Efficiency Structure Hypothesis: An application to the Argentine Banking Sector

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Abstract

The convertibility plan has been accompanied by significant changes in banking policy: opening up of the banking sector to foreign competition, public bank privatization and tightening of the regulatory stance. As a result, the solvency and the liquidity of banking system have improved but the degree of concentration has increased while bank profitability has declined. The latter two facts are consistent with the Efficiency - Structure Hypothesis in the sense that the increase in concentration and decrease in profitability can be viewed as an increase in efficiency.

Burdisso and D'Amato (1999), however, present evidence that in Argentina not only are banks which are more X–efficient less profitable but also that banks which operate in more concentrated (less competitive markets) have higher profitability. This evidence, on the other hand, lends weight to the Conduct Structure Performance Hypothesis in the sense that profitability is driven by market power and not by efficiency.

We develop a partial equilibrium model of the banking sector with perfect competition and heterogeneous banks in the vein of the efficiency structure hypothesis that can explain the evidence above:

If foreign banks are more X–efficient than local banks, and banking reform leads to lower opportunity costs of entering for large banks, entry into the banking sector results in higher concentration, lower profits and a more efficient banking sector.

If the opportunity costs of entry are relatively lower in regions with more developed financial markets, we will observe that banks which operate in such regions might earn lower profits even if they are more X–efficient.

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1 Introduction

The convertibility plan has been accompanied by significant changes in banking policy: opening up of the banking sector to foreign competition, public bank privatization and tightening of the regulatory stance. As a result, the solvency and liquidity of the banking system have improved but the degree of concentration has increased while bank profitability has declined.

The last two facts seem to be inconsistent with the traditional industrial organization literature, implicit in the **Structure–Conduct Performance** (SCP) **Hypothesis**[1]. This hypothesis says that structure causes performance in the sense that market power due to barriers to entry or implicit collusion leads to concentration and higher profitability.[2] From this point of view, the concentration process which has taken place in Argentina, could be detrimental to consumers.

The traditional theoretical view implicit in the SCP has been challenged by the **Efficiency - Structure** (ES) **Hypothesis** .[3] According to the ES view, performance causes structure. Specifically, firms which increase their efficiency firms gain market share at the expense of less efficient firms so that concentration increases. Viewed in this light, the concentration process would go hand in hand with a more efficient banking system.

The evidence from Argentina presented above seems to support the latter hypothesis. A recent study on restructuring and competition in the Argentine banking industry conducted by Burdisso and D'Amato (1999), however, present some evidence which is not easily rationalized by the ES hypothesis. In particular, Burdisso and D'Amato (1999) regress bank profitability against a local Herfindahl–Hirschman index ($LHHI$) and an X–efficiency measure and find that:

- Banks with higher X–efficiency are less profitable.
- $LHHI$ is positive and very significant, which could imply that banks which operate in more concentrated (less competitive markets) have higher profitability.

Nonetheless, they also find that banks with a higher $LHHI$ are those which operate in regions where the banking sector is less developed.

In this paper we develop a partial equilibrium model of the banking sector (in the sense that the extent of the market is exogenous) under perfect competition and heterogeneous banks that can rationalize the facts mentioned above. Specifically, we introduce heterogeneity by allowing banks to differ in their X–efficiency and fixed costs. We show that:

1. If foreign banks are more X–efficient than local banks, and banking reform leads to lower opportunity costs of entering for large banks, entry into the banking sector results in higher concentration, lower profits and a more efficient banking sector.

[1] See, for example, Mason (1939) and Bain (1951)

[2] There exists a close cousin to the SCP theory known as the **Market Power Hypothesis (MP)** which is developed in Mueller (1983) and Ravenscraft (1980) for example. According to the MP theory, market power due to product differentiation or quality allows banks to capture market share, charge higher prices and earn higher profits.

[3] See, for example, Demsetz (1973), Peltzman (1977) and Brozen (1982)

2. If the opportunity costs of entry are relatively lower in regions with more developed financial markets, we will observe that banks which operate in such regions might earn lower profits even if they are more X–efficient.

The paper is divided in four sections. In Section 2 we develop a partial equilibrium model of the banking sector with heterogenous banks. In Section 3 we use the model to analyze the two facts just mentioned: i) the relationship between concentration, foreign ownership and profitability and ii) the relationship between financial development and efficiency. In Section 4 we present the conclusions and some extensions.

