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**SIGNALLING AND ENTRY DETERRENCE
IN BANKING**

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Abstract

In this paper we review and explore the strategic mechanisms which deter entry in banking. The existing models of entry deterrence in banking primarily highlight adverse selection as the main driving force behind deterrence. We show that adverse selection (emphasizing the asset side of bank balance sheets) is not a necessary condition for creating barriers to entry. Instead we rely on cost differences of different types of incumbents and show that even with private information about these costs there can be entry deterrence. In a one period model, a loan commitment option contract issued by banks is a sufficient signalling mechanism for deterring entry conditionally. Weak (high cost) banks cannot deter entry. However, in a multiperiod model where signalling is done through fighting at the spot market, the weak incumbent can also prevent entry in the initial periods though they cannot prevent it altogether. Further, incorporating adverse selection in the model does not create blockaded entry.

Section 1 : Introduction

History testifies to the fact that there have been formidable barriers to entry in the banking industry in developed as well as less developed countries. One reason behind this has been regulatory protection. Different legislative barriers like exclusive banking charters (USA), monopoly over the right of note issue (France) or exclusive privileges regarding formation of joint stock banks (England) have been in force in different stages of banking history. Given the political and economic implications of stability of the banking industry and the allegedly destabilizing role of free competition¹, it is easy to see why banking regulators came forward to give patronage and create entry barriers for the incumbents. Other reasons of regulatory barriers could be found in the subsidy requirements for agriculture (leading to protected and nationalized banking as in India or France) or the necessary protection for local business (creating interstate barriers in USA) or capital flight (which concerns the emerging market countries). Also, in many cases, concerns beyond pure public interest have created regulatory barriers. During monarchical rule in the European and Asian countries, loans to the Sovereign of the State have given the incumbent bank or a cartel of incumbents the monopoly right in banking in a particular territory, in specific products and with respect to certain clientele types. Bankers eager to cultivate profitable relationships with the Sovereign(s) of States and thereby acquire these special privileges used to offer loan commitments.² While the history of banking is a story of protectionist regulation to a large extent, the recent past have seen a dramatic reversal of such

tendency with the weakening of regulatory barriers in different countries in the wake of financial liberalization and increasing faith in competition³. However, entry patterns have not been uniform across different States and regions. In Europe, despite the formation of the Union, cross border movement has been relatively small. The national banking markets of most of these countries are still remarkably segmented and well protected with an oligopoly of big banks commanding the major share of assets and a periphery consisting of small banks. In the United States on the other hand, the relaxation of interstate barriers have led to movements and consolidation across State lines. At the same time evidence on cross border branching show capital has an increasing tendency to move through and acquisitions of the US and Spanish multinational banks at a global level. In this context it is important to compare the global advantage of these multinational banks and the home field advantage of the local banks. Berger, Udell, Young and Genay (2000) test the competing claims of home field advantage hypothesis versus that of global field advantage hypothesis taking data on cross border banking in Spain, Germany, France, UK, and USA in the 1990s. Interestingly, while they reject unconditional global advantage hypothesis, they find that a limited form of global advantage hypothesis is not rejected against the (alternative of home advantage hypothesis) where the limited form is applicable to banks of a limited sample of countries with specific regulatory, organizational and industrial structures. What emerges is that entry or comparative advantage in international banking is conditional on the attributes of the home country environment of the potential entrants. While multinational banks from

USA have comparative advantage both at home and away, only a few countries have equal efficiency in foreign conditions and most countries have comparative advantage at home and disadvantage in foreign markets. While more such studies with data on within as well across the borders are warranted, it is evident that entry is conditional not only on a set of regulatory but natural barriers as well. One needs to develop an industrial organization model of banking that addresses this issue satisfactorily.

There has been a proliferation of work on entry deterrence in the Industrial Organization Literature (IO). Do we need separate answers on entry deterrence in banking other than the general theories on deterrence already put forward by this literature? What do we learn from this literature when we try to use it in the context of banking industry? Let us look at some of the standard IO way of looking at entry deterrence.

