ELSEVIER European Economic Review 39 (1995) 889–918

EUROPEAN ECONOMIC REVIEW

Spatial competition in the banking system: Localization, cross subsidies and the regulation of deposit rates

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Received June 1992, final version received December 1993

Abstract

The paper analyses a spatial competition model of the banking sector. Banks offer two kind of services (deposits and credit) and can either borrow or lend on the money market. We investigate the consequences of the regulation of rates paid on deposits. The main conclusions are as follows. Regulation first increases network size beyond social optimum. In the long run it results in lower equilibrium credit rates because of increased competition. Secondly, regulation generates tied sales contracts, by which banks propose bundles of credit and deposit services. Tied sales, in turn, motivate the introduction of cross-subsidies between the two activities, the rent levied upon regulated deposits financing lower rates in the credit market. Finally it is shown that in a regulated environment, the effectiveness of

* Corresponding author. This paper was presented at seminars at the Banque de France, the Association Française de la Banque and the French Ministry of Finance in Paris and at the IAE in Barcelona. Useful comments from the participants and from P. Rey, J.C. Rochet, M. Vaquin, X. Vives and M.O. Yanelle are gratefully acknowledged. Also we are especially indebted to J. Tirole for valuable suggestions and references, and to F. Henrot for illuminating discussions. Errors are ours.

SSDI 0014-2921(94)00016-S

monetary policy is reduced in the sense that fluctuations of money market rates are less than fully transmitted in credit rates.

Keywords: Banking sector; Regulation; Spatial competition

JEL classification: G21; G28

1. Introduction

From the perspective of European monetary integration, the harmonization of financial regulation across EEC countries has attracted considerable attention. Among the most controversial issues is the regulation of deposit rates. While banks in most EEC countries can freely pay interest on deposits, a few governments still impose strong restrictions upon such payments. This is the case in France, where the question of deregulation is, however, vividly discussed.

While some benefits of regulation – e.g., those dealing with the prevention of systemic risks – are specific to 'the banking sector' (see for instance Diamond and Dybvig (1983), Keeley (1990), Smith (1984); a good survey is in Bhattacharya (1991)), most costs are not. Conventional economic wisdom suggests that, whatever the sector, regulation induces price distortions, which in turn generate suboptimal behaviour and allocative inefficiencies. In banking, the latter may result in overbranching, cross-subsidies, biased competition, and others. Surprisingly enough, these aspects have often been overlooked in the debates on this issue. Still, they are crucial in assessing the costs of regulation, and therefore should be considered with some care.

The purpose of this paper is precisely to evaluate the consequences of deposit rates regulation upon the structure of the banking sector. Our tools are borrowed from standard industrial organization theory. Specifically, we develop a model of imperfect competition among banks in a regulated environment. The originality of our approach lies in the distinctive assumptions needed to reflect the specificities of financial activities. Three particular features should be emphasized.

(i) *Banks compete on prices (here, interest rates); and each competitor does have market power*. Our approach, thus, can be contrasted with many models of competition in the banking industry that have been developed previously, and that consider either Cournot or Bertrand oligopoly. We believe, on the one hand, that prices (rather than quantities) should be considered as the main instrument of competition between financial institutions. On the other hand, though the Bertrand approach can, from a fundamentalist viewpoint, provide illuminating insights on the role of financial intermediation (see for instance Yanelle (1988, 1989), we believe that a more 'realistic' formalization should allow for a demand for financial services that is not infinitely price- (or rate-) elastic.

More precisely, we introduce an element of product differentiation across banks by embedding our approach within Salop's model of a circular economy with uniformly distributed households. Banks are allowed to locate branches upon the circle, and market power results from transportation and installation costs. This assumption can be given two interpretations. In a narrower sense, it is aimed at studying the effects of regulation upon the size of banking industry. In a highly regulated environment, banks are likely to compete on service as well as (or instead of) price. Overbranching thus appears as a plausible outcome, which we consider with some care in the paper. In a broader sense, however, many of our results do not depend on the particular source of market power. The key point is that the demand function each bank is facing continuously depends on both its rates and the competitors' rates. Hence, the location model could also be seen as a convenient fiction, that illuminates some basic consequences of monopolistic competition in the banking sector.

