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Bank pricing under oligopsony-oligopoly: Evidence from 103 developing countries

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Contents

Walid Marrouch* and Rima Turk-Ariss+

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Abstract

We propose a generic oligopsony-oligopoly model to study bank behavior under uncertainty in developing countries. We derive a pricing structure that acknowledges market power in both the deposit and loan markets and identify two theoretical components to the loan rate: a rent extraction component resulting from the interaction between the choke price of loans and prevailing banking structures, and a markup on deposit funding costs that captures the transformation efficiency of financial intermediation. We then test our structural specification with longitudinal data for 103 non-OECD countries and find that both the market structure under uncertainty and the deposit rate matter significantly in pricing. However, the role played by the rent-extraction share in pricing, on average, dominates funding costs in developing countries, and so underscores the importance of market structure in banks‟ pricing power.

Keywords: intermediation, bank pricing, market structure, uncertainty, developing countries
JEL codes: C33, G21, L13

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1 Introduction

The input-output approach in financial intermediation theory, which sees banks as intermediaries that transform deposits into loans, has received considerable attention in the banking literature. It was first formalized by Klein (1971), followed by Sealey and Lindley (1977), and later served as the basis for numerous studies on banks‟ market power (See e.g. Zarruk, 1989 and Molnar, 2008). In this literature, banks are financial institutions that intermediate funds between two different markets - the deposit and loan markets. In doing so, they collect and process valuable information about clients and thus reduce the information asymmetry between lenders and borrowers while gaining the right to market power entitlements.

In most OECD countries, the presence of deep and active financial markets fuels disintermediation and intensifies competition in the provision of financial services. Traditional banking is transformed into a universal and complex business providing retail, commercial, investment and insurance services.[1] These developments are highlighted in developed countries and are difficult to reconcile with traditional theories of financial intermediation, but they remain quite muted in developing nations where capital markets are either underdeveloped or virtually non-existent.

We argue in this paper that the business model of banking in developing countries is better approximated by the traditional financial intermediation paradigm in a strict sense, where banks are financial intermediaries that are mainly involved in the transformation of deposits (input) into loans (output).[2] Stylized facts summarized in Table 1 for both OECD and non-OECD countries include the ratios of stock market capitalization to Gross Domestic Product (GDP) and of bank-provided domestic credit to GDP. The figures reveal that, over the past decade, the size of the stock market relative to the economy is, on average, smaller in non-OECD countries than in OECD nations. In developed capital markets, a wide spectrum of debt and equity instruments is available, whereas in developing countries there are fewer savings options for storing wealth outside of banks. In other words, banks in developing countries are likely to exercise oligopsony power as buyers of customer deposits. On the lending side, banks in developing nations also dominate the credit market, as the small size of capital markets is indicative of subdued fund raising activity by corpora-

[1] See Allen and Santomero (1998) for an excellent overview of secular changes in US financial intermediation structure.
[2] Throughout the text, we use the terms non-OECD and developing countries interchangeably.

tions. Moreover, bank-provided domestic credit relative to GDP is less than half the ratio for OECD countries, again pointing to the under-provision of lending that is typical of oligopolistic behavior in the loan market.

Table 1 Roles of banks and stock market in financing the economy

The table gives the ratios of stock market capitalization to Gross Domestic Product (GDP) and domestic credit provided by banks to GDP in OECD and non-OECD countries.

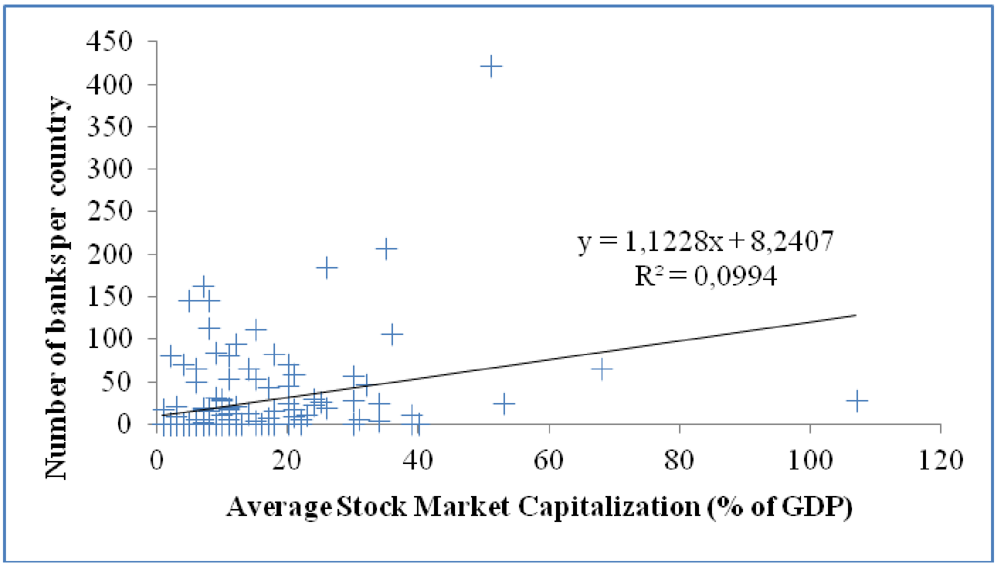
	OECD countries	non-OECD countries
Stock market capitalization / GDP	75.22	46.70
Domestic credit provided by banks / GDP	122.80	49.66

Source: Authors" calculations from International Financial Statistics database.