Increasing returns - It has primarily focused on the strategic excess capacity creation effect by the incumbent(s) which can directly lead to entry deterrence. See for example, Spence (1977) and Dixit (1980) which use Stackelberg model of sequential capacity choices. The presence of increasing returns in this industry certainly makes capacity creation a natural instrument for deterrence or blockade. However, in recent times, fixed costs of capacity creation have become less relevant due to rapid rate of obsolescence in information gathering, processing and disseminating technology on which banking depends so heavily⁴. Under the threat of entry by a technologically sophisticated entrant, the only survival strategy of the

incumbent is to scrap his existing capacity and start with almost a new one or restructure and update the old technology heavily to adapt to the features of the new.⁵ Therefore, what amount of capacity a bank has becomes highly irrelevant in today's context and capacity embodied in systems architecture does not remain a credible threat for deterring entry. In fact, the higher rate of entry in banking as well as faster rate of technology adoption can be attributed to this cause apart from the obvious facilitating role of relaxed protective regulatory barriers in this industry.

Further, the evidence on economies of scale in banking is mixed. Using data from the 1980s, Berger and Humphrey (1991) found that medium sized banks achieved the optimal scale while Berger, Hanweck and Humphrey (1987) found little evidence on scope and product mix efficiency. On the other hand, using the data from the 1990s Berger and Mester (1997) found significant scale efficiency for very large banks (though the sample size was too small to get firm conclusions). These analyses are not strictly comparable since the latter studies take into account the risk reduction and product mix benefits associated with increasing scale.

Absolute cost advantages - Cost advantages for the incumbent can lead to limit pricing to deter entry. One issue is whether such cost differentials are common or private information. Milgrom and Roberts (1982) address the point. They analyze a limit pricing game where the cost of the incumbent is private information and derive the conditions for separating and pooling equilibrium. Cost differentials can arise due to cheaper input procurement systems, or different regulatory and

organizational attributes. Economists have seriously started investigating the nature and source of cost differentials in banking. One study worth mentioning is Gehrig and Sheldon (1999) who conduct an analysis of scale, scope and x-efficiency of European banks and find significant cost differentials especially within the national borders. The major part of cost differential stems from differences in x-efficiency rather than economies of scale or scope. Berger, Udell, Young and Genay (2000) test the competing claims of home field advantage hypothesis versus that of global field advantage hypothesis taking data on cross border banking in Spain, Germany, France, UK, and USA in the 1990s. Interestingly, while they reject unconditional global advantage hypothesis, they find that a limited form of global advantage hypothesis is not rejected against the (alternative of home advantage hypothesis) where the limited form is applicable to banks of a limited sample of countries with specific regulatory, organizational and industrial structures. What emerges is that entry or comparative advantage in international banking is conditional on the attributes of the home country environment of the potential entrants. While multinational banks from USA have comparative advantage both at home and away, only a few countries have equal efficiency in foreign conditions and most countries have comparative advantage at home and disadvantage in foreign markets.

Other factors which can deter entry include product differentiation advantages, capital requirements, and contracts as a barrier to entry (Aghion and Bolton 1987). The last one is particularly important given the

fact that incumbent banks can hardly use excess capacity as the deterrent.

Let us now look at the new literature on financial intermediation that attempts to explain entry deterrence. The most important paper so far has been that of Dell Ariccia, Friedman and Marquez (1999). They show that where only incumbent(s) can first screen and make accept/reject decisions on loan applicants, and entrant(s) can only screen after those accepted have already received credit in the first period, an adverse selection problem develops for the latter and blockades entry. This is basically that entrants cannot identify those rejected by the incumbents. This raises the screening costs and reduces profitability of entrants creating blockaded entry or deterred entry. Ariccia (1998) analyzes the effects of informational asymmetries on the market structure of the banking industry in a multi period model of spatial competition. Incumbent banks gather proprietary information about their clients in the process of lending, acquiring an advantage over potential entrants. This informational advantage may act as a barrier to entry unless the growth rate of new borrowers is sufficiently high. Finally, the paper shows that even in the absence of fixed costs, there will be a finite number of banks in the steady state.

Gehrig (1998) tackles the issue of sequential competition and is similar to our model in spirit. He shows that when the above adverse selection problem exists for entrants, and, to reinforce that, incumbents can offer contracts that meets the lowest interest rate offered by entrants (competition meeting clauses), barrier to entry remains very high. However, to the

extent that screening costs are increased due to greater competition, both entrants as well as incumbents will have the incentive to reduce screening intensity. As a result there will be some entry but the asset qualities of banks may worsen severely due to negative effects on screening incentives.