2 Model

We will assume that there is a continuum of entities called banks distributed in the unit interval which have the technology necessary to supply banking services. However, although any bank $s \in [0,1]$ could service the market, in each equilibrium only a subset $M \subseteq [0,1]$ will be actually competing:

$$M = \{s \in [0,1] \, | q(s) > 0\}$$

where $q(s)$ is the production of bank s.

2.1 Consumer

There exists a representative consumer which decides how much to buy from each bank. His consumption problem is given by:

$$\max_{d(s)} \quad \int_{[0,1]} d(s)ds \tag{1}$$

$$\text{subject to } I = \int_{[0,1]} p(s)d(s)ds \tag{2}$$

where $d(s)$ is demand for the banking services provided by bank s, $p(s)$ is the price of banking services quoted by bank s and I is total income spent by the representative consumer in banking services.

Since all banks are perfect substitutes from the point of view of consumers, all banks which produce must charge the same price:

$$d(s) > 0 \Rightarrow p(s) = p \text{ for all } s^4 \tag{3}$$

.

2.2 Banks

Producer are heterogeneous in the sense that they differ in their cost functions. In particular, the total cost function of bank s is given by $TC(s, q(s))$ where $q(s)$ is the supply by bank s. We will assume that total cost can be written as:

$$TC(s, q(s)) = \kappa(s) + VC(\phi(s), q(s))$$

where $\kappa(\cdot)$ and $VC(\cdot)$ denote total fixed cost and total variable cost respectively and $\phi(s)$ is a measure of X–inefficiency of bank s. The cost structure of a bank of type s is shown graphically in Figure 1.

To isolate efficiency issues from cost of entry issues, we will assume that

1. $\kappa(\cdot)$ is a function of s but not of $\phi(s)$.
2. $VC(\cdot)$ has the form:
$$VC(\phi(s), q) = \phi(s) \cdot g(q)$$
where the function $g(q)$ is common to all banks.
3. The average variable cost curve (i.e. $g(q)/q$) is U shaped and marginal cost (i.e. $g'(q)$) is increasing in q.
4. Both $\kappa(s)$ and $\phi(s)$ are step functions.

Given these assumptions, the supply side conditions of the banking industry can be summarized by a vector valued function $F : [0,1] \rightarrow R^2_{0+}$ which we will call "supply structure":

$$F(s) = \begin{bmatrix} \kappa^F(s) \\ \phi^F(s) \end{bmatrix}$$

An example of a possible supply structure is given in Figure 2.

The bank maximizes profits taking the prices of their competitors as given:

$$\pi(s) \equiv \max \left\{ \max_{q(s)} pq(s) - TC(s, q(s)), 0 \right\} \tag{4}$$

where the outer max $(\cdot)$ follows because each bank has the option not to produce.

We assume that banks are price takers. Consequently, since all banks which produce charge the same price in virtue of (3) we have that for all banks which produce (i.e all s such that $x(s) > 0$).

$$p = MC(s, q(s)) = \phi(s)g'(q(s)).$$

2.3 Equilibrium

The only equilibrium condition we require is that the market for bank services clears:

$$d(s) = q(s) \quad \text{for all } s \in M \tag{5}$$

Integrating equation (5) for all s we find:

$$D(p) \equiv \int_M d(s)ds = Q(p) \equiv \int_M q(s)ds \tag{6}$$

where $D(p)$ and $Q(p)$ are the aggregate demand and aggregate supply of banking services respectively.

Furthermore, given the budget constraint (2), the definition of Aggregate Demand in (6) and since all banks charge the same price, we have:

$$D(p) = I/p$$

which implies that we have a downward sloping aggregate demand curve.

