= h^{-\rho(1-\alpha)}\frac{\partial q}{\partial h}\frac{\partial h}{\partial r} - h^{\frac{1}{\gamma}}\frac{\partial h}{\partial r}. \end{aligned}$$

We prove by contradiction that $\frac{\partial u}{\partial r} < 0$. Suppose the welfare effects of an increase in the interest rate is positive ($\frac{\partial u}{\partial r} > 0$). Then we have

$$\begin{aligned} h^{-\rho(1-\alpha)}\frac{\partial q}{\partial h}\frac{\partial h}{\partial r} - h^{\frac{1}{\gamma}}\frac{\partial h}{\partial r} &> 0 \\ h^{-\rho(1-\alpha)}\frac{\partial q}{\partial h}\frac{\partial h}{\partial r} &> h^{\frac{1}{\gamma}}\frac{\partial h}{\partial r}. \end{aligned}$$

The first step is to divide by $\frac{\partial h}{\partial r}$, which, given the solution for h above, is clearly negative. Thus, noting that goods market clearing and $A = 1$ imply $q = h^{1-\alpha}$, we have

$$\begin{aligned} h^{-\rho(1-\alpha)}\frac{\partial q}{\partial h} &< h^{\frac{1}{\gamma}} \\ h^{-\rho(1-\alpha)-\frac{1}{\gamma}}\frac{\partial q}{\partial h} &< 1 \\ h^{-\rho(1-\alpha)-\frac{1}{\gamma}-\alpha} &< \frac{1}{1-\alpha} \\ \left[\frac{(1-\alpha)}{(1+r)}\right]^{\frac{-[\rho(1-\alpha)+\frac{1}{\gamma}+\alpha]}{\alpha+\frac{1}{\gamma}+\rho(1-\alpha)}} &< \frac{1}{1-\alpha} \\ \frac{1+r}{1-\alpha} &< \frac{1}{1-\alpha} \\ 1+r &< 1. \end{aligned}$$

Since r can never be negative as long as $0 < \beta \leq 1$ (a standard assumption meaning that in steady state, consumers value present consumption as lease as much as future consumption), the last statement can not be true and $\frac{\partial u}{\partial r}$ likewise can never be negative.□

E Bank-level Data

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

to the assets invested.

- Ratio of personnel expenses to total interest earning assets

Following previous studies, we eliminate the 1st and 99th percentile for each variable within each country's observations in each year.

Table 2: Countries with M&A Surges in the Financial Sector during the Sample Period

Country	Begin Date	End Date
Surge between 2000Q1 and 2005Q4		
All tests indicate break		
china	2003Q4	..
indonesia	2004Q1	
lithuania	2000Q1	2002Q3
pakistan	2001Q4	..
russianfed	2002Q3	..
slovakrep	2000Q2	2002Q1
turkey	2001Q3	..
Only BIC indicates break		
caymanislands	2001Q4	..
lebanon	2001Q3	..
netherlands	2000Q2	..
spain	2001Q3	..
taiwan	2002Q2	..
Mid-surge at the beginning of 2000 (All tests indicate break)		
argentina	1997Q3	2001Q2
brazil	1997Q1	2001Q1
canada	1995Q4	2001Q2
chile	1995Q4	2000Q1
denmark	1999Q3	2002Q1
estonia	1998Q4	2001Q2
france	1991Q1	2002Q3
greece	1998Q2	2002Q4
hongkong	1992Q2	2002Q3
hungary	1995Q4	2002Q4
japan	1999Q4	2002Q4
poland	1999Q2	2002Q2
singapore	1999Q2	2002Q3
sweden	1993Q2	1995Q3
thailand	1997Q3	2000Q1
venezuela	1996Q1	2001Q1