Hauswald and Marquez (2000) focus on the interaction of the adverse selection effect which curtails competition and the effect of competition on informational rent erosion. In their model, with increasing competition, banks tend to shift more resources in their core sector where they have closer relationships with clients (where the adverse selection problem for the competing entrants is greatest) and move away from the periphery where they give transactions loans.

Boot and Thakor(2000) show that prospect of higher competition between banks forces them to develop relationships and customize services. As already noted in the basic IO literature, this relaxes price competition and prevents rents from being completely competed away. However, they assume the threat of competition or entry to be exogenous and unaffected by the degree of relationship orientation.

Our approach in this paper, is that of exploring the importance of different conditions for entry deterrence where we first turn to the contractual and cost difference aspects and later on integrate it with the adverse selection problem :

1. We show that cost asymmetry is a sufficient condition for entry deterrence even under incomplete information
2. we show contractual variations in financing are permissible in the extended version of the model which retains the basic conclusion
3. we show that first mover advantage is not a necessary condition for entry deterrence in a multiperiod setting
4. We show that when adverse selection and cost asymmetry are simultaneously present, and screening takes place through contracts (in the Rothschild and Stiglitz (1976) sense), entry is possible even when the incumbent has lower costs.

Section 2 : The benchmark model

Contractual Time Structure

There are two dates $t = 0$ and $t = 1$ which mark the beginning and the end of a contractual period respectively. At $t = 0$ a forward market for loan commitment opens where the incumbent bank can promise a loan to a borrower. At $t = 1$ the contract signed at $t = 0$ is either exercised or it expires at the option of the borrower. At $t = 1$ the spot market for credit opens.

Borrower

There is a single borrower who has no funds of her own and needs one unit of credit at $t = 1$. Her project has return R . We assume that the borrower is non-strategic since it is depicted as a representative of the entire market.

Banks

I: Incumbent

There is a single incumbent bank. It can be of two types distinguished by its cost funds r_i (where i denotes type) and type can be strong ($i = s$) or weak ($i = w$) with probability p and $1 - p$ respectively.

A1. $r_w > r_s$

The incumbent knows its type but others don't.

E: Entrant

The entrant appears at $t = 1$. His cost of funds is r_e .

A2. $r_w > r_e > r_s$

The above inequality is the only interesting and non-trivial case. Assuming the entrant's cost is higher than either type ($r_e > r_w > r_s$) rules out entry trivially and similarly assuming a cost advantage over both ($r_w > r_s > r_e$) generates entry with probability one in all states of nature.

The game

The following matrix gives the sequence of date event pairs:

Date	Event
$t = 0$	Nature determines type "i"
$t = 0$	Incumbent offers forward contract $r(i)$
$t = 0$	Borrower accepts or rejects
$t = 1$	Entrant decides on entry
$t = 1$	Bertrand competition if entry

The incumbent can offer any rate of interest belonging to the real line R . Note that given the forward contract offer the entrant can make an inference about the type of the incumbent. Thus we have a posterior probability function $q_i(r(i))$. The entrant can either enter or decides not to. Given the posterior beliefs of the entrant about the incumbent type, there is a optimal decision function of the entrant which maps each possible belief to a unique point in the binary action space of the entrant (enter, don't enter).

Equilibrium

As described above, we have in our hands, a dynamic game of incomplete information. The relevant equilibrium concept for this type of game is Perfect Bayesian Equilibrium. Therefore equilibrium of this signalling game G is a strategy profile $[r(i), d_e(r(i))]$ and posterior beliefs $q_i(r(i))$ such that :

- (i) $\forall i, r(i) \in \arg \max \Pi_i[q_i(r(i)), d_e(q_i)]$
- (ii) $\forall r(i), d_e(q_i) \in \arg \max \Pi_e[r(i), q_i(r(i))]$
- (iii) For the information sets belonging to the equilibrium path of the game G , the posterior probabilities are related to the priors in the following way :

$$q_i(r(i)) = [p(i) \cdot p(r(i) | i)] / \sum [p(i) \cdot p(r(i) | i)]$$

(Bayes' Rule).