To help assess the extent of financial disintermediation in developing countries, Figure 1 illustrates the relationship between the number of banks and the ratio of stock market capitalization to GDP. The number of banks positively correlates with stock market capitalization, but most observations lie close to the origin, pointing to weak evidence of disintermediation across non-OECD countries. When stock markets are small or nonexistent, the number of banks is also usually small, supporting the assumption of the presence of oligopoly in banking in developing countries.

Figure 1 Financial disintermediation, 2000-2009

The figure illustrates the relationship between number of banks and the ratio of stock market capitalization to GDP in non-OECD countries.



Source: Authors" calculations from International Financial Statistics and BankScope databases.

Thus, individuals with excess funds in developing countries have limited financial investment options outside of the banks, and borrowers' recourse to funding is also largely via banks. The banks are the main buyers of deposits from depositors and the main sellers of loans to borrowers, which gives them considerable market power in both the deposit and loan markets. As a result, banks" behavior in developing nations is more akin to oligopsony in the deposit market and oligopoly in the loan market, so that the market structure is best described in the main as an oligopsony-oligopoly. The study of an oligopsony-oligopoly banking market in an input-output framework is analyzed by Van Hoose (2010) who also discusses the implications of three other market structures (perfect competition, monopoly-monopsony, and monopolistic competition)[3] for the joint operation of banks in the deposit and loan markets.[4]

In this paper, we acknowledge joint rent extraction in both deposit and loan markets and develop a generic model of bank pricing under oligopsony-oligopoly based on financial intermediation theory but without explicitly modeling a cost function. We focus on pricing decisions because they are crucial to the conduct of banking and because the loan rate also serves as a major screening device.[5] Our model enables a theoretical breakdown of the loan rate based primarily on the interaction between the choke price of loans, the number of banks in the industry, the probability of loan repayment or loan uncertainty, the deposit rate, and the efficiency of transforming deposits into loans.

In considering both deposit and loan markets, our model is consistent with the standard theory of financial intermediation and with real-world banking. The theoretical model of Boyd and De Nicolò (2005) demonstrates that focusing on deposit market competition and ignoring the loan market will give an incomplete picture of banks" market power. Similarly, the applied multimarket competition study by Park and Pennachi (2009) shows that bank operations have disparate effects in the deposit and loan markets.

Our pricing model is a variant of Van Hoose"s (2010) model of the bank under oligopoly-oligopsony that employs a Cournot-Nash framework in order to model the mark-

[3] See Chapter 3: Alternative Perspectives on Bank Behavior, p. 27-51.

[4] Alternative frameworks for analyzing bank behavior include Ho and Saunders (1981) who model the role of banks as dealers between providers and users of funds. Their so-called integrated theory rests on banks" ability to match the random arrivals and departures of deposits and loans, respectively, and which allows banks to set the interest rate margin or spread. A strand of literature on the determinants of bank interest margin followed Ho and Saunders (1981). See, for example, Allen (1988), Wong (1997), and Angbazo (1997), among others.

[5] High interest rates on loans may attract high risk borrowers (adverse selection effect) or induce borrowers to undertake riskier projects (moral hazard effect); see Stiglitz and Weiss (1981).

up (mark-down) on loans (deposits) vis-à-vis the bank"s marginal cost. We additionally capture uncertainty in banking via the probability of loan repayment and study its impacts on the equilibrium outcomes. We then test our structural pricing model under dual market power using longitudinal data on banks in 103 non-OECD countries over the period 2000-2009.[6]

We identify two main components to loan pricing under oligopsony-oligopoly that are based on theory: a rent extraction component resulting from interaction between choke price of loans and the prevailing banking structures, and a mark-up on deposit funding costs that captures the transformation efficiency of financial intermediation. Our empirical findings indicate that both market structure under uncertainty and the deposit rate are key determinants of pricing in non-OECD countries. We also find that the role played by the rent extraction share in pricing dominates, on average, funding costs in developing countries, underpinning the importance of market structure in bank pricing power.

The rest of the paper unfolds as follows. Section 2 lays out a model of financial intermediation for non-OECD countries. Section 3 introduces the empirical specification of the structural model and the estimation method. Section 4 presents the data and discusses the empirical findings. In section 5, we run a series of validity checks. Section 6 concludes.

2 A model of financial intermediation

2.1 Oligopsony-oligopoly

In this section, we consider a generic model of banking focused on the financial intermediation role of banks whose primary function is collecting customer deposits and making loans to borrowers. Our analysis is guided by the stylized facts presented in the introduction about the business model of banking in non-OECD countries.