Along the former interpretation, which will be implicitly adopted in our work, it should also be noted that the conclusions will largely differ, according to whether the number of banks is taken as given, or whether it is assumed to adapt to the economic and regulatory environment. Typically, if we are interested in short-term effects, then size effects can be forgotten, while they may become crucial when longer periods are considered. Throughout the paper, we shall carefully distinguish the two points of view, and indicate to which of them each result can be related.

(ii) A second aspect that is introduced explicitly in our framework is the fact that banks *typically provide a range of different services*. For some of those (e.g., deposit management), the set of potential consumers is the whole population, whereas other activities may concern a much smaller audience. In our model, banks simultaneously collect deposit (from, potentially, all consumers), and lend money to a fraction of the population. The technology of the loan/deposit activity is quite elementary. Banks can lend up to the total amount of deposits they hold at no cost. Each bank can finance further loans by borrowing on the money market, at some given rate ρ; conversely, the fraction of deposits that is not lent to customers can be invested in the money market, at the same rate. Of course, the interest rates respectively paid on deposits and charged on loans (resp. r and t in what follows) will be different, but closely related. That is, banks will in general consider sophisticated tariff-determination issues, possibly involving cross-subsidies between loans and deposits; and the final outcome may (and actually will) depend on the regulation governing the banking sector. In fact, the coupling may be quite complex; it may entail the emergence of specific contracts, through which both activities are 'tied' in some way. These aspects will be carefully analyzed throughout the paper.

(iii) A last characteristic of the banking industry that is emphasized in our work is *the role of monetary policy*. We assume that monetary authorities are willing to control the total amount of credit in the economy by varying the money market rate. We are not interested here in the manner in which ρ is actually controlled. We rather concentrate upon the efficiency of such a tool – namely, the sensitivity of credit rates to the rate on the money market. A last goal of the paper is precisely to investigate how this key parameter can be affected by regulation.

Finally, we shall, in what follows, assume that each of the n banks behaves 'independently'; i.e., we rule out the case of competition between multi-branch banks. Two reasons can be invoked to justify this choice. First, a multi-branch setting would make the model enormously more complex. We believe that the gain in insight, though nonnegligible, would still be insufficient to compensate the loss in tractability; and that, in particular, most of our conclusion are qualitatively robust to the introduction of more complex assumptions. More convincingly perhaps, it should also be noted that in our linear setting, free entry is more likely to result in a large number of 'small' banks than a small number of large banks. The reason for this is that, for any bank already in the market, the installation of an additional branch generates a negative externality upon the market shares of the bank's other branches; the larger the existing network, the larger the externality. It follows that an increase in network size is always more profitable to a small bank than to a large bank and, as a matter of fact, that entry is always more profitable for an incumbent bank than the creation of a new branch for a bank already in place. If we assume, for instance, that new branches are created first by those firms for which the decision generates the highest profit, networks never appear. [1]

Given these assumptions, our conclusions can be summarized as follows:

(i) First, the regulation of deposit rates, not surprisingly, affects the equilibrium structure of the market; the number of branches, in particular, is larger than under free competition. To put this result in perspective, we may recall that,in the general class of models we consider, free competition itself results in a number of firms above the social optimum. The intuition is that, from a comparative static viewpoint, regulation of deposit rates generates a rent which artificially increases profits in the banking sector. With free entry, this, in the long run, boosts new installations far beyond the free competition level. But overbranching, in turn, increases competitive pressures by reducing each branch's market power. This affects not only the market for deposits, but also the market for credit. Specifically, in the long run, regulation of deposit rates always results in more branches and lower credit rates.

(ii) A second and probably more innovative conclusion is that the qualitative

[1] For a more detailed discussion of this effect in the case of a linear economy, see Tirole (1988, ch. 8)

characteristics of equilibrium contracts are also affected by regulation. More precisely, we consider the introduction of 'tied sales' contracts, in which a loan is granted to a borrower conditionally on his agreement to deposit his current account in the same bank. In other words, credit and deposit services are packaged in bundles, rather than being sold separately.