We assume here that entrant won't enter if it does not make positive profit. Also, in case of Bertrand competition, there will be limit pricing by whoever has lower cost and the other one will drop out of the market if it makes zero profit at that interest rate.

Proposition 1: There exists a unique separating equilibrium (in pure strategies) where the strong incumbent deters entry and entry takes place if the incumbent is weak.

Proof:

Step 1. A separating equilibrium exists

The strong type solves $\max r(s) - r_s$

w.r.t $r(s)$

s.t. $r(s) \leq R$ (participation constraint)

$r(s) - r_w \leq 0$ (incentive compatibility)

Given that $r_s \leq r_w \leq R$, the optimal solution is $r(s) = r_w$. Note that it just satisfies the participation constraint and that the weak type cannot mimic this contract with positive profit.

When the entrant observes the contract it correctly infers that with probability one the incumbent is of strong type. Given that it cannot make a positive profit in case of a strong incumbent, deterrence results and the borrower has no option but to exercise the loan commitment.

For all other contracts r the entrant infers that with probability one the incumbent is of weak type. Therefore, in such cases, it enters.

Step 2. The equilibrium is unique

Suppose there exists another separating equilibrium. For any other contract which satisfies the participation constraint and the incentive constraint above, $r(s) < r_w$.

But this does not maximize the profit of the strong incumbent. So we get a contradiction and therefore the separating equilibrium is unique.

Step 3. A pooling equilibrium does not exist

In a pooling equilibrium, the strong type does not solve the no mimicking condition. Therefore $r(s) = r(w) = R$. Given this entry occurs since with probability $(1 - p)$ the entrant (correctly) believes the incumbent is of weak type in which case it will enter and bertrand competition will lead to a spot rate r_w at which the incumbent leaves the market. In case of a strong incumbent the entrant makes zero profit. So the expected profit of the entrant in a pooling equilibrium is $(1 - p) r_w$. So the entrant enters. Given this strategy, the strong type knows that bertrand competition will ensure that it can charge r_e only. Since $r_e < r_w$ therefore it is optimal for the strong incumbent to charge r_w . But in that case there will not be any pooling equilibrium since the no mimicking condition is satisfied.

QED.

Section 3 : Contractual Variations

A. Concessionary Finance to a Sovereign

As mentioned before, loans to a Sovereign (especially during wars) were instrumental in acquiring monopoly rights in banking. The question that arises is under what conditions, incumbents would be able to persuade the Sovereign to accept the contract and deter entry. As we shall show here, a straightforward extension of the benchmark model answers this question.

Let there be two borrowers each demanding one unit of credit where the first borrower is the sovereign and the second is a subject of the sovereign. In exchange for a concessionary loan commitment contract to the sovereign, the incumbent demands an exclusive banking right. With exclusive charter it is a monopoly over the subject of the sovereign in the credit market and can charge a maximum interest rate $r_m > r_w$. In other words, it can charge such a high interest rate that it makes a profit even if it is a weak type with a high cost of funds. Now, as before, we have a separating equilibrium where entry is deterred if and only if the incumbent is of strong type. To start with, one has to examine the expected interest rate of the sovereign if it rejects the forward contract offer⁶.

If the type is strong, the interest $r(S)$ charged to the sovereign, will be such that

$$r_m + r(S) - 2 r_e = 0 \text{ or } r(S) = 2 r_e - r_m.$$

If the type is weak, interest will be $r(S) = 2 r_w - r_m$.

Therefore the expected interest rate faced by the sovereign if it rejects the forward contract is $E(r) = p \cdot (2 r_e - r_m) + (1-p) \cdot (2 r_w - r_m)$.

Now, this is less than $2 r_w - r_m$, the minimum interest to be charged by the weak incumbent in order to break even. Therefore, the strong type will offer $r(S) = E(r)$ and entry deterrence results as before when the type is strong.

B. Signalling through debt and equity combination

In Japan and Germany, banks hold equity in firms where they have lent⁷. Relationship banking of this type is also associated with entry deterrence. We sketch a simple model where the use of equity contract (along with debt contract) is necessary for generating entry deterrence.