Define the minimum average cost of bank s as:

$$AC^*(s) = \min_q \frac{g(q)\phi(s) + \kappa(s)}{q} \tag{7}$$

Lemma 1 *Assume that the equilibrium price p satisfies:*

$$\min_s AC^*(s) < p.$$[8]

Then, under the assumptions of this section,

- *A bank s will be indifferent between producing or not iff:*

  $$p = AC^*(s)$$

- *A bank s will produce an strictly positive amount if:*

  $$AC^*(s) < p$$

- *Production, profits and profitability of bank s are non–decreasing in p. They are strictly increasing in p for all s such that $AC^*(s) < p$.*

- *The set of banks which compete at a given price p is given by:*

  $$M(p) = [0, \max t(p)]$$

  where $t(p)$ is an increasing function almost everywhere except at some finite amount of prices where it becomes an u.h.c. correspondence which is also increasing in p.

- *Aggregate supply $Q(p)$ is an u.h.c. correspondence which is increasing in p.*

Proof. See Mathematical Appendix.

Intuitively, the Lemma simply says that for i) a given price, the most efficient banks and/or banks with lower fixed costs should be competing, ii) as prices increase, more banks will be able to compete and the banks already producing will increase their production, iii) as prices increase more banks enter the market so that iv) aggregate supply is increasing in p.

The properties of the set $M(p)$ and of the aggregate supply correspondence $Q(p)$ merit further discussion.

Properties of $M(p)$. Since the only factor that determines whether a bank is producing or not is whether the price is above its minimum average cost, one can order the set of banks according to their minimum average costs in the sense that as p rises, banks with increasingly higher minimum average cost enter the market. Consequently, without loss of generality, one can always assume the banks in B are arranged in terms of their minimum average cost:

$$AC^*(s) \geq AC^*(s') \text{ for all } s \geq s'$$

Since both $\kappa(s)$ and $\phi(s)$ are step functions, we also have that $AC^*(s)$ is a step function of s.

Given that $AC^*(s)$ is a step function, banks can be grouped into sets called types. Specifically, two banks s and s' are said to be of the same type iff:

$$AC^*(s) = AC^*(s')$$

Also because $AC^*(s)$ is a step function, there are n types where n is a finite integer. Denote by $s(i) \in [0,1]$ and $\rho(i)$ $(i \leq 1, ..., n)$ the points at which $AC^*(s)$ increases discretely and the values $AC^*(s)$ takes at these points respectively. This is shown graphically in Figure 3.

Since a bank s is will produce if $p > AC^*(s)$, will be indifferent between producing or not when $p = AC^*(s)$ and since there are n possible values for $AC^*(s)$; for almost all p (i.e. those p such that $p <> \rho(i)$, $i = 1, ..., n$) the set of banks which will be competing is given by:

$$M(p) = [0, t(p)]$$

where $t(p)$ is the minimum s such that $AC^*(s) = \rho(i)$. On the other hand, when $p = \rho(i)$, all the banks of type i will be indifferent between producing or not. Consequently, the set of banks which are producing an strictly positive amount is the interval given by:

$$t(p) = \left[t^l(p), t^h(p)\right]$$

where $t^l(p)$ and $t^h(p)$ are the minimum and maximum s such that $AC^*(s) = \rho(i)$. This implies that we can write the set of banks which produce an strictly positive amount as:

$$M(p) = [0, t(p)] \tag{8}$$

where $t(p)$ is a continuous and non-decreasing function for almost all p except for some p in which it is an u.h.c. correspondence (i.e. those prices that satisfy $p = AC^*(s)$ for some s). The correspondence $t(p)$ is shown graphically in Figure 4.

Properties of $Q(p)$. For any banks which prefer producing to not producing, (i.e. for all i such that $\rho(i) > p$), individual supply is an increasing function of p. In addition, as prices enter, more firms will enter the market. Consequently, aggregate supply is strictly increasing in p.

Aggregate supply is correspondence for some finite p, because when $p = \rho(i)$ for some p and i, all the banks of type i will be indifferent between producing or not. Consequently, for these prices, aggregate supply can take an interval of values depending on how many banks are actually competing. The supply correspondence is shown graphically in Figure 5, Panel A.

Equilibrium. Since aggregate production is increasing in p while aggregate demand is decreasing in p, an equilibrium exists and can be found using a standard supply and demand diagram. This is shown in Figure 5, Panel A where $D(p)$, $Q^F(p)$, p^0 and X^0 are the aggregate demand curve, the aggregates supply curve and the equilibrium price and aggregate quantity respectively.