In our model, bundling does not arise as a price discrimination device, as when the seller has imperfect knowledge of consumer preferences (as, for instance, in McAffee et al. (1989)). Indeed, there is no asymmetry of information in our setting; agents are assumed identical (but for the distinction between borrowers and creditors). As a consequence, tied sales do not appear under free competition. However, when deposit rates are regulated, unilateral introduction of such contracts does provide a bank with a competitive advantage. At equilibrium, independent contracts are ruled out, and only tied sales remain. The point is that in a regulated environment, tied sales may allow one to get around the regulation, pretty much in the same way as vertical integration does in different contexts.

(iii) The emergence of tied-sales contracts in turn influences the pricing policy of each bank. We show that, with independent contracts as well as under free competition, banks do not cross-subsidize. However, tied-sales contracts, together with the regulation of deposit rates, create an incentive to artificially lower credit rates, in order to attract new deposits. This effect is distinct from those due to excess size of the banking industry as a whole; in the long run, the two mechanisms combine. Again, it should be emphasized that, in the model, all technologies (including transportation!) are linear and additive, so that cross-subsidies cannot appear as a result of economies of scale and/or of scope.

Our claim, hence, is that even in the absence of these technological specificities (which are known to generate this kind of consequences), the mere existence of regulation in a world of imperfect competition is sufficient to induce sophisticated tariff-determination policies, of which a (simplified) illustration is provided in the paper. Note that this result contradicts the classical 'separation' result emphasized by the literature. According to the latter, there should be no link between credit and deposit activities. Our conclusion is that this property does not hold true in the presence of regulation.

In particular, our approach suggests an explanation for a somewhat puzzling phenomenon, namely customer credit rates being lower than market rates (a situation that occurred in particular in France and Spain between 80 and 85). In our model, cross-subsidies induced by regulation may well result in a paradox of this kind; we show that this is more likely to occur when market rates are high.

(iv) Finally, the effectiveness of monetary policy is also affected by regulation. When the number of banks is fixed, any increase of the money market rate is immediately and totally transmitted to credit rates, at least under free competition. In contrast, in the case of regulation, the emergence of tied sales will hamper full transmission. An additional percentage point on the money market will typically generate further incentives to cross-subsidize, and the ultimate effect upon credit rates will be less than one. Hence, a further consequence of deposit regulation is to loosen the link between money market rate and credit rates, thus weakening the government control of economic activity through monetary policy.

The paper is organized as follows. Section 2 analyzes the benchmark case of independent competition on the two markets. In Section 3, we allow for 'tied-sales' contracts, and show how previous conclusions are modified. Finally, the conclusions, together with some empirical insights, are put forth in the last section.

2. A spatial competition model with deposits and loans as independent contracts

Throughout the paper, we use Salop's model of spatial competition around the unit circle (Salop, 1979). Hence, we consider an economy where a continuum of customers are located uniformly (with density 1) around a unit circle. Banks are located on the circle; C denotes the fixed cost of each installation. Each customer on the circle has one unit of cash, that must necessarily be deposited in a bank; the latter will pay an interest t. We suppose that depositors have a transportation cost α per unit of length.

In addition to collecting funds, each bank can also make loans to customers. We note r the loan interest rate at which a bank lends its funds; β is the unit transportation cost for loans. Of course, β is not necessarily equal to the transportation cost for deposits, α; in other words, we allow the respective price elasticities of deposits and loans to differ. We suppose that borrowers represent a fraction λ of the total population, and are uniformly distributed around the circle. Note, in particular, that borrowers are also depositors; this is a crucial assumption, that we discuss in Section 4. Each loan is of a fixed size L; we suppose that, for each borrower, the surplus generated by the loan is 'large enough', so that he will actually borrow at the prevailing rate. Finally, the prevailing 'technology' is linear. Specifically, each bank finances its loans out of the deposits it has collected plus, if necessary, from additional funds obtained on the money market; conversely, any deposit that is not lent to borrowers may be reinvested on the money market. The money market rate, ρ, is set exogenously by monetary authorities.

Aggregate net demand of the banking sector on the money market is equal to $\lambda L - 1$. An interesting special case obtains when aggregate net demand is zero; then the total volume of loans made by the banking system, $V = \lambda L$, must be equal to the total volume of deposits:

$$V = \lambda L = 1$$

(which implies that the size of each loan is $1/\lambda$).