A4 . An incumbent of type "i" can augment project return by $x(i)$ amount where $x(s) > x(w)$.

This makes the signalling problem more difficult because now if the strong type wants to charge a higher interest rate in order to get compensation for its advisory role in the project, the weak can costlessly mimic such a high interest rate contract. Even if the contract makes the repayment conditional on project return enhancement, it may not be possible to separate the weak and the strong. For example, let the contract be $(E(r), x(i))$ where $E(r)$ is the fixed interest obligation of the debt contract and $x(i)$ is return on the equity held by the bank. If $E(r) + x(w) > r_w$ then it is feasible for the weak type to mimic this type of contract. Therefore, the strong bank is forced to bring innovations in terms of the contract. What it can do viably is to write a written agreement to incorporate a penalty clause which punishes the advisor if the "promised return" is not forthcoming.

Proposition 2. Entry deterrence takes place when the type is strong and for sufficiently high penalty rate n .

Proof : strong type solves max $r(s) - r_w$
wrt $r(s), n$

subject to

$$R + x(s) - r(s) \geq R - E(r)$$

$$r(s) - r_w - n < 0$$

Let $r(s,+)$ be the return when the promised return $x(s)$ is forthcoming. Let $r(s,-)$ be the return when it does not materialize.

The solution yields $r(s,+) = E(r) + x(s)$

and $n > E(r) + x(s) - r_w$

so $r(s,-) = E(r) + x(s) - n < r_w$

$r(s,-)$ is debt (fixed claim)

$r(s,+) - r(s,-)$ is equity (contingent claim)

Section 4: Asymmetric Costs and Adverse Selection

Our benchmark model can be easily modified to accommodate the adverse selection problem in the credit market.

In this section we modify the benchmark model in the following way

(I) there are two types of borrowers : the high type (denoted by the superscript h) has a marginal revenue ϕ_h^s from borrowing with probability p_h and the low type

(denoted by the superscript l) has a marginal revenue ϕ_l from borrowing with probability p_l where

$$p_l \phi_l < p_h \phi_l < r_w < p_h \phi_h \quad \text{and}$$

$$(\lambda) / (1-\lambda) \geq (\phi_h - \phi_l) / \{(\phi_h - (r_w / p_h))\}$$

(II) each bank faces a resource constraint : $B_1 \cdot \lambda N + B_2 (1-\lambda)N = L$

where L is total loanable funds, λ is the proportion of high type of borrowers, N is the total number of borrowers, B_1 is the amount lent to high type and B_2 is the amount lent to low type of borrowers.

We have the following proposition.

Proposition 3: The strong incumbent will offer contract for the high type of borrower only. When the incumbent is strong the entrant will enter only if $\phi_l \cdot p_l > r_e$ (in this case the entrant will target the low type of borrower) and the entrant will not enter if $r_e \geq \phi_l \cdot p_l$. When the incumbent is weak the entrant will enter and offer a contract for the high type. The weak type of incumbent will not offer any contract.

Proof : We check the three cases where the incumbent gives loan to high, low or both types.

(a) strong incumbent gives loans to type "h" only

where (R_1, B_1) solves

$$\max. \{R_1 \cdot p_h - r_s \cdot B_1\} \lambda N$$

s.t.

$$p_h (\phi_h B_1 - R_1) \geq 0$$

$$0 \geq (R_1 - p_h - r_w \cdot B_1) \lambda N$$

The no mimicking condition binds : $(R_1 - p_h - r_w \cdot B_1) \lambda N = 0$

$$\text{then } R_1 = r_w \cdot B_1 / p_h$$

$$\text{Or } R_1 / B_1 = r_w / p_h$$

where $r_w / p_h < \phi_h$ (so the other constraint is satisfied).