2.4 Concentration

Since we will be discussing concentration issues, we need a working definition for concentration. Specifically, define the H index of concentration as:

$$H \equiv \sum_i^n s^2(i)$$

where $s(i)$ is the market share of type i banks.

Since we are dealing with a continuum of banks the definition of $s(i)$ needs some clarification. In particular, assume that;

$$s(i) \equiv \mu_i \sigma_i$$

where μ_i is the measure of type i banks which are producing an strictly positive amount and $\sigma_i = px(i)/I$ is the "individual" market share of bank i if he did produce.

3 Comparative Statics

This section is divided as follows. In the first sub–section we analyze under which circumstances supply shocks will lead to changes in equilibrium. In the second section we analyze the effect of changing the fixed costs of a type of banks. In the last subsection we use the results derived in the previous section to shed a light on the Argentine experience.

3.1 Supply Shocks

The following Lemma is useful to determine under which conditions changes in the supply structure (i.e. changes in the distribution of banks minimum average costs) will lead to change in equilibrium prices.

We say that supply structure F is different from supply structure G iff:

$$\kappa^F(s) <> \kappa^G(s) \text{ or } \phi^F(s) <> \phi^G(s) \text{ for at least one } s$$

Define the inverse supply function p^I given production X and supply structure Φ as:

$$p^I(X, \Phi) = \left\{ p \in R_+^0 | Q(p, \Phi) = X \right\}$$

Lemma 2 *Suppose that starting in an equilibrium with equilibrium prices* p^0 *and aggregate equilibrium quantity* X^0 *and* F *is some supply structure that supports this equilibriumm (i.e.* $p^I(X^0, F) = p$*).*

Then, there will be a decline in prices iff:

$$p^I(X^0, G) < p^0.$$

Proof. See Appendix.

Intuitively, the Proposition says that prices will fall only if there is "relevant" supply decline. This Proposition is illustrated graphically in Figure 5. In panel A, the "bank" whose average cost falls is relatively inefficient in the sense that it would have to face a relatively high decline in its minimum average costs before it can start to compete with existing banks. Consequently, although the supply curve shifts down, it does not affect the price. In panel B, the bank is relatively efficient in the sense that although it was not able to compete before the change in average costs, it is able to compete once they do fall. In this case the shift in the supply curve does cause average price to fall.

3.2 Fixed Costs and Equilibrium

The following Proposition tells us what happens when some banks which were not competing in the original equilibrium "benefit" from a decline in fixed costs.

Proposition 1 *Suppose that the fixed cost of all banks of type* i *which were not competing in some original equilibrium falls in such a way that* $\rho^F(i) \geq \rho^G(i)$ *where the superscripts* F *and* G *denote the supply structures before and after the change in fixed costs.*

- *Then, there is a change in equilibrium if and only if:*

$$\rho^G(i) < p^0$$

If this is the case,

1. *Prices fall. Aggregate production increases.*
2. *Profitability, profits, production and market shares fall for all banks whose type is different than* i*. Some of them may leave the market.*
3. *At least some type* i *banks enter the market. The rest of the banks of type* i*, which are indifferent between entering or not, choose not to enter. The market share of banks of type* i *increases.*

   If not all the type i *banks enter, they all earn* 0 *profits.*
4. *Concentration falls if* i *is more* X*–inefficient than the most* X*–inefficient bank staying in the market.*

Proof. See Appendix.

The fall in average costs implies that the type of bank which experiences the fall in fixed costs will enter at a lower price but will produce the same amount at any given price.

For the change in the fixed costs of type i to influence the equilibrium, however, the bank should be able to earn positive profits at the initial price to make entry worthwhile (i.e. that the profits if the bank enters are strictly positive) which will only occur if $\rho^G(i) < p^0$. Consequently, prices will fall iff $\rho^G(i) < p^0$. If prices fall, all the banks in the initial equilibrium will suffer (i.e. profitability, profits, etc. fall) at the expense of the banks which are experiencing a fall in fixed costs and enter the market.

3.3 Theory and Evidence

3.3.1 Competition and Foreign Entry

Suppose that deregulation and growth of the Argentine banking system made the Argentine banking sector relatively more attractive to foreign players. In our model, this can be represented by a fall in fixed costs for some group of banks. As Proposition 1 shows, if the entering (foreign) banks are more X–efficient than existing (domestic) banks, not only does profitability, production and market share of existing banks falls but concentration increases.