We assume that the banking industry is an oligopsony-oligopoly comprising n symmetric banks operating simultaneously in the deposit and loan markets. For a given bank i and any time period, its customer deposits are assumed to be the only source of

[6] We believe that coverage of the financial crisis (2008 and 2009) does not bias our findings since banks in non-OECD countries were generally less affected by the 2008 global crisis than were those in OECD economies. In the validity checks section, we exclude years 2008 and 2009 but get the same main results.

funding and also the sole determinant of the bank's ability to make loans to borrowers. In other words,

$$l_i(d_i) = \alpha d_i \quad \forall_i = 1, \dots, n. \tag{1}$$

Where $\alpha > 0$ is a production efficiency factor that captures the bank's ability to transform its sources of funds (mainly deposits, d_i, at bank i) into productive uses (loans, l_i , generated by bank i), in line with the core financial intermediation function of banks.[7] In what follows, we refer to α as the indicator of financial intermediation transformation efficiency. Let $D = \sum_{i=1}^{n} d_i$ and $L = \sum_{i=1}^{n} l_i$ be respectively the total quantity of deposits and loans in the market. Given (1), we define $L(D) = \sum_{i=1}^{n} l_i(d_i) = \alpha D$. In the input market, each bank faces an upward-sloping market supply of deposits given by

$$r_D(D) = \beta D. \tag{2}$$

Where $r_D(D)$ is the interest rate paid on deposits by the banking sector, and β a positive parameter representing the slope of the inverse supply function.
In the output market, all banks face a downward-sloping market demand for loans given by

$$r_L(L) = a - bL, \tag{3}$$

where $r_L(L)$ is the interest rate on loans charged by the banking sector; a is the choke price of loans, i.e. the rate at which loan demand is zero; and b is a positive parameter representing the absolute value of the slope of the inverse demand function.[8]

In line with the banking literature, we assume that on the funding side, deposits are insured (explicitly or implicitly), so that their supply does not depend on risk. On the lending side, loans to entrepreneurs are risky and are subject to default. Banks offer standard debt contracts with repayment probability (p) and probability of default $(1 - p)$, in which case bank revenues are normalized to zero.[9] The expected profit of bank i, to be maximized, then becomes:

$$E\pi_i = p r_L[L(D)] l_i(d_i) - r_D(D) d_i.$$

[7] For this reason, we abstract from modeling equity and investment in risk-free securities in equation (1).
[8] The linear demand function allows us to model explicitly the choke price of loans, the importance of which is revealed in the next sections.
[9] The model assumes that the recovery rate on risky loans is zero, i.e. that loss given default equals 100%.

Solving simultaneously for all the best-response functions under a symmetric equilibrium, we obtain the Nash-equilibrium market quantity of deposits,

$$D^* = \frac{n}{(n-1)+2/p}\left(\frac{a\alpha}{b\alpha^2+\beta}\right). \tag{4}$$

Using (1), it follows that the equilibrium market quantity of loans is

$$L^* = \frac{n}{(n-1)+2/p}\left(\frac{a\alpha^2}{b\alpha^2+\beta}\right). \tag{5}$$

Substituting (4) into (2) yields the equilibrium interest rate on deposits,

$$r_D^* = \frac{n}{(n-1)+2/p}\left(\frac{a\alpha\beta}{b\alpha^2+\beta}\right). \tag{6}$$

Substituting (5) into (3) yields the equilibrium interest rate on loans,

$$r_L^* = \frac{a[((n-1)+2/p)\beta+(2/p-1)b\alpha^2]}{[(n-1)+2/p](b\alpha^2+\beta)}. \tag{7}$$

Table 2 summarizes the comparative statics for equilibrium quantities and prices in both the deposit and loan markets.

Table 2 Equilibrium quantities and prices

The table gives the results of comparative statics for equilibrium quantities and prices.

	a	b	β	α	p
D^*	+	–	–	+/–	+
r_D^*	+	–	+	+/–	+
L^*	+	–	–	+	+
r_L^*	+	–	+	–	–

Faced with an increase (decrease) in the demand for loans (increase in a or decrease in b), a representative bank responds by increasing (decreasing) its deposits and loans, which raises the price of deposits or loans. However, an increase in the supply of deposits (decrease in β) will not have an identical effect across deposit/loan quantities and prices. A positive (negative) supply shock in deposits increases (decreases) quantities and reduces rates on deposits and loans. An increase in bank's transformation efficiency will increase the amount of loans supplied and result in a lower price, notwithstanding an indeterminate effect in the deposit market. An increase in the probability of loan repayment lowers the price of loans and enables the bank to extend a greater volume of credit. Under this scenario, the bank‟s reputation is also improved and it is able to attract more deposits, albeit at a higher cost.

Further examination of equilibrium outcomes enables us to derive a pricing relationship that links the deposit and loan markets. Using (3) and (2), simple manipulation of equilibrium deposit and loan rates in (6) and (7) yields

$$r_L^* = a\frac{2/p - 1}{(n-1) + 2/p} + \frac{1}{\alpha} r_D^*. \tag{8}$$

Equation (8) depicts a theoretical pricing structure for the banking industry under oligopsony-oligopoly that entails joint rent extraction in the deposit and loan markets. It also enables a theoretical breakdown of the loan rate, which is primarily determined by the interaction between the choke price of loans (a), the number of banks (n), the probability of loan repayment or loan uncertainty (p), the deposit rate (r_D^*), and the transformation efficiency (α).