As we shall see, there are different ways for banks to compete on the deposit and the loan markets. A banking firm may choose to propose independent contracts for deposits makers and borrowers; or the loan may be conditional on the borrower being previously a depositor of the bank. In this section we focus on the case of independent contracts for deposits and loans, while the next section considers the possibility for banks to propose 'tied deposit-loan' contracts. As before, our concern is the impact of deposit rates regulation on the nature of the competition in the banking industry.

The notation is as follows. Subscript m ('market') indicates free competition values, whereas R refers to regulation and s to social optima. Also, superscript S indicates 'short-term' values, obtained for a *given* number n of firms; note that these values depend on n. Superscript L refers to 'long-term' values, obtained when the number of banks is endogenous.

2.1. Unregulated competition

We first characterize the symmetric equilibrium in the deposit and the loan markets without regulation. In what follows, attention is restricted to symmetric equilibria in location and interest rates. Assume that n banks, located symmetrically around the circle, have entered the market; let t_i (resp. r_i be the deposit (resp. credit) interest rate offered by a typical bank i and $t°$ (resp. $r°$) the interest rate offered by his neighbour competitors (bank $i-1$ or $i+1$). A depositor located at a distance $X \in [0, 1/n]$ of bank i is indifferent between i and $i+1$ (or $i-1$) if

$$\alpha X - t_i = \alpha\left(\frac{1}{n} - X\right) - t°.$$

Similarly, a borrower located at a distance $Y \in [0, 1/n]$ of bank i is indifferent between i and $i+1$ (or $i-1$) if

$$\beta Y + r_i L = \beta\left(\frac{1}{n} - Y\right) + r° L,$$

which gives the following supply for deposits S^D and demand for loans D^L:

$$S^D(t_i, t°) = 2X = \frac{1}{n} + \frac{t_i - t°}{\alpha},$$

$$D^L(r_i, r°) = 2YV = \frac{V}{n} - \frac{r_i - r°}{\beta} VL.$$

The profit of bank i is, therefore

$$\Pi_i = (r_i - \rho)\left(\frac{V}{n} - \frac{r_i - r^{\circ}}{\beta} VL\right) + (\rho - t_i)\left(\frac{1}{n} + \frac{t_i - t^{\circ}}{\alpha}\right) - C.$$

Differentiating this profit function with respect to t_i and r_i and substituting $t_i = t^{\circ}$ and $r_i = r^{\circ}$ into the first-order conditions leads to the following characterization:

Proposition 1. At the symmetric equilibrium, unregulated short-term rates are given by

$$t_{\mathrm{m}}^{\mathrm{S}} = \rho - \frac{\alpha}{n} \quad \text{and} \quad r_{\mathrm{m}}^{\mathrm{S}} = \rho + \frac{1}{n}\frac{\beta}{L}. \tag{2.1}$$

Under the free-entry condition ($\Pi = 0$), the number of banking firms in the market n_{m}, as well as the long-run equilibrium values $t_{\mathrm{m}}^{\mathrm{L}}$ and $r_{\mathrm{m}}^{\mathrm{L}}$, are:

$$n_{\mathrm{m}} = \sqrt{\frac{\alpha + \beta V/L}{C}}, \quad t_{\mathrm{m}}^{\mathrm{L}} = \rho - \alpha\sqrt{\frac{C}{\alpha + \beta V/L}},$$

$$r_{\mathrm{m}}^{\mathrm{L}} = \rho + \frac{\beta}{L}\sqrt{\frac{C}{\alpha + \beta V/L}}. \tag{2.2}$$

Several remarks can be made here. First, as is usual in this type of model, the number of firms, at equilibrium, is negatively related to the fixed cost of installation C and positively related to transportation costs. The interpretation is that larger transportation costs result in stronger (local) monopoly power for each bank,; therefore, profits are higher for a fixed number of banks, which provides further incentives for entering the market.

Also, the equilibrium deposit and loan rates are deduced from the money market interest rate ρ through simple 'mark-down' and 'mark-up' (with a margin that depends positively on transportation costs and negatively on the intensity of competition, as given by the number of banks on the market). It follows that any increase of ρ due to some monetary policy of the government is transmitted on a one-to-one basis to the deposit rate offered by banks.