Table 3: Summary Statistics

	Observations	Mean	St. Dev.	Minimum	Maximum
No evidence of M&A surge after 1999 (69 countries)					
Net Interest Margins					
2000	2355	3.606	2.741	-1.330	23.210
2006	2304	3.197	2.505	-1.280	21.650
% change		-11.342	-8.610	-3.759	-6.721
Overhead Costs/Total Interest Earning Assets					
2000	2361	0.048	0.079	0.001	1.000
2006	2306	0.043	0.076	0.001	0.871
% change		-11.229	-4.046	4.852	-12.873
Personnel Expenses/Total Interest Earning Assets					
2000	2210	0.023	0.038	0.000	0.480
2006	2195	0.020	0.031	0.001	0.409
% change		-12.014	-17.858	16.777	-14.737
Some evidence of M&A surge after 1999 (11 countries)					
Net Interest Margins					
2000	337	4.438	5.010	-1.310	22.990
2006	425	3.515	3.144	-1.190	20.480
% change		-20.788	-37.236	-9.160	-10.918
Overhead Costs/Total Interest Earning Assets					
2000	346	0.048	0.058	0.002	0.417
2006	436	0.035	0.043	0.002	0.533
% change		-28.369	-25.258	-12.396	27.815
Personnel Expenses					
2000	174	0.034	0.034	0.001	0.197
2006	276	0.021	0.021	0.001	0.209
% change		-37.468	-36.956	-8.823	6.193

Table 4: Net Interest Earnings

		1st-Order Stochastically Dominant Distribution			Total
		2000	Neither	2005	
Surge identified by all break tests between 2000Q1 and 2005Q4 (7 countries)					
No surge	Frequency	19	50	4	73
	Row percentage	26.03	68.49	5.48	100.00
Surge	Frequency	3	2	2	7
	Row percentage	42.86	28.57	28.57	100.00
Surge identified by BIC between 2000Q1 and 2005Q4 (12 countries)					
No surge	Frequency	17	47	4	68
	Row percentage	25.00	69.12	5.88	100.00
Surge	Frequency	5	5	2	12
	Row percentage	41.67	41.67	16.67	100.00
Surge identified by BIC between 1999Q1 and 2005Q4 (16 countries)					
No surge	Frequency	15	45	4	64
	Row percentage	23.44	70.31	6.25	100.00
Surge	Frequency	7	7	2	16
	Row percentage	43.75	43.75	12.50	100.00

Net interest earnings equals interest revenues minus interest expenses divided by total interest-earning assets.

Table 5: Average Overhead Costs

		1st-Order Stochastically Dominant Distribution			Total
		2000	Neither	2005	
Surge identified by all break tests between 2000Q1 and 2005Q4 (7 countries)					
No surge	Frequency	18	54	1	73
	Row percentage	24.66	73.97	1.37	100.00
Surge	Frequency	5	1	1	7
	Row percentage	71.43	14.29	14.29	100.00
Surge identified by BIC between 2000Q1 and 2005Q4 (12 countries)					
No surge	Frequency	17	50	1	68
	Row percentage	25.00	73.53	1.47	100.00
Surge	Frequency	6	5	1	12
	Row percentage	50.00	41.67	8.33	100.00
Surge identified by BIC between 1999Q1 and 2005Q4 (16 countries)					
No surge	Frequency	16	47	1	64
	Row percentage	25.00	73.44	1.56	100.00
Surge	Frequency	7	8	1	16
	Row percentage	43.75	50.00	6.25	100.00

Average overhead costs equal overhead expenses divided by total interest-earning assets.

