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Market Structure and the Banking Sector

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Market Structure and the Banking Sector*

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Abstract

We propose a simple framework to explore how different market structures in the banking system affect credit allocation, and how deposits and number of entrepreneurs affect the equilibrium number of banks in the economy. We find that within the Marshallian aggregate surplus perspective, the number of entrants in the banking system is always larger than the socially optimal number of banks.

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1 Introduction

The mechanism through which the banking system impacts economic growth by providing liquidity, risk pooling and reducing agency problems is fairly well understood.[1] Unfortunately, much less attention has been devoted to study how market structure in banking affects credit allocation and subsequent growth. It is often argued that a departure from competition is detrimental to growth because banks with market power restrain the supply of loanable funds by setting higher interest rates. On the other hand, competition policies in banking may involve difficult trade-offs. While greater competition may enhance the efficiency of banks with positive implications for economic growth, greater competition may also destabilize banks with costly repercussions for the economy.

Within the partial equilibrium framework, the literature finds that under monopoly, the severity of the particular bank-borrower problem is reduced.[2] On the other hand, general equilibrium models tend to find that less competitive banking systems *may* be detrimental to the economy. In particular, Smith (1998) finds a negative impact of a monopolist banking system on bank structure, on income and the business cycle. Guzman (2000) also finds that under monopoly, banks ration

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[1] A few examples are Greenwood and Jovanovic (1990), Bencivenga and Smith (1991), King and Levine (1993), and Levine and Zervos (1998) among others.
[2] See Riordan (1993), Petersen and Rajan (1995), and Schinter (1998) for particular instances of the bank-borrower problem.

credit more heavily than competitive banks increasing monitoring costs, which results in negative consequences for capital accumulation and growth. On the other hand, Cetorelli (1995, 1997) studies the impact of monopoly on: (1) the financing of credit constrained firms and (2) the screening process for new loans. In particular, he finds that a monopoly bank promotes technology adoption and reduces screening costs but redistributes productive resources to itself rather than potential productive agents. Cetorelli and Peretto (2000) study the market structure effect on capital accumulation. They find that increasing the number of banks increases credit available to entrepreneurs, but also increases costly information acquisition about the risk of entrepreneurs' projects. They show that under this trade off, the market structure maximizing steady state income per capita is an oligopolistic structure (i.e. between monopoly and competitive).

Riordan (1993), Shaffer (1998) and Petersen and Rajan (1995) provide micro level evidence suggesting that concentration in banking may not always be undesirable. Levine (2000) finds greater bank concentration in Chile is not strongly associated with negative outcomes in terms of financial sector development, industrial competition, political and legal system integrity, economic growth or banking sector fragility. Beck, Demirguc-Kunt and Levine (2006) find that crises are less likely in more concentrated banking systems, in countries with fewer regulatory restrictions on bank competition and activities, and in economies with better institutions.

In this paper we propose a simple framework to explore how different market structures in the banking system affects credit allocation. In particular, we want to determine the equilibrium number of banks sustainable under limited resources when all banks are of equal size. We find that when resources in the banking system increases, the number of potential banks in the economy also increases. This finding provides an alternative reasoning for why we tend to find fewer banks in developing countries in comparison to more developed ones. Furthermore, when the return on the alternative investment of banks increases, the bank's potential for higher profits increases, inducing more banks into the banking system. We also show that when the number of entrepreneurs increases relative to deposits, the equilibrium number of banks that can be sustained decreases. Finally, we show that within the Marshallian aggregate surplus perspective, the number of entrants in the banking system is always larger than socially optimal. Throughout the paper, and whenever relevant, we discuss how our model differs and our results compare to the cited papers above.

We take this paper as a first step toward building a dynamic general equilibrium model of bank competition with frictions. Frictions can be introduced in the lending market using a directed search framework where entrepreneurs select over banks using mixed strategies (see Peters (1991), Julien, Kennes and King (2000) and Burdett, Shi and Wright (2001).