Given this strategy :

(i) whenever $R_1 / B_1 = r_w / p_h$, the entrant believes the incumbent is strong and targets the low type

where (R_2, B_2) solves

$$\text{max. } (R_2 - p_l - r_e \cdot B_2)(1-\lambda)N$$

s.t.

$$(\phi_l B_2 - R_2) \geq 0$$

$$(\phi_l B_2 - R_2) \geq (\phi_l B_1 - R_1) = B_1 \{\phi_l - (r_w / p_h)\} < 0$$

so at the optimum the participation constraint binds and the incentive constraint is satisfied : $R_2 / B_2 = \phi_l$

Note that this implies that incentive constraint for the high type is also satisfied

$$(\phi_h B_1 - R_1) = \{(\phi_h - (r_w / p_h))L / (\lambda N)\} \geq (\phi_h B_2 - R_2) = (\phi_h - \phi_l)L / ((1-\lambda)N)$$

Note that entrant enters only if $r_e < \phi_l \cdot p_l$.

(ii) whenever $R_1 / B_1 \neq r_w / p_h$, the entrant believes the incumbent is weak and targets the high type

where (R_1, B_1) solves

$$\max. \{R_1 \cdot p_l - r_e \cdot B_1\}(\lambda)N$$

s.t.

$$(\phi_h B_1 - R_1) \geq 0$$

$$(\phi_h B_1 - R_1) \geq (\phi_h B_2 - R_2)$$

and the weak incumbent maximizes

$$\max. \{R_2 \cdot p_l - r_w \cdot B_2\}(1-\lambda)N$$

s.t.

$$(\phi_l B_2 - R_2) \geq 0$$

$$(\phi_l B_2 - R_2) \geq (\phi_l B_1 - R_1)$$

Now we solve for the maximum payoff to the weak incumbent since it has the first mover advantage over the entrant.

$$(\phi_l B_2 - R_2) = 0$$

Maximum payoff to the weak incumbent is $\Pi(w) = \{(\phi_l p_l - r_w) B_2\}(1-\lambda)N < 0$.

So the weak incumbent will not offer any contract.

Therefore, $(\phi_h B_2 - R_2) = 0$ and the incentive constraint for the high type is the same as the participation constraint in the entrant's optimization problem and the constraint binds.

So, $\phi_h B_1 = R_1$

So if $r_e < \phi_l p_l$, then the payoffs are

- to the strong incumbent is $\Pi(s, h) = (r_w - r_s)L$
- to the weak incumbent is $\Pi(w, h) = 0$
- to the entrant is $\Pi(e, h) = p \{(\phi_l p_l - r_e)L + (1-p) \{ (p_h \phi_h - r_e)L \}$

If $r_e \geq \phi_l p_l$, then the payoffs are

- to the strong incumbent is $\Pi(s, h) = (r_w - r_s)L$
- to the weak incumbent is $\Pi(w, h) = 0$
- to the entrant is $\Pi(e, h) = (1-p) \{ (p_h \phi_h - r_e)L \}$

(b) strong incumbent gives loans to type "l" only : given this the entrant will target the high type.

For the strong incumbent (R_2, B_2) solves

$$\max \{R_2 \cdot p_l \cdot r_s \cdot B_2\}(1-\lambda) N$$

$$(\phi_l B_2 - R_2) \geq 0$$

$$(\phi_l B_2 - R_2) \geq (\phi_l B_1 - R_1)$$

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$$0 \geq \{R_2 \cdot p_l - r_w \cdot B_2\}(1-\lambda)N$$

Note that the no mimicking condition is satisfied whenever the first constraint is satisfied.

We check for the maximum payoff of the incumbent due to its first mover advantage.

The maximum payoff is achieved when $(\phi_l B_2 - R_2) = 0$.

So the incentive constraint which the entrant has to provide for the low type binds since

$$(\phi_h B_1 - R_1) \geq (\phi_h B_2 - R_2) = B_2 ((\phi_h - \phi_l) > 0$$

$$\text{So } R_1 = \phi_h L/(\lambda N) + L/((1-\lambda)N) (\phi_l - \phi_h) < \phi_h L/(\lambda N)$$

Note that the incentive constraint for the low type is satisfied since the participation constraint for the low type and incentive constraint for the high type are satisfied.

If $p_h[\phi_h L/(\lambda N) + L/((1-\lambda)N) (\phi_l - \phi_h)] - r_e \cdot L > 0$ then entrant enters, otherwise not.

The payoff to the strong incumbent is $(p_l \phi_l - r_s)L < (r_w - r_s)L$.

Therefore the strong incumbent will not find it optimal to give loans to low type only.