3.3.2 Financial Development and Efficiency

During the privatization process which took place during 1995 to 1998, most of the privatized banks did not go to foreign banks nor the more efficient local players. Since these banks are, in general, more efficient it is fair to say that the opportunity cost of entering these markets was relatively large for these banks. Consequently, large domestic which are expanding and/or foreign banks which are entering shy away from small markets and expand into large markets. As a result, banks operating in more developed markets which are more efficient are less profitable than banks operating in local markets which are relatively less efficient.

4 Conclusion

It is a fact that while concentration in the Argentine banking system has increased along with an increase in foreign ownership, lending rates and deposit rates have declined. The model developed in this paper shows that an increase in concentration is not harmful but quite the contrary: concentration will increase if and only if banks which are entering are sufficiently efficient. In addition, the model can also be used to reconcile the relationship between profitability and efficiency with the efficiency market hypothesis.

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A Appendix

A.1 Proof of Lemma 1

Define

$$\eta(\phi,\kappa) \equiv \min_q \frac{g(q)\phi+\kappa}{q}$$

Applying the envelope theorem,

$$\begin{aligned}\frac{\partial \eta(\phi,\kappa)}{\partial p} &= \frac{g(q^*)}{q^*} \\ \frac{\partial \eta(\phi,\kappa)}{\partial \phi} &= \frac{\kappa}{q^*}\end{aligned}$$

where $q^* = \arg\min \min_q \frac{g(q)\phi+\kappa}{q}$. Consequently, $\eta(\phi,\kappa)$ is increasing and continuously differentiable in both arguments.

The conditions under a bank will produce or not are straightforward.

Since with perfect competition, $p = \partial C(q, \phi(s), \kappa(s))/\partial q = \phi(s)g'(q^*)$ for all banks s which are producing and $g''(q) > 0$ production is increasing in p for these banks. As to the profitability of these banks, notice that since they are producing above their minimum average cost (i.e. above $AC^*(s)$), marginal cost increases faster than average cost. Consequently, prices increase faster than average costs so that profitability is increasing in prices. Coupled with the increase in production, profits also increase.

To prove the properties of $Q(p)$ and $t(p)$, a few definitions are useful. Given the definition of $AC(s)$ in (7) and the definition of η above, we have that $AC^*(s) = \eta(\phi(s), \kappa(s))$. Since $\kappa(s)$ and $\phi(s)$ are step functions and $\eta(\cdot)$ is differentiable in both arguments, $AC^*(s)$ is also a right hand continuous step function with n jumps. Without loss of generality, we can assume that the banks in B are ordered according to increasing $AC^*(s)$ and denote by $s(i) \in [0,1]$ and $\rho(i)$ $(i \leq 1, ..., n)$ the points at which $AC^*(s)$ increases discretely and the values $AC^*(s)$ takes at these points respectively.

Properties of $t(p)$ Consider $p \in (\rho(i), \rho(i+1))$. Since $\eta(s)$ is constant for any $s \in (s(i), s(i+1))$, there will be no entry in this interval and we can write $t(p) \equiv s(i)$. Second, consider $p = \rho(i)$. In this case, all s such that $\eta(s) = p$, are indifferent between competing or not so that we can define $t(p) \equiv [s(i), s(i+1)]$. Since

$$\begin{aligned}\lim_{\varepsilon\to 0^-} t(p+\varepsilon) &= s(i) \text{ and } \lim_{\varepsilon\to 0^+} t(p+\varepsilon) = s(i+1) \\ t(p) &= [s(i), s(i+1)]\end{aligned}$$

it follows that $t(p)$ is u.h.c. in p.