Assume, in particular, that $V = 1$. Aggregate net demand for money is zero; furthermore, at the equilibrium, no bank either lends or borrows on the money market. As a consequence, *banks' average costs do not depend on the money market rate* ρ. Still, the value of ρ drives the whole set of equilibrium rates.

The latter conclusion is spectacular but not really surprising. Economic theory traditionally tells us that opportunity or marginal costs, rather than average costs, are what matters. Here, ρ is, at the equilibrium, both the opportunity cost of money and its marginal cost. Elementary as it may be, the lesson is nevertheless of some interest, because this basic intuition is often overlooked in current debates. It is often argued, for example, that any institutional or technological change that increases the cost of deposits will automatically result in higher credit rates. Our results clearly indicate that such reasoning should be considered with caution, because changes that modify *average* costs might in some cases have no effect upon *marginal* costs. Consider, for instance, a technological innovation resulting in lower transportation costs for depositors (lower α), hence in higher rates being paid on deposits. According to (2.1), this typically leaves lending rates unaffected, at least in the short run (i.e., when the number of branches is taken as given) – despite the fact that the cost of banks' resources is clearly increased.

The last remark should, however, be qualified, since in the long run the number of branches becomes endogenous. Not surprisingly, the level of short-term profits, hence the long-term number of firms under free entry, is positively related to both α and β. Lower transportation costs for depositors means less monopoly power for the banks in the market for deposits, hence lower short-term profits and a smaller number of branches. But then competition is lessened on the credit side, leading to higher rates on loans. Hence, links appear in the long run between the two markets; but those links are essentially indirect, and operate through changes in the global market structure.

2.2. *Competition with deposit rates regulation:*

Now let us consider the case in which the government imposes a regulated deposit interest rate $\bar{t}$ which is lower than the equilibrium deposit rate t_{m}. Because loan contracts are independent of deposit contracts it is easy to see that competition between banks on loans yields the following equilibrium loan interest rate in relation to the number of banks:

$$r_{\mathrm{R}}^{\mathrm{S}} = \rho + \frac{\beta}{Ln} \tag{2.3}$$

and the profit function of a bank is given by

$$\Pi = \left(r_{\mathrm{R}}^{\mathrm{S}} - \rho\right) D^{\mathrm{L}}\left(r_{\mathrm{R}}^{\mathrm{S}}, r_{\mathrm{R}}^{\mathrm{S}}\right) + \left(\rho - \bar{t}\right) S^{\mathrm{L}}\left(\bar{t}, \bar{t}\right) - C$$

or

$$\Pi = \frac{\beta V}{n^2 L} + \frac{\rho - \bar{t}}{n} - C. \tag{2.4}$$

The free entry condition then gives the number of banks in the market n_{R} which is the positive root of the quadratic equation $\Pi = 0$. The results are summarized in the following statement:

Proposition 2. At the regulated equilibrium with independent contracts, the short-term credit rate is

$$r_{\mathrm{R}}^{\mathrm{S}} = \rho + \frac{\beta}{nL}.$$

Long-term values are given by

$$n_{\mathrm{R}} = \frac{2\beta V/L}{-(\rho-\bar{t}) + \sqrt{(\rho-\bar{t})^2 + 4C\beta V/L}} \tag{2.5}$$

and

$$r_{\mathrm{R}}^{\mathrm{L}} = \rho + \frac{-(\rho-\bar{t}) + \sqrt{(\rho-\bar{t})^2 + 4C\beta V/L}}{2V} \tag{2.6}$$

2.3. Social optimum

In this simple version, where the size of total demand is fixed, the socially optimal number of bank firms is given by the minimization of fixed costs of installation of firms plus customers' transportation costs:

$$\mathrm{Min}_n \left[nC + 2n\int_0^{1/2n} \alpha x \,\mathrm{d}x + 2n\lambda\int_0^{1/2n} \beta x \,\mathrm{d}x \right],$$

which yields

$$n_s = \frac{1}{2}\sqrt{\frac{\alpha+\lambda\beta}{C}}\,. \tag{2.7}$$

2.4. Comparison

2.4.1. Market size

From the previous equations, it is easy to see that since $\bar{t} < t_{\mathrm{m}}$, we have

$$n_{\mathrm{R}} > n_{\mathrm{m}}.$$

Hence, the size of the banking sector under deposit rate regulation is larger than without regulation. The intuition is that regulated deposits increase short-run banks' profits and this stimulates further entry in the long run. Or, to put it differently, when prevented from competing on prices, banks compete on services; additional branches appear, which reduce the customers' transportation costs.