◦ strong incumbent gives loans to both types

$$\text{Max } \{R_1 \cdot p_h - r_s \cdot B_1\}\lambda N + \{R_2 \cdot p_h - r_s \cdot B_2\}(1-\lambda) N$$

w.r.t. $\{ (R_1, B_1), (R_2, B_2) \}$

s.t.

$$p_h (\phi_h B_1 - R_1) \geq 0 \quad (1)$$

$$p_h (\phi_h B_1 - R_1) \geq p_h (\phi_h B_2 - R_2) \quad (2)$$

$$p_l (\phi_l B_2 - R_2) \geq 0 \quad (3)$$

$$p_l (\phi_l B_2 - R_2) \geq p_l (\phi_l B_1 - R_1) \quad (4)$$

resource constraint :

$$B_1 \cdot \lambda N + B_2 (1 - \lambda) N = L$$

and no mimicking by the weak incumbent :

$$0 \geq \{R^*_1 \cdot p_h - r_w \cdot B^*_1\} \lambda N + \{R^*_2 \cdot p_h - r_w \cdot B^*_2\} (1 - \lambda) N$$

and the no destabilizing condition

$$\{(r_c - r_w) \cdot B^*_1\} \lambda N + \{R^*_2 \cdot p_h - r_w \cdot B^*_2\} (1 - \lambda) N \geq 0$$

Note that since the objective function is linear in B_1 and B_2 therefore we shall get a corner solution which implies lending to both types cannot be optimal.

Therefore from the above analysis it is evident that strong incumbent will offer incentive compatible contract to high type only.

QED.

Our results are comparable with Jan Bouckaert and Hans Degryse (2001) who show that small size entry occurs in banking if adverse selection effect is not too high or low. For low adverse selection effects there is

large scale entry and for very harsh adverse selection effects there is no entry at all.

Section 5 : Intertemporal tradeoffs in a two period model

Here we consider a long lived incumbent whose type is private information and a sequence of entrants. The nature of equilibrium depends on prior probabilities and the cost parameters. There are two periods and each period has a forward market in the beginning and a spot market in the end. The basic idea here is that now a weak incumbent can sustain a first period loss if she is compensated through entry deterrence in second period. Given this, the signalling role is assumed by the spot market rate. As we shall see this leads to conditional entry deterrence by the weak type, and secondly redundancy of the forward contract.

Proposition 4: If $(r_w - r_e) < \delta(C_1 - r_w)$ then for sufficiently high p , the weak incumbent can also deter entry in period 1.

Proof : If $(r_w - r_e) < \delta(C_1 - r_w)$ then it pays to fight in period 1 if that deters entry in period 2. Therefore if entrant 1 enters the weak incumbent will find it optimal to fight with a positive probability. If its strategy is not to fight at a loss, then the entrant will believe she is strong with probability one if it fights and it will be then optimal to deviate from the strategy of not fighting. As Fudenberg and Kreps (1987) and Kreps and Wilson (1982) point out, the exact nature of the equilibrium will depend crucially on the prior p and the cost parameters.

To make the analysis interesting we assume that there is a fixed cost F of entry.

(A) If $(r_w - r_e)(1-p) < F$ then there won't be entry in the first period. Therefore the priors will be unchanged and as a result no entry will occur in second period also. As mentioned in the one period model, a high enough fixed fee will trivially cause entry deterrence and does not seem to be a particularly interesting case. Now we turn to the more interesting case: $(r_w - r_e)(1-p) > F$

(B) Since $(r_w - r_e)(1-p) > F$ then entrant will surely enter in the first period if incumbent does not fight at a loss. It cannot be optimal for the weak incumbent to fight with probability one as the posterior probability will not be high enough to deter entry. Therefore the weak incumbent will randomize. This in turn requires that entrant in period 2 also randomizes because as long as entrant 2 finds it optimal to enter, weak incumbent will find it optimal to reduce the probability of fighting in period 1. Conversely, when the entrant 2 finds it suboptimal to enter because the posterior probability of strong given fighting (at the price r_w) is too high, the weak incumbent will find it optimal to revise upwards the probability of fighting. Therefore at equilibrium the posterior q will be such that

$$(r_w - r_e)(1-q) = F$$

or $q = [(r_w - r_e) - F] / (r_w - r_e) = \alpha$, say. (We assume $[(r_w - r_e) - F] > 0$ since fixed fee is negligible.)