Properties of $Q(p)$ First, notice that since individual supplies for any banks which are producing are strictly increasing and as p rises more banks enter the market, aggregate production must be increasing. Second, consider $p \in (\rho(i), \rho(i+1))$. Since $t(p)$ is constant and individual supplies are unique, there is a unique value of $Q(p)$ for any p and $Q(p)$ is function. Finally, consider $p = \rho(i)$. In this case, all $s \in t(p) \equiv [s(i), s(i+1)]$ are indifferent between producing or not while all $s \notin t(p)$ produce a unique amount of banking services. Hence, supply is given by the interval:

$$\left[\int_0^{s(i)} q(p,t)dt, \int_0^{s(i+1)} q(p,t)dt\right]$$

so that it is a correspondence. The proof that $X(p)$ is u.h.c. is analogous to the proof that $t(p)$ is u.h.c. ■

A.2 Proof of Lemma 2

First we prove that $p^I(Q^0, G) < p^0$ implies that $p^1 < p^0$ by contradiction. Suppose to the contrary that $p^1 \geq p^0$. Then, since the aggregate demand curve is downward sloping, $Q^1 \leq Q^0$ and so:

$$p^I(Q^0, G) \geq p^I(Q^1, G) = p^1 \geq p^0$$

which contradicts the fact that $p^I(Q^0, G) < p^0$.

Second, we prove that $p^1 < p^0$ implies that $p^I(Q^0, G) < p^0$. Since the demand curve is downward sloping $p^1 < p^0$ implies $Q^1 > Q^0$. Consequently,

$$p^I(Q^0, G) \leq p^I(Q^1, G) = p^1 < p^0$$

where the first inequality follows from the fact that the supply curve is not downward sloping. ■

A.3 Proof of Proposition 1

First, notice that for all banks except those of type i, the amount of production at any given price has not changed i.e. $\rho^F(j) = \rho^G(j)$ for all $j <> i$. Banks of type i whose fixed costs have declined, however, will enter the market at a lower price.

If $\rho^G(i) > p^0$, bank i will not enter even with lower fixed costs with the original equilibrium costs. Consequently,

$$p^I(X^0, G) = p^0$$

and by Lemma 2, there is no change in prices.

Suppose that $\rho^G(i) = p^0$. In this case, although the bank is indifferent between entering or not when prices equal p,the inverse demand function does not change. By Lemma 2, prices do not change either.

Consequently, $p^1 < p^0$ iff $\rho^G(i) < p^0$.

Suppose that $p^1 < \rho^G(i)$. Then, $q = 0$ for all banks of type i and so:

$$\begin{aligned} X^0 &= Q(p^0) = \int_{M(p^0)} q(p^0 s)ds \leq \int_{M(p^0)} q(p^1, s)ds \\ &\leq \int_{M(p^1)} q(p^1, s)ds = Q(p^1) = X^1 \end{aligned}$$

where the first inequality follow because with a lower p all banks of type different from i decrease their production and the second because some of these banks could leave the market as prices fall. However, this contradicts the fact that since the aggregate demand function is downward sloping, $X^0 > X^1$. Consequently, $p^1 \geq \rho^G(i)$.

It can be shown that if $q = 0$ for all banks of type i we also reach a contradiction. Consequently, at least some banks of type i will produce in the final equilibrium. How many depends on change in fixed costs which determines $\rho^G(i) - \rho^F(i)$. Moreover if all banks of type i end up producing, since they are identical they will all earn the same profits which can be positive or nil.