2 The Model

The economy consists of N entrepreneurs and m banks. Each entrepreneurs is endowed with one unit of labor. Entrepreneurs have the ability to activate individual-specific technologies if they inelastically supply their unit of labor and if their project is funded. Once the technology has been activated, their demand for capital and the proceeds of their project are observed by intermediaries. Entrepreneurs produce the single final good using the same constant returns to scale technology with capital and entrepreneurial labor as inputs. In particular, let L represent entrepreneurial labor, and let K denote total capital stock per entrepreneur. Production per entrepreneur, Y, is given by the following Cobb-Douglas production function[3]:

$$Y = F(K, L) = K^{\alpha}L^{1-\alpha}.$$

Let $f(k)$=k^{α} denote the entrepreneur intensive production function and k the per capita capital stock per entrepreneurial unit of labor. We assume that if the project is funded, the entrepreneur will hire her own services, and the factors of production are paid their marginal product,

$$w \equiv w(k) = f(k) - kf^{'}(k) = (1-\alpha)k^{\alpha} \text{ and } r = f^{'}(k) = \alpha k^{\alpha-1}; \tag{1}$$

where w is the wage received by the entrepreneur and r is the rental rate for capital. This is different than the Cetorelli and Peretto (2000) model where entrepreneurs provide the funds to final producers at the competitive rate and the latter acquire capital, hire labor and pay wages. Our results holds under such assumption.

2.1 Entrepreneurs Behavior

When funded, entrepreneurs produce the final good and extract utility from consumption $U(c)$ with $U'(c) > 0$ and $U''(c) < 0$. Their objective is summarized as:

$$\max_{c} U(c) \;\; s.t. \; c \leq w \quad \Rightarrow \quad c = w = \begin{cases} (1-\alpha)k^{\alpha} & \text{if funded} \\ \underline{w} & \text{if not funded;} \end{cases}$$

where $\underline{w}$ represents the entrepreneur's alternative sources of income (maybe home production) without capital input requirement. This alternative source of income implies that there is a minimum amount of capital they are willing to borrow defined by $\underline{w} = w(\underline{k})$,or $\underline{k} = \left(\frac{\underline{w}}{(1-\alpha)}\right)^{\frac{1}{\alpha}}$. The minimum acceptable wage simply represent an outside option for the entrepreneur. Assuming it away implies no minimum capital requirement to induce entrepreneurs to bid for loans and do not affect the results. The outside option can also be endogenized, for example, by introducing preferences for home production without affecting the results.

2.2 Intermediaries

All lenders save through intermediaries. Although this assumption might be rationalized by assuming the presence of some friction, such as a relatively large minimum scale at which capital investment can be undertaken, Freeman (1986), we do not explicitly model such a friction here. We interpret these intermediaries as an *ex ante* coalition of lenders that pool resources. Intermediaries are also assumed in Guzman (2000) and Cetorelli and Peretto (2000). Among others, Diamond (1984) and more recently Wiliamson (1986, 1987) provide a theoretical framework modelling financial intermediaries. Banks arise to overcome the asymmetric information problems since it is costly for lenders to acquire information about borrowers and their projects. In their model, banks have economies of scale in information extraction and gathering, and on monitoring. Modelling intermediaries formation would not affect the results but only add a prior stage to our model. To keep our model simple we abstract from informational asymmetry between the intermediary/bank and funded entrepreneurs. We assume that each intermediary can costlessly verify the projects

[3] The results are robust to a neoclassical production function satisfying the Inada conditions.

that it has funded. Our results are robust to the introduction of asymmetric information and a screening mechanism as used in Cetorelli and Peretto (2000).

The aggregate amount of deposits, Δ, is assumed equally distributed among banks so that each bank as $\Delta_i = \Delta/m$ funds. Banks have access to an alternative investment that is not entrepreneur specific, a linear technology, whereby one unit of capital yields X units of consumption. Banks take deposits, Δ_i, from lenders, and decide to allocate these resources between the linear technology and/or extending credit to entrepreneurs. Although we assume an exogenous amount of deposits (i.e. abstract from the saving and borrowing side), our results hold if were were to relax this assumption by allowing saving and banks to offer interest on deposits. (see Cetorelli and Peretto (2000). Instead of having a cost for banks in paying interest to attract deposits, we introduce an alternative investment for banks (returning X per unit of capital) as an opportunity cost of lending to entrepreneurs. Bonds or other such assets are examples. This assumption allows us to investigate the impact of an increase in returns on the alternative investments on the banking structure. This result is not present in other models cited above.

Banks allocate their funds through credit auctions. This particular mechanism for allocating resources is commonly used in money markets. Since interest rates map one for one into prices, the bidding behavior of banks can be interpreted as bidders submitting their true inverse demand for funds, which are given by:

$$D^{-1}(k) = \begin{cases} 0 & \text{if } k < \underline{k} \\ f'(k) & \text{if } k \geq \underline{k}. \end{cases}$$

Once the entrepreneurs submit these bids to all of the existing banks in the economy, credit is allocated.