Now q must also satisfy

$$q = p / [p + (1-p)\beta]$$

where β is the conditional probability of a weak incumbent fighting at a loss in period 1. Therefore $\beta = p(1-q) / q(1-p)$

The total probability of fighting in period 1 is $p.1 + (1-p)\beta = p/q$. So entrant will stay out in period 1 if $\alpha < p/q$ or $p > \alpha^2$.⁹

QED

Corollary : The equilibrium of the game is unchanged if the forward market does not open.

Proof : If entry is deterred in period 1, then spot market monopoly is able to extract the entire surplus. The forward contract is not needed since signalling is completely done through the spot market competition.

Conclusion

In this paper we review and explore the strategic mechanisms which deter entry in banking. The existing models of entry deterrence in banking primarily highlight adverse selection as the main driving force behind deterrence. We show in this paper that adverse selection is not a necessary condition for entry deterrence. Cost asymmetry does equally well. To signal the cost of incumbent we have used the mechanism of loan commitments.¹⁰ The fundamental insight generated is that such contracts can convey incumbent strength and discourage entry when the incumbent is strong thus leaving the borrower no other choice but to

accept the preemptive contract. However, we show that forward contracts lose their signalling value in multiperiod model and is substituted by the signalling role of spot market competition. We also show that when screening takes place through contracts and cost asymmetry is present, adverse selection need not deter entry. This result should alert us that it is not adverse selection per se but how it is modelled, which can lead to different conclusions about entry deterrence.

Before finishing we should mention that the bank merger literature is also relevant for entry. In IO models, mergers are usually anti competitive and deter entry in an industry in most cases though there are exceptions to this general rule. In the banking context, we have seen a wave of mergers throughout the world in recent times though one is yet to arrive at a robust theory of causes and consequences of mergers. This is due to the controversy surrounding the issue of the degree of increasing returns present in banking and different kind of performances of merged banks in Europe and USA. Berger et al(1999) find that mergers among incumbents increase entry by de novo lenders. On the other hand Selig and Critchfield (1999) find that local market entry by acquisition deters concurrent entry by de novo banks and thrifts. Two aspects are highlighted in these studies : 1) mergers between big banks can cause a gap in small business lending which de novo banks are can fill up and 2) entry can take place by acquisition rather than branching. These indicate that the strategy choices for both incumbents as well as entrants can be quite rich. Also the types of incumbents (strong or weak, big or small etc) and entrants (established in other markets versus de novo lenders)

matter. This remains an interesting avenue for future theoretical research. As a preliminary conjecture, in our setup the entrant may have an incentive to merge with the strong type but prefer to take the weak type as a competitor (see Mallick and Moitra (2001) for more on this theme) if type-separating signals arise in equilibrium.

Notes

¹ Caminal, Ramon., Carmen Matutes (2000)

² One important example of this is the banking practices of the House of the Rothschilds see (Ferguson 1998). Also see Kennedy ((1989) in his discussion on finance, geography and the winning of wars.

³ See Besanko, D. And A.V. Thakor (1992)

⁴ See Kane E.J. (1984)

⁵ For example, the large public sector banks in India which delayed the adoption of information technology saw their market share of credit worthy borrowers plunging.

⁶ In contrast to the earlier case the Sovereign is a strategic borrower.

⁷ See Cameron (1966)

⁸ While we assume constant returns to scale here, our main conclusions are preserved in case of diminishing returns to scale.

⁹ Note : More generally, for a multiperiod model of N periods, one can show by induction that the entrants stay out until the first period k such that $p < \alpha^k$.

The expected interest rate of the borrower is the monopoly rate for the first $N - k$ periods since it knows that entry will not take place.

¹⁰ We have interpreted loan commitment in a broad way. For this we did not need any upfront fixed fees and penalties for not exercising the option. Therefore, one should be careful in comparing these strategic loan commitments with those commitment contracts which solve risk sharing or adverse selection problems. Since the orientation of the paper is towards entry deterrence rather than the contractual aspects of loan commitments, we feel justified in taking the above mentioned approach.

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