Figure 1: Costs

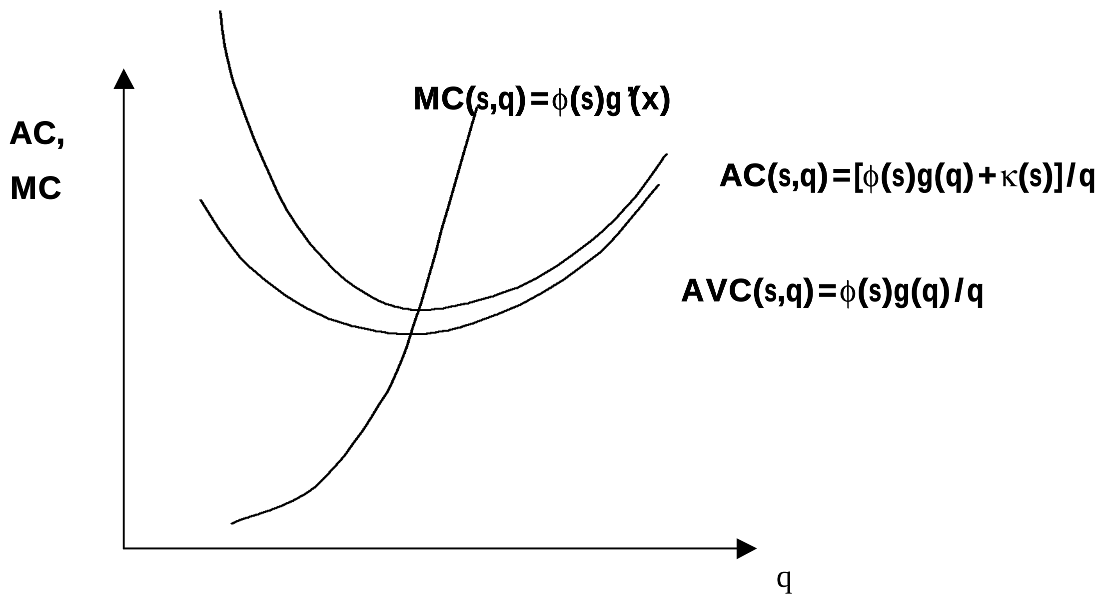


Figure 2: Supply Structure

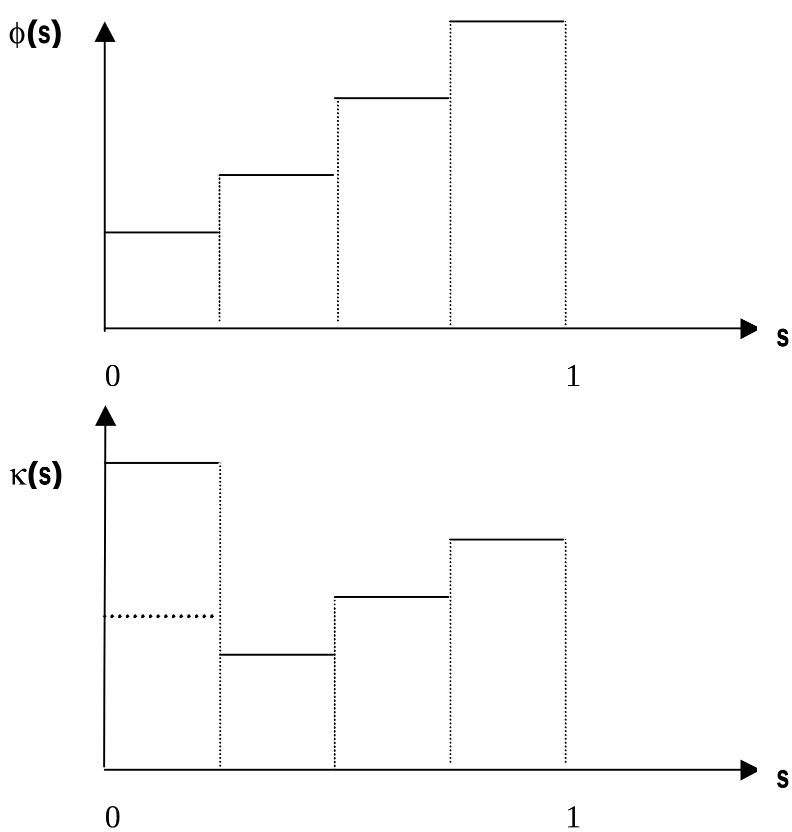


Figure 3: Types and Minimum Average Costs

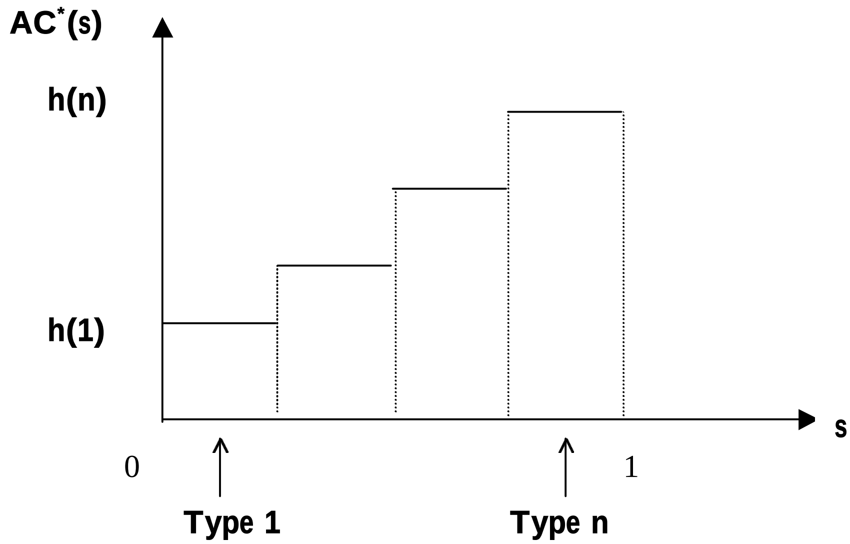


Figure 4: Entry and Prices