3 Oligopolistic Banking Structure

The interaction between banks and entrepreneurs is modeled as follows:

1. Banks announce the amount of funds they have available to all of the entrepreneurs in the economy, a maximum of $\Delta_i = \Delta/m, i = 1, ...m$, which is to be divided among the N entrepreneurs.

2. Given the bidding behavior of the entrepreneurs, banks compete in funds.

3. Entrepreneurs submit bids to all of the m banks describing the interest rate they are willing to pay for each amount of available funds, which is from $\underline{k}$ to Δ_i.

A representative bank's profit per entrepreneur is given by $\pi_i = (f'(K) - X)\, k_i$ where k_i is the capital per entrepreneur given by bank i and $K = \sum_{j=1}^{m} k_j$.

Since the bank has two distinct investment opportunities, there will be a capital threshold, after which there will be no resources allocated to entrepreneurs. In particular, the threshold is obtained when the return of the linear technology and the rental rate on capital are equal; i.e, $f'(k^*) = X$, implying $k^* = \left(\frac{\alpha}{X}\right)^{\frac{1}{1-\alpha}}$.

A representative bank's overall profits is simply $\Pi_i = N\pi_i$. Banks maximize profits by choosing the per entrepreneur amount of capital solving:

$$\Pi_i = \max_{k_i \in [\underline{k}, \min\{k^*, \Delta_i/N\}]} N(f'(K) - X)k_i = \max_{k_i \in [\underline{k}, \min\{k^*, \Delta_i/N\}]} N \left(\alpha \left(k_i + \sum_{\substack{j=1 \\ j \neq i}}^{m} k_j \right)^{\alpha-1} - X \right) k_i$$

We can impose symmetry since all banks are identical *ex ante*, i.e, $k_j = k, \forall j$. The unique interior solution for the optimal capital per entrepreneur, per bank, under oligopoly is given by:

$$k^c(m) = \frac{1}{m} \left[\frac{\alpha}{X} \left(\frac{m-1+\alpha}{m} \right) \right]^{\frac{1}{1-\alpha}} \leq \min\{k^*, \Delta_i/N\}. \tag{2}$$

We have $\frac{\partial k^c(m)}{\partial m} < 0$ as long as $m \geq 2$, with $\lim_{m \mapsto \infty} k^c(m) = 0$. Since each entrepreneur submits a bid to all of the m banks, the total amount of capital that each entrepreneur receives is $mk^c(m)$; which is an increasing quantity in m, $\forall m \geq 1$. The quantity per bank supplied in equilibrium is $Nk^c(m)$ and each bank's profit is then given by:

$$\Pi_i(m) = \left(\alpha \left(mk^c(m) \right)^{\alpha-1} - X \right) Nk^c(m)$$

with $\lim_{m \to \infty} \Pi_i(m) = 0$, the standard perfect competition outcome. The aggregate amount of capital supplied to all the entrepreneurs in the economy is then $K^c(m) = Nmk^c(m)$.

Proposition 1 *The equilibrium allocation of funds by an oligopolistic banking structure depends on the aggregate amount of resources available as follows:*

*a. If $\Delta < Nm\underline{k}$ then **no lending** takes place and all resources are invested by banks in the linear technology.*

*b. If $\Delta = Nm\underline{k}$, each entrepreneur obtains its **minimal capital** $m\underline{k} = m\Delta_i/N = \Delta/N$, and each bank lend all their available resources $N\underline{k} = \Delta_i = \Delta/m$.*

c. If $Nm\underline{k} < \Delta < K^c(m)$, each entrepreneur obtains $m\Delta_i/N = \Delta/N$, and each bank lend all their available resources $\Delta A_i = \Delta/m$.

d. If $Nm\underline{k} < K^c(m) < \Delta$, each entrepreneur obtains $mk^c(m)$, and each bank lend $Nk^c(m)$ to entrepreneurs and invest $(\Delta_i - Nk^c(m))$ in the linear technology.[4]