2.2 Market spectrum

When we set $n = 1$, we have a monopsony-monopoly (M). From (4) and (6) we get the monopsony-monopoly amount and price of deposits, respectively

$$D^M = \frac{a\alpha}{(b\alpha^2 + \beta)(2/p)}; \qquad r_D^M = \frac{a\alpha\beta}{(b\alpha^2 + \beta)(2/p)}.$$

From (5) and (7) we obtain the monopsony-monopoly amount and price of loans, respectively

$$L^M = \frac{a\alpha^2}{(b\alpha^2 + \beta)(2/p)}; \qquad r_L^M = \frac{a(b\alpha^2 + \beta)(2/p) - ab\alpha^2}{(b\alpha^2 + \beta)(2/p)}.$$

When $n \to \infty$, pure competition (C) prevails jointly in the deposit and loan markets, leading to the following equilibrium input/output quantities and prices

$$D^C = \frac{a\alpha}{b\alpha^2 + \beta}; \qquad r_D^C = \frac{a\alpha\beta}{b\alpha^2 + \beta}.$$

$$L^C = \frac{a\alpha^2}{b\alpha^2 + \beta}; \qquad r_L^C = \frac{a\beta}{b\alpha^2 + \beta}.$$

Interestingly, the probability of repayment (p) does not appear in the equilibrium outcomes above, suggesting that uncertainty has no role under joint competition.

We rank quantities and prices in the deposit and loan markets using the range of equilibria under different market structures. In the deposit market,

$$D^M < D^* < D^C,$$

$$r_D^M < r_D^* < r_D^C.$$

In the loan market,

$$L^M < L^* < L^C,$$

$$r_L^M > r_L^* > r_L^C.$$

Comparing prices across markets, we obtain the ranking

$$r_D^M < r_D^* < r_D^C < r_L^C < r_L^* < r_L^M.$$

This ranking indicates that the rate on deposits is always lower than the rate on loans regardless of the market structure. A monopsony-monopoly will pay the lowest possible rate on deposits and reap the highest rate of return on loans, thereby resulting in the widest possible spread $(r_L^M - r_D^M)$ between rates. As competition increases, however, the spread narrows down to a minimum of $(r_L^C - r_D^C)$ under joint competition. Furthermore, comparative statics on the spread $(r_L^* - r_D^*)$ indicate that a decrease in repayment probability p or a higher probability of default will translate to a wider interest rate margin. As loan repayment uncertainty increases, banks will compensate the higher risk exposure by charging a larger spread.

3 Empirical specification

3.1 The structural model

We next test the empirical validity of the structural pricing model of equation (8). For each observable variable, we introduce subscripts j for country and t for time and in our stochastic structure:

$$r_{jt}^{L} = a\left(\frac{2/p_{jt}-1}{(n_{jt}-1)+2/p_{jt}}\right) + \left(\frac{1}{\alpha}\right)\left(r_{jt}^{D}\right) + \varepsilon_{jt}. \tag{9}$$

Here, r_{jt}^{L} and r_{jt}^{D} denote the prevailing loan and deposit rates, respectively, in the banking industry of country j;[10] n_{jt} represents the number of banks; p_{jt} is the probability of loan repayment; a and $(1/\alpha)$ are parameters to be estimated reflecting the choke price of loans and the transformation efficiency of the banking industry, respectively; and $\varepsilon_{jt} = \theta_j + u_{jt}$ is a random error term where θ_j captures unobserved country heterogeneity.

The structural model of equation (9) suggests that the equilibrium loan rate in the banking industry can be decomposed into two parts, a funding cost component $[(1/\alpha)(r_{jt}^{D})]$ and a rent extraction component $\left[a\left(\frac{2/p_{jt}-1}{(n_{jt}-1)+2/p_{jt}}\right)\right]$, where $\left(\frac{2/p_{jt}-1}{(n_{jt}-1)+2/p_{jt}}\right)$ gives the prevailing banking structures, which reflect the interplay between (n) and (p). In setting the loan rate, the banking industry first covers the funding costs associated with collecting deposits and transforming them into loans. Funding costs are incremented by a rent extraction component that augments the choke price of loans (a) by the interplay between uncertainty (p_{jt}) and the number of banks in the industry (n_{jt}). These two components must be positively additive by construction. Therefore, we also expect the estimates of parameters (a) and $(1/\alpha)$ to be positive, implying that the loan rate r_{jt}^{L} is increasing in both the rent extraction component and the industry"s deposit rate.

[10] More precisely, subscript j denotes banking industry in country j.

3.2 Estimation method

A standard methodology for estimating equation (9) would assume the same vectors of covariates (a) and $(1/\alpha)$ for all countries using either fixed or random effects. Differently stated, the standard regression estimations generally focus on mean covariates across countries and how they change over time.