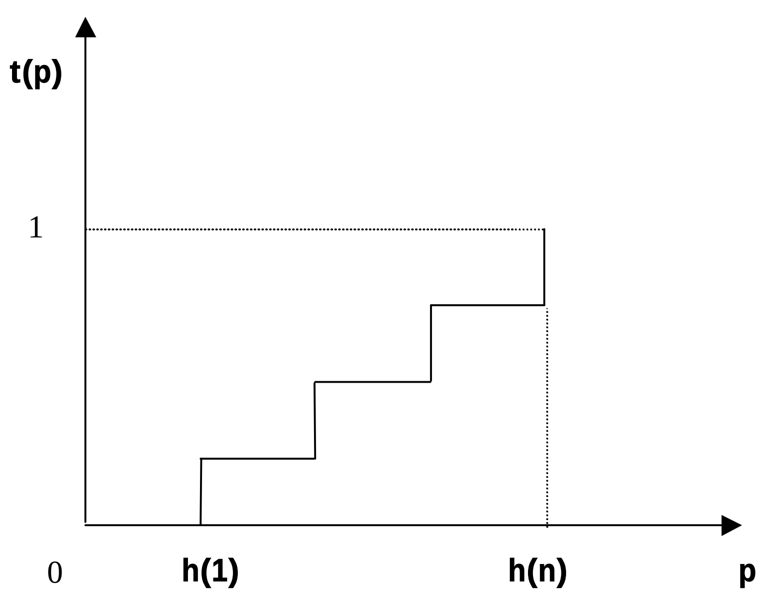
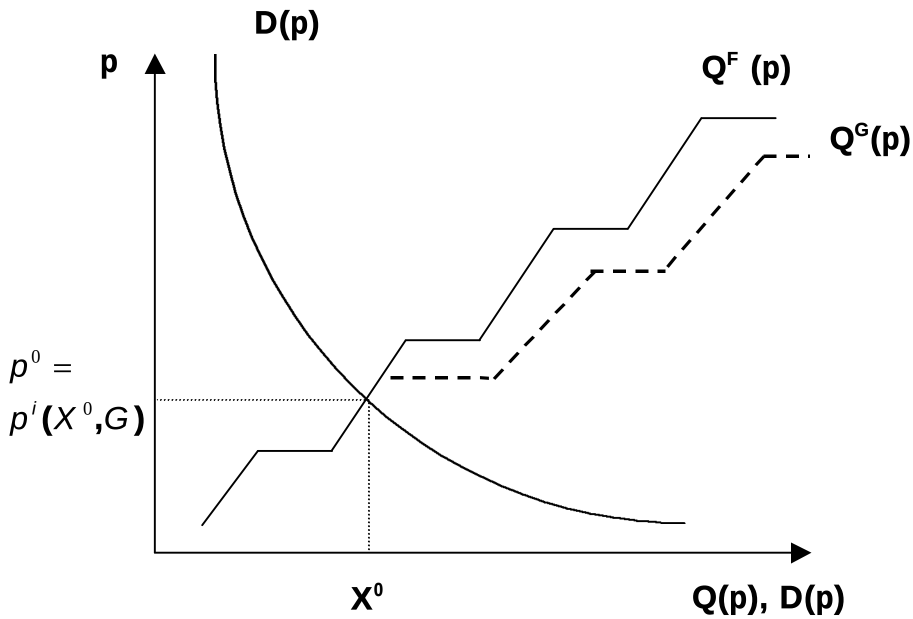


Figure 5: Change in the Average Cost of a type of Bank

Panel A: Relatively Inefficient "Bank"



Panel B: Relatively Efficient "Bank"