When the resource constraint is not binding, more banks in the economy increases capital per entrepreneur, increases total output, reduces the interest charged on loans and increases the wages that entrepreneurs receive. This result implies that under a monopoly bank ($m = 1$) the economy would experience its lowest capital per entrepreneur, total output, highest interest on loans, and lowest wages. The partial equilibrium results corroborate those of Guzman (2000) and Cetorelli and Peretto (2000), respectively, in either moving from competitive to monopoly bank, or

[4] The proof follows directly and is omitted for simplicity.

from reducing the number of banks in a general equilibrium model with oligopoly banks screening borrowers. However, when the resource constraint is binding, each entrepreneur gets its minimal capital. Moreover, the constraint may be so severe that no lending takes place. Notice that under an oligopoly or monopoly banking structure, profits are realized. We assume that profits simply go to the exogenous intermediaries as in Cetorelli and Peretto (2000). However, the results hold if we were to assume that aggregate profits are equally redistributed to borrowers (entrepreneurs).

3.1 Entry in the Banking System

Let m^* be the free entry number of banks. The equilibrium number of banks depends on the resource constraint. When the constraint is non binding, $k^* \leq \Delta/N$, the free-entry condition yields an infinite number of banks. This is verified by the zero profit condition $\Pi_i(m^*) = 0$, which yields $m^* k^c(m^*) = \left(\frac{\alpha}{X}\right)^{\frac{1}{1-\alpha}} = k^*$. The only way for this equality to hold is when $m^* \mapsto \infty$. If the resource constraint is binding, $\Delta/N < k^*$, then the free-entry condition gives a number of banks that solves $m^* k^c(m^*) = \Delta/N$, which results in:

$$m^* = \frac{\alpha(1-\alpha)}{\left(\alpha - X\left(\frac{\Delta}{N}\right)^{1-\alpha}\right)}.$$

Comparative statics yields:

$$\frac{\partial m^*}{\partial \Delta/N} = \frac{\alpha(1-\alpha)^2 X \left(\frac{\Delta}{N}\right)^{-\alpha}}{N\left(\alpha - X\left(\frac{\Delta}{N}\right)^{1-\alpha}\right)^2} > 0 \text{ and } \frac{\partial m^*}{\partial X} = \frac{\alpha(1-\alpha)\left(\frac{\Delta}{N}\right)^{1-\alpha}}{\left(\alpha - X\left(\frac{\Delta}{N}\right)^{1-\alpha}\right)^2} > 0.$$

First, since m^* is increasing in Δ/N, there is a minimum amount of per-entrepreneur deposits below which only a monopoly bank will serve the entrepreneurs. Second, when the return on the alternative investment of banks, X, increases, the bank's potential for higher profits increases, inducing more banks into the banking system. Third, when the number of entrepreneurs, N, increases, the sustainable number of banks in the economy decreases, reflecting that banks are more constrained by aggregate deposits when facing more entrepreneurs competing for funds. Each bank's reaction as modeled by "quantity" competition is to increase funds available as evidenced by $K^c(m)$, being strictly increasing in N.[5] Since banks' resources are limited in the aggregate, this uncoordinated desired expansion cannot be realized by all banks. Given that deposits are equally distributed among banks, the only way for such expansion to materialize is for some banks to attract away deposits from other banks. This leaves two alternatives for each bank: either attract deposits away from other banks or let other banks attract away its deposits and exit the industry. Although the actual process through which banks lure deposits away from other banks is not explicitly modeled here, this simple structure suggests the following intuition. Banks must offer the highest interest rate possible to depositors in order to attract more funds. An upward pressure in demand for funds created by more entrepreneurs requiring funds would induce banks to bid up the interest earnings offered on deposits, leading to lower profits and inducing some banks

[5] Note that these derivatives are well defined as long as $X\left(\frac{A}{N}\right)^{1-\alpha} \neq \alpha$ or as long as $K^f \neq A$. When $K^f = A$ the equilibrium number of banks under free entry converges to infinity.

to exit the industry. Our findings then suggest that a competitive banking system with infinitely many banks may not always be possible.