Comparing now to the socially optimum size, n_{S}, one finds that

$$n_{\mathrm{m}} > n_{\mathrm{S}}. \tag{2.8}$$

In words, the purely competitive size is itself above the optimum. It follows that deposits regulation moves the equilibrium banking structure under deposits further away from the social optimum.

A more interesting conclusion stems from the form of n_{R}. Indeed, in contrast with the unregulated case, the size of the system under regulation is positively correlated with the level of (long-term) interest rates on the money market. This is because the rent generated on the deposit side by regulation is itself increasing with ρ. Thus, in a regulated economy, the persistence of high nominal rates results in larger economic inefficiencies due to excessive incentives to enter. In particular, *regulation typically increases the cost of inflation within the economy* – a fact which is interesting from a macro viewpoint as well. [2]

2.4.2. Credit rates (given market size)

A second remark is that, for any *given* number of banks n, the equilibrium rate on the loan market, r^{S}, is the same as without regulation: the rent created by regulation does increase banks' profits, but does not affect behaviour on the credit side. In particular, *banks do not cross-subsidize*; i.e., they do not use their cheaper access to deposits to compete in a tougher way on the credit market. Again, this conclusion illustrates the point made above, that only opportunity costs matter. Though the average cost of resources is low (and may even be zero) because of regulation, opportunity costs remain unchanged; hence, competitive strategies are not affected. A contrario, deregulation of deposit rates should not, in this framework, result in higher credit rates, at least in the short run.

It must, however, be stressed that the previous conclusion relies upon two assumptions: a fixed number of branches, on the one hand, and independent loan and deposit contracts on the other hand. The case of endogenous market size is considered below, whereas 'tied sales' are introduced in the next section. In both situations, credit rates will be shown to depend on the regulated rates on deposits.

2.4.3. Endogenous market size

It can easily be checked that

$$r_{\mathrm{R}}^{\mathrm{L}} < r_{\mathrm{m}}^{\mathrm{L}}. \tag{2.9}$$

That is, in the long run, cheaper bank resources give lower credit rates. Again, this effect comes from changes in market structure. Regulation of deposit rates, by boosting entry, results in tougher competition on the credit market, with lower equilibrium rates as a consequence. It should also be noted that, in the long run, the credit rate under regulation $r_{\mathrm{R}}^{\mathrm{L}}$ now depends on the (average) money market rate in a quite complex way (Eq. (2.6)). Indeed, the mark-up itself varies with ρ through size effects. We come back to this point in the next section.

3. Regulation and competition

In this section, we discuss in more details some *qualitative* effects of regulation. More precisely, we investigate how regulation of deposit rates, by altering

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[2] Note that the rent levied of deposits is proportional to the difference between nominal money market and (regulated) deposit rates. In particular, in countries where regulation imposes a zero nominal rate on deposits, all the effects we describe depend on the nominal money market rate.

the incentive structure faced by each bank, may affect the kind of contracts that emerge as the outcome of the competitive process. This idea has clearly a general scope – although the 'contracts' we consider here, due to the simplified structure of our model, are quite elementary.

The kind of qualitative effect we concentrate upon is the emergence of tied sales. It has been assumed so far, that any borrower was free to put his deposits in a given bank and simultaneously apply for a loan to any other bank (though this did not happen at equilibrium). However, a bank might offer a specific contract, stipulating that agents applying for a loan must simultaneously deposit their cash balances in the bank. Applications for loans only (without simultaneous deposits) will either be rejected, or be charged with a higher interest rate. The potential advantage of such a contract is that it allows the bank, by lowering interest rates, to attract not only new borrowers, but new depositors as well. The rent levied from those marginal deposits alleviates the cost of reduced rates and provides the firm with a competitive advantage. Should this be the case, then the initial equilibrium would not be robust to the introduction of new 'tied sales' contracts. Therefore, unless such contracts are prohibited, they will become dominant in the long run, and will lead to a new equilibrium structure. As we shall see, tied sales contracts, in our model, are generated by regulation. The idea is that banks compete on the market for deposit via the natural tool, i.e., the interest rate. In particular, tied sales are not advantageous under free competition. However, when banks are prohibited by regulation to increase deposit rates, they resort to bundling to attract customers. [3,4]