Table 6: Average Personnel Costs

		1st-Order Stochastically Dominant Distribution			Total
		2000	Neither	2005	
Surge identified by all break tests between 2000Q1 and 2005Q4 (7 countries)					
No surge	Frequency	15	58	0	73
	Row percentage	20.55	79.45	0.00	100.00
Surge	Frequency	3	3	1	7
	Row percentage	42.86	42.86	14.29	100.00
Surge identified by BIC between 2000Q1 and 2005Q4 (12 countries)					
No surge	Frequency	14	54	0	68
	Row percentage	20.59	79.41	0.00	100.00
Surge	Frequency	4	7	1	12
	Row percentage	33.33	58.33	8.33	100.00
Surge identified by BIC between 1999Q1 and 2005Q4 (16 countries)					
No surge	Frequency	14	50	0	64
	Row percentage	21.88	78.13	0.00	100.00
Surge	Frequency	4	11	1	16
	Row percentage	25.00	68.75	6.25	100.00

Average personnel costs equal personnel expenses divided by total interest-earning assets.

Table A.1: Full Break Testing Results

Country	Starting year	Break point	Confidence interval 95% Min	Confidence interval 95% Max	Confidence interval 90% Min	Confidence interval 90% Max
Break point exists according to all tests						
One break						
australia	1985Q2	1994Q3	1986Q3	1997Q2	1988Q4	1996Q2
belgium	1986Q3	1992Q1	1985Q4	1993Q2	1987Q3	1992Q4
china	1991Q4	2003Q4	2002Q2	2004Q1	2002Q4	2004Q1
germany	1985Q1	1989Q3	1987Q4	1989Q3	1988Q2	1989Q3
india	1990Q4	1999Q3	1997Q4	2000Q1	1998Q2	1999Q4
indonesia	1991Q2	2004Q1	2003Q1	2004Q2	2003Q2	2004Q2
italy	1985Q2	1990Q3	1987Q2	1991Q1	1988Q2	1990Q4
jamaica	1996Q1	1998Q1	1997Q2	2001Q1	1997Q3	2000Q2
mexico	1987Q4	1996Q3	1993Q2	1997Q2	1994Q1	1997Q1
norway	1988Q4	1997Q1	1989Q1	1998Q4	1991Q2	1998Q1
pakistan	1992Q1	2001Q4	1997Q4	2002Q2	1999Q1	2002Q2
philippines	1986Q1	1994Q1	1977Q3	1995Q2	1982Q1	1994Q4
russianfed	1991Q4	2002Q3	2001Q4	2004Q4	2002Q1	2004Q1
southkorea	1989Q3	1998Q3	1996Q3	1998Q4	1997Q1	1998Q3
switzerland	1985Q2	1988Q2	1984Q4	1988Q4	1985Q4	1988Q3
turkey	1988Q3	2001Q3	1995Q1	2001Q4	1996Q4	2001Q4
unitedkingdom	1984Q1	1987Q3	1986Q3	1988Q4	1986Q4	1988Q3
More than one break						
argentina	1985Q2	1994Q3	1991Q1	1994Q4	1992Q1	1994Q4
		1997Q3	1996Q2	1998Q1	1996Q3	1997Q4
		2001Q2	2001Q1	2002Q2	2001Q1	2002Q1
brazil	1986Q4	1997Q1	1996Q2	1997Q2	1996Q3	1997Q2
		2001Q1	2000Q1	2002Q2	2000Q2	2002Q1
canada	1984Q1	1995Q4	1993Q4	1997Q1	1994Q2	1996Q3
		2001Q2	2000Q3	2003Q3	2000Q4	2003Q1
chile	1987Q3	1995Q4	1991Q3	1997Q1	1992Q4	1996Q3
		2000Q1	1999Q2	2003Q4	1999Q3	2002Q4
denmark	1988Q3	1992Q4	1991Q4	1993Q1	1992Q1	1993Q1
		1995Q2	1994Q3	1996Q2	1994Q4	1996Q1
		1999Q3	1998Q4	1999Q4	1999Q1	1999Q4
		2002Q1	2001Q1	2002Q4	2001Q2	2002Q4
estonia	1995Q4	1998Q4	1982Q4	1988Q3	1984Q2	1988Q2
		2001Q2	1990Q2	1993Q4	1990Q2	1992Q4
france	1985Q1	1991Q1	1988Q4	1994Q1	1989Q2	1993Q2
		2002Q3	2001Q2	2005Q1	2001Q4	2004Q2
greece	1990Q3	1998Q2	1997Q1	1998Q4	1997Q2	1998Q3
		2002Q4	2000Q3	2004Q3	2001Q1	2004Q1
hongkong	1985Q1	1992Q2	1990Q1	1993Q3	1990Q4	1993Q1
		2002Q3	1999Q1	2005Q2	2000Q1	2004Q3
hungary	1989Q4	1995Q4	1993Q3	1997Q3	1994Q2	1997Q1
		2002Q4	2001Q2	2005Q2	2001Q4	2004Q4
japan	1986Q1	1996Q3	1992Q3	1996Q4	1993Q3	1996Q4
		1999Q4	1997Q3	2000Q3	1998Q2	2000Q2
		2002Q4	2002Q2	2005Q3	2002Q3	2004Q4
lithuania	1994Q4	2000Q1	1999Q3	2001Q1	1999Q3	2000Q4
		2002Q3	2002Q2	2003Q1	2002Q2	2003Q1
peru	1992Q4	1994Q3	1988Q3	1994Q3	1989Q4	1994Q2
		1996Q2	1994Q3	1999Q4	1994Q3	1998Q2
poland	1991Q3	1994Q4	1993Q3	1995Q1	1994Q1	1995Q1
		1999Q2	1997Q3	1999Q3	1998Q1	1999Q3
		2002Q2	2002Q1	2003Q2	2002Q1	2003Q1
singapore	1988Q3	1999Q2	1994Q2	1999Q3	1995Q3	1999Q3
		2002Q3	2002Q2	2007Q1	2002Q2	2005Q4
slovakrep	1993Q1	2000Q2	1997Q2	2000Q3	1998Q2	2000Q3
		2002Q1	2001Q2	2007Q1	2001Q3	2005Q3
sweden	1989Q4	1993Q2	1989Q4	1989Q4	1989Q4	1989Q4
		1995Q3	1989Q4	1989Q4	1989Q4	1989Q4
thailand	1989Q1	1997Q3	1995Q1	1997Q4	1995Q3	1997Q3
		2000Q1	1999Q2	2004Q2	1999Q3	2003Q1
venezuela	1991Q3	1996Q1	1992Q1	1997Q1	1993Q2	1996Q4
		2001Q1	2000Q4	2004Q3	2000Q4	2003Q3