These findings are consistent with Robinson's (1952) observation that the need for a large financial intermediation sector is not justified when there are not enough savings or demand for direct investment.[6] Our findings then provides an alternative explanation other than differences in the structure in the tax system, tax compliance, industrial policy, political corruption and the efficiency of the legal and accounting system, of why we tend to find less concentrated banking systems in more developed countries than in less developed ones. Barth, Caprio and Levine (2001) find that the average concentration index in high income countries is 63.75, 66.48 for upper middle income countries, 72.35 for lower middle income countries and for lower income countries is 72.91.[7] Using their data, one can calculate that OECD members have an average number of banks equal to 763.4, while non-OECD countries have a much lower average of 48.4 banks. Considering the average number of banks per 100,000 habitants, we find that for OECD countries the average is 8.9 and for the non-OECD countries is 0.7.[8]

4 Entry in the Banking System and Welfare

This section compares the free entry number of banks with the number maximizing social welfare. We use the Marshallian aggregate surplus as measure of welfare given by:

$$W(s) = \int_0^{A/N} f'(s)ds - mX.$$

The socially efficient number of banks is an integer that maximizes $W(s)$, denoted by m^o.

Proposition 2 *Assume that $mk(m) < A/N$ and (a) $mk(m)$ is strictly increasing in m, (b) $k(m)$ is strictly decreasing in m and (c) $\pi_i(m) > 0, \forall m$, then the equilibrium number of entrants m^*, is at least $m^o + 1$, where m^o, is the socially optimal number of entrants.*

Proof: See appendix.

Conditions (a) requires the aggregate output increases when more banks enter the banking sector, condition (b) requires that the rental rate on capital is never below the return on the linear technology regardless of the number of firms entering the industry, and finally condition (c) says that each bank makes positive profit regardless of the number of entrants. All these conditions are satisfied in our framework for all $m < m^*$. The regulator would like to have fewer banks than under free entry. The tendency for excess entry in the presence of market power is fundamentally driven by the business-stealing effect. When business stealing accompanies new entry and price exceeds marginal cost, part of the new entrant's profit comes at the expense of existing banks, creating an excess incentive for the new bank to enter.

[6] Over the course of an economy's development, its financial sector grows in size relative to the rest of the economy. But whether financial development *causes* economic growth has been difficult to determine. See for example, King and Levine (1993).

[7] Barth *et al* use the World bank's classification when sorting countries according to their income level. The concentration measure they use is the percentage of deposits accounted by the 5 largest banks in a given country.

[8] When computing these average we excluded countries that have offshore banking. The OECD classification used in this exercise is the one used by World Bank.

5 Conclusion

We developed a simple static framework to explore how different market structures in the banking system affect credit allocation. The framework is suitable to analyze how entry is affected by limited resources in the banking system. We show that when resources in the banking system increases, the number of potential banks in the economy also increases, providing an alternative explanation for bank concentration. We find that when the return on the alternative investment of banks increases, the bank's potential for higher profits increases, inducing more banks into the banking system. A result not investigated in existing models. We also show that when the number of entrepreneurs increases relative to deposits, the equilibrium number of banks that can be sustained decreases. Finally, we show that within the Marshallian aggregate surplus perspective, the number of entrants in the banking system is always larger than the socially optimal number of banks. This is a simple partial equilibrium model corroborating the main findings of existing general equilibrium models on the relationship between credit constraints and banking structure. We take the model as a first step toward building a general equilibrium model of bank competition with frictions in the lending market to explore similar issues. Work along this line is in progress by the authors.

6 Appendix

Proof of Proposition 1. The result is trivial if $m^o = 1$, so suppose that $m^o > 1$. Under the assumption of the proposition, $\pi_i(m)$ is decreasing in m. To establish the result, we just need to show that $\pi_i(m^o) < 0$. In order to prove this, note first that by the definition of m^o we must have that $W(m^o) - W(m^o + 1) \geq 0$, or

$$\int_{m^o k(m^o)}^{(m^o+1)k(m^o+1)} f'(s)ds - (m^o + 1)X + m^o X \geq 0.$$

Using $\pi_i(m^o + 1) = (f'((m^o + 1)k(m^o + 1)) - X)\, k(m^o + 1)$, we have

$$\begin{aligned} \pi_i(m^o + 1) &\geq f'((m^o + 1)k(m^o + 1))k(m^o + 1) - \int_{m^o k(m^o)}^{(m^o+1)k(m^o+1)} f'(s)dsk(m^o + 1) \\ &\geq f'((m^o)k(m^o))k(m^o + 1) > 0 \end{aligned}$$

Therefore $\pi_i(m^o + 1) > 0$, which implies $m^* < m^o$. Finally, $m^o < \infty$ since $m^o k(m^o) < A/N$ and $m^o k(m^o)$ is strictly increasing in m. ■

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