3.1. Unregulated competition

We begin with the benchmark case of nonregulated markets. Let us first consider the equilibrium without tied sales, as discussed in the previous section;

[3] It should be noted that, within such contracts, only borrowers of the bank are constrained to put their deposits in another bank; however, depositors are free to borrow elsewhere if they wish. One may think of contracts imposing the opposite kind of restriction; namely, any depositor who is willing to borrow would be imposed to borrow from the bank. This kind of contract would, however, be very difficult to implement, because it is impossible for the bank to distinguish between borrowers and 'pure depositors'. A depositor can always claim not to be a borrower at all, then secretly apply for a loan to some other bank; of course, the latter will not disclose the information. For this reason, contracts of the latter kind will be excluded in what follows.

[4] Other explanations of tied sales rely upon asymmetric information; bundling can then be used as a price discrimination device, as for instance in McAffee et al. (1989). More specific to the banking sector is the fact that, in the presence of adverse selection and/or moral hazard on the market for credit, the observation of deposits may allow the bank either to screen the agents or to monitor their behaviour in a more effective way. Better selection and/or monitoring may, in turn, create a competitive advantage that enables the bank to charge lower rates; then unilateral introduction of tied sales is profitable. In our model, however, information is assumed to be symmetric.

i.e. the rates for loans and deposits are respectively: $r = \rho + \beta/Ln_{\mathrm{m}}$ and $t_{\mathrm{m}} = \rho - \alpha/n_{\mathrm{m}}$, where $n_{\mathrm{m}} = \sqrt{(\alpha + \beta V/L)/C}$. Assume that, once such an equilibrium has been reached, one bank – say, bank i – unilaterally introduces a tied sales contract; i.e., its borrowers must deposit their balances in the bank. What rates will it charge, and what will be the corresponding profit? The answer is given by the following result:

Proposition 3. Assume that there are n_{m} banks, all (but possibly bank i) charging rates r_{m} and t_{m} without tied sales contracts. Then bank i's optimal strategy with a tied sales contract is to charge rates r_{m} and t_{m} as well. In particular, unilateral introduction of tied-sales contracts does not increase profit.

A complete proof is given in the appendix. Let us briefly indicate the basic intuition. As argued above, a tied-sales contract is profitable insofar as it allows the bank to attract new borrowers and new depositors by reducing credit rates only. If, starting from the equilibrium, the credit rate is decreased by $\mathrm{d}r$, a (marginal) borrower may shift from bank $i-1$ (or $i+1$) to bank i if the amount thus saved, $L.\mathrm{d}r$, is greater than the additional transportation cost. The indifference distance of borrowers y is thus increased by $\mathrm{d}y = [L/2(\alpha+\beta)]\mathrm{d}r$. The increase in deposits is $\lambda \times 2\mathrm{d}y = V.\mathrm{d}r/(\alpha+\beta)$; since each of this new depositors also borrows L, the total of loans increases by $VL\mathrm{d}r/(\alpha+\beta)$. Thus profit variation is

$$\mathrm{d}\pi = -\frac{V\,\mathrm{d}r}{n_{\mathrm{m}}} + (r_{\mathrm{m}} - \rho)\frac{VL\,\mathrm{d}r}{\alpha+\beta} + (\rho - t_{\mathrm{m}})\frac{V\,\mathrm{d}r}{\alpha+\beta}.$$

But, here, $r_{\mathrm{m}} - \rho = \beta/Ln_{\mathrm{m}}$ *and* $\rho - t_{\mathrm{m}} = \alpha/n_{\mathrm{m}}$; hence $\mathrm{d}\pi = 0$.