However, we opt not to use either fixed or random effects for both economic and statistical reasons. First, fixed or random effects estimations "do entail the not entirely plausible assumption that there is no parameter variation across [countries]" (Greene, pp. 318-19, 2003). Our structural model of equation (8) is country-specific, and it is unrealistic to assume that economic conjectures (captured by a) and technological conditions (affecting $1/\alpha$) are similar across countries. Therefore, estimating mean values for choke price and transformation efficiency across all countries lacks an economic rationale. Second, assuming either fixed or random effects necessitates imposing a constant term in the formulation of equation (9), since unobserved country heterogeneity would be statistically captured by an intercept. However, adding a constant term modifies equation (9) and is inconsistent with our objective to empirically validate the pricing structure in equation (8) in a strict sense. In what follows, we take particular care not to incorporate any exogenous or control variable that is not necessitated by our theoretical model.[11]

We, therefore, model parameter heterogeneity across countries as stochastic variations around their mean values using a random coefficient model (RCM) to estimate (a_j) and (α_j) in a reformulation of the structural model (9):

$$r_{jt}^{L} = a_j\left(\frac{2/p_{jt}-1}{(n_{jt}-1)+2/p_{jt}}\right) + \left(\frac{1}{\alpha_j}\right)\left(r_{jt}^{D}\right) + \varepsilon_{jt}. \tag{10}$$

Denoting $\omega_j = [a_j \;\; \alpha_j]'$, $\omega_j = \omega + u_j$ with $E[u_j] = 0$, $E[u_j u_j{}'] = \Omega$ and $E[u_i u_j{}'] = 0 \; \forall j \neq i$.

The RCM accounts for the peculiar economic features of each country in our sample and generates country-specific choke prices of loans and transformation efficiency. Typically, economic conditions differ across countries and are likely to result in different choke

[11] We nonetheless estimate our structural model using both fixed and random effects, to check for robustness; the results are available upon request.

prices of loans. Similarly, the use of technology in banking is disparate across countries and implies different levels of transformation efficiency. Swamy (1970) and Swamy and Tavlas (1995) discuss the rationale for RCM, which has been used successfully on a range of macro and micro economic applications, including interest rate-budget deficit equations, money demand, exchange rate, behavior of share prices, and farm machinery investment.[12]

> *"The motivation for using the procedure is that in cases in which specification errors [...] are present, it is unreasonable to expect all the 'noise' to affect only the disturbance term in an equation. The noise should affect all the coefficients in the equation, and the more noise there is, the greater would be the expected impact on all coefficients. Furthermore, while fixed coefficients cannot usually be interpreted as direct effects, random coefficients usually represent economists' beliefs"* (Swamy and Tavlas, 1995, p.167).

4 Data and empirical findings

4.1 Data

We use annual data on loan, deposit, and GDP growth rates for all non-OECD countries in $2000-2009$, from the International Financial Statistics database.[13] Equation (10) also requires the number of banks (n_{jt}) per country per year as well as a proxy for the probability of loan repayment or uncertainty in the industry (p_{jt}). To generate these variables, we retrieve data on all banks that operate in non-OECD countries from the Bankscope database provided by Bureau van Dijk and Fitch Ratings.[14] The varying number of banks over the years points to entry, exit, and merger activity. To obtain the probability of loan repayment, we generate a proxy for the probability of default or $(1-p_{jt})$ as the ratio of loan impairment charges to gross loans for the banking industry per country per year and so compute (p_{jt}).[15]

[12] For more recent applications of the RCM, see O'Brien and Berkowitz (2005), Cole (2005), and Smith and Tasiran (2010).
[13] In our sample of non-OECD economies, four countries joined the OECD in 2010, Chile, Estonia, Israel, and Slovenia. We keep these countries in our sample because they were not part of the OECD in 2000-2009.
[14] The total number of banks is $3{,}562$.
[15] We generate another proxy for (p_{jt}) using the ratio of reserves for impaired loans to gross loans, for checking validity.

Our original sample includes 164 developing countries, but it is reduced to 103 countries due in each case to either missing data on key variables or too few observations for the study period.[16] Table 3 gives descriptive statistics on our variables of primary interest in equation (10). The lending rate dominates the deposit rate across all percentiles, empirically validating the finding of section 2.2 on the existence of a positive spread, on average, in the banking industry. The average number of banks is about 19, and the median number of banks is only 9, lending support to our hypothesis on the prevalence of oligopsony-oligopoly in banking in the non-OECD countries.[17]

Table 3 Descriptive statistics across 103 non-OECD countries, 2000 – 2009

The table displays descriptive statistics on key variables of equation (10). (n) is the number of banks; (p) the probability of loan repayment; (r^D) and (r^L) the deposit and lending rate, respectively, expressed in percentages; $\left(\frac{2/p-1}{(n-1)+2/p}\right)$ denotes banking structure, which reflects the interplay between (n) and (p).

	n	p	r^D	r^L	$\left(\frac{2/p-1}{(n-1)+2/p}\right)$
Mean	18.55	0.9385	6.99	15.95	0.1563
Std deviation	61.21	2.3039	4.92	9.46	0.1489
25th percentile	4	0.9775	3.53	9.46	0.0525
50th percentile	9	0.9889	5.72	14.02	0.1042
75th percentile	19	0.9948	9.33	19.48	0.2083

Further, of all the variables considered, only the number of banks (n) and the probability of loan repayment (p) have a standard deviation much larger than the respective average value. However, the interplay of these two variables in the term $\left(\frac{2/p-1}{(n-1)+2/p}\right)$ produces much less variability in banking structures across developing countries.