continued on next page

Table A.1, continued

Break point exists according to only the BIC						
caymanislands	1988Q3	2001Q4	1996Q4	2002Q4	1998Q1	2002Q2
lebanon	1991Q2	2001Q3	2000Q3	2011Q2	2001Q1	2008Q3
malaysia	1986Q4	1990Q1	1981Q3	1991Q4	1983Q4	1991Q1
netherlands	1986Q3	2000Q2	1997Q2	2004Q4	1998Q1	2003Q3
spain	1988Q1	2001Q3	1999Q2	2010Q4	2000Q1	2008Q2
taiwan	1990Q2	2002Q2	1996Q1	2002Q4	1997Q4	2002Q3

No break point identified	
andorra	1994Q2
austria	1988Q3
bahamas	1987Q4
bahrain	1992Q1
belarus	1996Q4
croatia	1995Q4
cyprus	1998Q3
czechrepublic	1993Q4
elsalvador	1993Q3
finland	1988Q4
ghana	1996Q4
iceland	1998Q4
ireland-rep	1986Q4
israel	1992Q2
jordan	1998Q3
kazakhstan	1994Q4
kenya	1995Q1
kuwait	1994Q4
latvia	1995Q3
luxembourg	1987Q3
newzealand	1987Q4
nigeria	1993Q1
panama	1992Q3
portugal	1989Q3
southafrica	1986Q4
ukraine	1995Q3
vietnam	1993Q3

Dataset begins: 1984Q1