4.2 Empirical findings

We first show the results for the mean RCM estimates across all countries in Table 4 following the pricing structure of equation (10). In our sample, we identify 11 countries where the number of banks exceeds 40, and which are likely to bias our findings.[18] Some

[16] Among the excluded countries are Angola and Zimbabwe, which experienced hyperinflation during our study period.
[17] Interestingly, in the fitted line of Figure 1, when the ratio of market capitalization to GDP is zero, the predicted average number of banks is 8.24.
[18] These countries are Argentina, Brazil, China, Croatia, Indonesia, Kenya, Malaysia, Nigeria, Panama, Russia, and Ukraine.

of these countries (e.g. Russia and Ukraine) rely heavily on borrowing from abroad thereby breaking the link bethween the domestic deposit base and domestic lending. To avoid such bias, we run regressions for the entire dataset (Model 1) and when excluding these 11 countries (Model 2).

Table 4 RCM regression results for structural pricing model

Random effects regression results for equation (10). The dependent variable is the loan rate per country per year; n is the number of banks per country. Banking structures denote the first component of equation (10), which reflects the interplay between number of banks and loan uncertainty; its estimated coefficient is the average choke price of loans for all countries. The coefficient in the deposit rate is the estimated inverse of the transformation efficiency. Model 1 uses the entire dataset and Model 2 excludes 11 countries with many banks. Robust standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

	Model 1	**Model 2**
Banking Structures	77.323	49.976
	(22.366)***	(7.134)***
Deposit Rate	1.37	1.404
	(0.089)***	(0.094)***
Observations	901	801

The results of our structural estimation indicate that both banking structures and the deposit rate are highly significant at the 1% level. The results are consistent across both the full dataset and when countries with many banks are excluded. Under conditions of uncertainty, the coefficient of banking structure $(\hat{a})$, i.e. the average choke price of loans for non-OECD countries, is significant at the 1% level; it takes the value 77.32% in Model 1 and just 49.98% in Model 2. As predicted in section 3.1, the coefficient $(1/\hat{\alpha})$ is positive, and it also exceeds one, suggesting that the total costs incurred by banks in transforming deposits (input) into loans (output) are, on average, 1.37 times the deposit cost of funds in Model 1. This markup on (r_{jt}^{D}) captures implicit factor costs other than the cost of funding deposits, which are not directly accounted for in our theoretical pricing model and which might include the input costs of labor and capital. It also reflects the prevailing technology. Interestingly, the model captures the costs of financial intermediation implicitly and obviates the need to formulate an explicit cost function. Further, the value of the $(1/\hat{\alpha})$ coefficient implies that the average transformation efficiency $(\hat{\alpha})$ for all 114 countries is 0.7299.[19] On average, every dollar of new deposits funds 73 cents in loans. A value of $(\hat{\alpha})$

19 The figure 0.7299 is the inverse of the estimated coefficient, 1.37.

between 0 and 1 is consistent with the traditional financial intermediation function of banks in non-OECD countries, where loans are mainly funded by core deposits rather than non-deposit liabilities such as money market funds and subordinated debt.

We also explore which of the two components of the pricing structure is dominant in non-OECD countries, the rent extraction component or the funding costs component. As in section 3.1, we generate the average rent extraction as the product of estimated choke price and the mean value of banking structure. We also compute average funding costs as the product of the estimated inverse of transformation efficiency and the mean value of the deposit rate. Table 5 displays the average component shares of the rent extraction and funding costs in our pricing structure.

Table 5 Component shares of pricing structure

Rent extraction is the product of the estimated choke price and the average value of banking structure. Funding costs is the product of the estimated inverse of transformation efficiency and the average value of the deposit rate. Model 1 uses the entire dataset and Model 2 excludes 11 countries with many banks. All figures are in %.

Component Shares	**Model 1**	**Model 2**
Rent Extraction	55.79	58.71
Funding Costs	44.21	41.29
Total	100.00	100.00

The values of choke price and the inverse of transformation efficiency are from Table 4. From Table 3, we obtain the mean values of banking structures (0.1563) and deposit rate (6.99) for the full sample (Model 1) and the corresponding values for the reduced sample of Model 2, 0.1743 and 6.92, respectively. It is evident from Table 5 that the rent extraction component accounts for the largest part (55.79%) of the loan rate, and its share becomes more striking (58.71%) when we exclude countries with many banks. This finding constitutes evidence of the importance of market structure for bank pricing power under uncertainty.

Finally, the RCM allows us to empirically estimate for each individual non-OECD country the choke price of loans and the transformation efficiency of financial intermediation. We report the results in Table 6 and their percentile distribution in Table 7

Table 6 RCM individual country estimates of choke price and transformation efficiency

Individual country estimates for choke price ($\hat{a}_j$, in %) and transformation efficiency $(\hat{\alpha}_j)$ are generated using a RCM following equation (10). * significant at 10%; ** significant at 5%; *** significant at 1%.

Country	Choke Price	Significance	Transformation Efficiency	Significance
Albania	30.41	**	0.7526	***
Anguilla	0.70	-	0.5010	***
Antigua and Barbuda	14.77	**	0.4916	***
Argentina	4.12	-	0.7081	***
Armenia	67.85	***	0.8115	***
Aruba	8.67	**	0.5840	***
Azerbaijan	70.53	***	0.8036	***
Bahrain	63.29	***	1.3158	***
Bangladesh	114.59	***	0.8164	***
Barbados	18.09	***	0.7395	***
Belize	23.55	***	0.8222	***
Bhutan	35.84	***	2.0459	***
Bolivia	83.13	***	0.7114	***
Bosnia-Herzegovina	40.63	**	0.5374	***
Brazil	643.11	***	0.3338	***
Bulgaria	91.04	***	0.8227	***
Cameroon	62.38	***	0.4524	***
Cape Verde	13.08	***	0.7468	***
Central African Republic	18.64	***	0.5305	***
Chad	22.57	***	0.3964	***
Chile	1.41	-	0.5865	***
China-People's Rep.	51.20	***	0.5122	***
Colombia	55.90	***	0.6951	***
Congo, Democratic Rep.	245.26	***	0.5882	***
Costa Rica	176.34	***	0.7030	***
Croatia	274.81	***	1.5539	*
Djibouti	32.57	***	4.6500	***
Dominica	10.02	***	0.7168	***
Dominican Republic	184.65	***	0.8745	***
Ecuador	65.70	-	0.5301	***
Egypt	155.07	***	1.2680	***
Estonia	15.67	***	0.8731	***
Ethiopia	24.05	***	0.8767	***
Gabon	27.61	***	0.4263	***
Gambia	6.05	-	0.5538	***
Georgia Rep.	179.85	***	1.2837	*
Grenada	21.69	***	1.0420	**
Guatemala	93.64	***	0.5327	***
Guyana	46.91	***	1.4732	***
Haiti	64.70	***	1.8462	-
Honduras	89.91	***	0.7465	***
Hong Kong	71.79	***	0.7513	***
Indonesia	411.79	***	1.3423	***
Israel	21.10	***	0.7387	***
Jamaica	11.67	-	0.4835	***
Jordan	66.14	***	1.5553	***
Kenya	190.22	***	0.6332	***
Kuwait	14.36	***	0.8665	***
Kyrgyzstan	8.51	-	0.3236	***

Country	Choke Price	Significance	Transformation Efficiency	Significance
Laos	51.06	***	0.5578	***
Latvia	30.79	***	0.5928	***
Lesotho	26.68	***	0.6794	***
Liberia	17.16	***	0.4771	***
Lithuania	49.23	***	1.4727	***
Macau	49.69	***	1.2019	***
Macedonia (FYROM)	56.73	***	0.8082	***
Madagascar	153.85	***	2.9263	***
Malawi	135.93	***	1.2480	***
Malaysia	40.81	*	0.6427	***
Maldives	.-	-	-	-
Malta	11.00	***	1.0511	***
Mauritius	22.28	-	0.5039	***
Moldova Rep.	15.04	**	0.8065	***
Mongolia	17.71	-	0.5268	***
Montenegro	45.18	***	1.0899	***
Morocco	25.29	***	0.5938	***
Mozambique	34.51	***	0.8259	***
Myanmar Union of	1.61	-	0.7058	***
Namibia	4.27	**	0.6277	***
Nepal	58.15	***	0.9572	***
Nigeria	12.02	-	0.6747	***
Oman	33.11	***	1.4113	***
Palestinian Territories	12.44	***	1.0563	***
Panama	214.23	***	1.1568	***
Papua New Guinea	27.23	***	0.8518	***
Paraguay	360.93	***	1.3477	***
Peru	259.34	***	0.7897	***
Qatar	24.59	***	1.1860	***
Romania	157.79	***	0.7725	***
Russian Federation	607.92	***	0.5190	***
Rwanda	19.40	-	0.6878	***
San Marino	21.65	***	0.8238	***
Seychelles	3.38	-	0.5506	***
Sierra Leone	25.40	-	0.4963	***
Singapore	29.74	***	0.6975	***
Slovenia	61.69	***	1.2249	***
South Africa	7.30	-	0.7185	***
Sri Lanka	40.04	**	0.7546	***
Suriname	11.39	*	0.5737	***
Swaziland	31.96	***	0.9046	***
Syria	4.21	**	0.8597	***
Tajikistan	40.78	***	0.7169	***
Tanzania	29.63	***	0.5451	***
Thailand	92.52	***	1.4095	***
Trinidad and Tobago	74.24	***	1.2462	***
Uganda	130.61	***	0.8917	***
Ukraine	567.65	***	1.5903	**
Uruguay	0.47	-	0.6115	***
Vanuatu	9.66	***	0.4524	***
Venezuela	30.98	-	0.7566	***
Vietnam	23.63	***	0.8076	***
Yemen	11.24	-	0.8383	***
Zambia	94.52	***	0.6619	***

Table 7. Percentile distribution of individual-country RCM estimates

Percentile	Choke Price	Transformation Efficiency
p1	0.7	0.3338
p5	4.12	0.4524
p10	8.51	0.5010
p25	17.16	0.5865
p50	32.84	0.7519
p75	74.24	1.0420
p90	184.65	1.4095
p95	274.81	1.5553
p99	607.92	2.9263

The bulk of individual-country RCM estimates are highly significant and consistent in sign with the results in Table 4. The averages of the individual estimated RCM parameters are 78.08% for $(\hat{\alpha})$ and 1.36 for $(1/\hat{\alpha})$, and these figures are in line with the parameters reported in Table 4, 77.32% and 1.37, respectively. The estimated values of individual choke prices are all positive. The majority of these estimates (75%) also exceeds 17%, which points to reasonable loans rates at which loan-taking ceases. The estimates of individual-country transformation efficiency $(\hat{\alpha})$ are between 0 and 1 for 78 of 103 countries, consistent with the traditional financial intermediation paradigm, while values of $(\hat{\alpha})$ that exceed 1 are indicative of higher leverage for a small subset of developing countries.[20] The reported choke prices capture various macroeconomic and structural idiosyncrasies at the country level and it is no surprise to have large variations in table 6. A high choke price indicates high tolerance to expensive loan taking, while a small choke price points to an aversion to loan taking. Both behaviors can be explained by macroeconomic and/or cultural reasons.

[20] The 25 countries where $(\hat{\alpha})$ exceeds the value of 1 are: Bahrain, Bhutan, Croatia, Djibouti, Egypt, Grenada, Guyana, Haiti, Indonesia, Jordan, Lithuania, Macau, Madagascar, Malawi, Malta, Montenegro, Oman, Palestinian Territories, Panama, Paraguay, Qatar, Slovenia, Thailand ,Trinidad and Tobago, and Ukraine..

5 Validity checks

We test the sensitivity of our results using an alternative proxy for the probability of loan repayment. From the Bankscope database, we generate another proxy for (p_{jt}) as the ratio of reserves for impaired loans to gross loans and run the RCM again. We also exclude the years 2008 and 2009 from our sample since it might be argued that the global financial crisis might affect our findings. Our main results are maintained.

Although our objective is to empirically validate the pricing structure in equation (8) in a strict sense, without adding any control variable or interactive term to the stochastic specification that is not explicitly spelled out by our structural model, we nonetheless run a series of validity checks for completeness. We capture the effect of business cycles by including in equation (10) the growth rates of nominal GDP across time and countries and run our baseline regressions again. Alternatively, we use a dummy variable, *Recession*, to capture periods where GDP growth rates are negative. The intuition is that adverse economic conditions affect asset returns differently and may change the weights in our decomposition of return on loans (See e.g. Amihud 2002, Acharya and Pedersen 2005). Finally, we use fixed and random effects to estimate our structural model.[21] In all cases, our results are qualitatively unchanged.

6 Concluding remarks

This paper studies bank pricing under the oligopsony-oligopoly market structure that characterizes the banking industry in developing countries. We develop a model where banks have a dual role in catering to the savings needs of depositors and to the financing requirements of borrowers. Considering both deposit and loan markets is consistent with the reality and the theory of financial intermediation. Using standard optimality conditions, we derive a theoretical pricing structure that ties in the loan rate to the number of banks, uncertainty about loan repayment, the transformation efficiency of deposits to loans, and the deposit rate. We test our structural model using data from 103 non-OECD countries and find that both banking structures and the deposit rate are significant determinants of the loan rate. We also document that the rent extraction component dominates funding costs in bank pricing under dual market power. Even when we use alternative estimation methods, controlling for the macroeconomic environment, our main estimates are maintained and are in line with our theoretical pricing formula.

The novelty of our model is that it abstracts from any explicit exogenous cost function for banks, these being typically unobservable or difficult to estimate without restrictive (and probably unrealistic) assumptions. We implicitly capture labor and capital factor costs in banking using what we label as transformation efficiency in converting deposits into loans. Thus, our model is parsimonious, minimizing the number of assumptions needed for an explicit formulation of the cost function. Further, our assumption of a linear demand function allows us to estimate a country-specific choke price of loans that reflects different economic conjectures.

Future extensions of the bank pricing model could include the development of new measures of the degree of market power in the banking industry. The early literature on the Structure-Conduct-Performance (SCP) paradigm identifies traditional measures of concentration as a source of rent extraction, whereas the New Empirical Industrial Organization (NEIO) literature does not account for market structure and infers firms' conduct directly (Degryse et al., 2009). However, NEIO market power measures such as the Panzar and Rosse (1987) H-statistic, the conjectural variation measure by Breshnhan and Lau, and Lerner indexes are contested measures of competition (Schaffer, 2004) and can be seriously biased (Corts, 1999). Indeed, none of the *ad hoc* measures currently employed in the empirical banking literature is derived under the assumption that banks operate on and extract rents from two markets simultaneously, the deposit and loan markets. Our bank pricing model, which views banks as institutions that collect savings from depositors and provide loans to borrowers, is better connected to financial intermediation theory, and it suggests that market structure matters significantly in bank pricing. More importantly, our pricing decomposition allows for the estimation of rents at the industry level, which may shed light on the competition-fragility debate in banking.

[21] The null hypothesis of the Hausman test cannot be rejected at the 1% level, indicating that a random specification of the structural model is more appropriate than a fixed-effects estimation. In our model, the RCM captures such random effects via coefficients that vary across countries.

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