In words: without tied sales, lower credit rates attract borrowers only. With tied sales, the borrowers that are attracted are depositors as well. However, the number of agents thus attracted is now lower, since transportation costs have raised to $\alpha+\beta$. Equilibrium rates are such that the second effect exactly offsets the first. Or, to put it in a different way: it is exactly as profitable to attract a new depositor by means of tied sales plus lower credit rates as by higher rates on deposits!

3.2. Regulation of deposit rates and the emergence of tied sales contracts

We may now turn to the case of regulation. The story is essentially identical to the one above, but for one crucial difference: the rate on deposits is lower (hence the rent levied on depositors higher) than under free competition. Specifically, using the same notations as above, shaving credit rates in tied-sales contracts will increase profit by $\mathrm{d}\pi = [-(1/n_{\mathrm{m}}) + [\beta/(\alpha+\beta)n_m] + (\rho - \bar{t})/(\alpha+\beta)]V\,\mathrm{d}r$.

Since $\bar{t}$ is, by hypothesis, smaller than $\rho - \alpha/n_{\mathrm{m}}$, we conclude that $\mathrm{d}\pi$ is positive. The case of independent contracts is no longer a Nash equilibrium when tied sales contracts are allowed. The rent on deposits is so high that, whenever it is possible to lock in the deposits of new borrowers through tied-sales contracts, it pays to attract new borrowers by increasing cross-subsidies and lowering credit rates.

A possible objection would be that tied sales are difficult to implement in practice, since a borrower is not *formally* committed in general; i.e., he could presumably, once he has received the loan, withdraw his deposits from the bank. It must, however, be emphasized that our conclusion does not rely upon a commitment assumption for the client. Indeed, the latter has nothing to gain by withdrawing his deposits, precisely because no other bank will pay him more than the regulated rate!

3.3. Equilibrium with tied sales: A characterization

It follows that regulation typically generates a new kind of equilibrium, where tied-sales contracts are dominant. The characteristics of such an equilibrium are summarized by the following proposition:

Proposition 4. At any equilibrium with tied-sales contracts and free entry, the number n'_R of firms and the credit rate r'_R are given by

$$r_R'^S = \left(1 - \frac{1}{L}\right)\rho + \frac{1}{L}\bar{t} + \frac{\alpha + \beta}{Ln} \tag{3.1}$$

and

$$n'_R = \frac{(1-\lambda)(\rho - \bar{t}) + \sqrt{(1-\lambda)^2(\rho - \bar{t})^2 + 4C(\alpha + \beta)\lambda}}{2C}, \tag{3.2}$$

$$r_R'^L = \left(1 - \frac{1}{L}\right)\rho + \frac{1}{L}\bar{t} + \frac{\alpha + \beta}{Ln'L_R}. \tag{3.3}$$

Proof. Let $\bar{t} < \rho - \alpha\sqrt{C/((\alpha + \beta V)/L)}$. If there are n banks in the industry, $(n-1)$ of them with a loan interest rate of $\hat{r}$, then bank i's profits are

$$\Pi = (1-\lambda)(\rho - \bar{t})\frac{1}{n} + \lambda[\rho - \bar{t} + L(r - \rho)]\left[\frac{1}{n} + \frac{(\hat{r} - r)L}{(\alpha + \beta)}\right]$$

and the first-order condition gives, in a symmetric equilibrium,

$$r_R'^S = \rho + \frac{1}{L}\left[\frac{\alpha + \beta}{n} - (\rho - \bar{t})\right].$$

The free-entry condition determines the number of banks:

$$n'_R = (1-\lambda)(\rho - \bar{t}) + \sqrt{\frac{(1-\lambda)^2(\rho - \bar{t})^2 + 4C(\alpha + \beta)\lambda}{2C}}$$

and the loan interest rate is

$$r_{\mathrm{R}}^{\prime \mathrm{L}}=\left(1-\frac{1}{L}\right)\rho+\frac{1}{L}\bar{t}+\frac{\alpha+\beta}{Ln_{\mathrm{R}}^{\prime}}.$$

3.4. Comparison

It is interesting to compare these results with those of the previous case – i.e., regulation without tied sales – as well as with the no-regulation case.

3.4.1. Number of banks

Corollary 1. Under a regulated rate on deposits, the equilibrium number of firms is smaller with tied-sales contracts than without. In both cases, however, the number of firms is larger than under free competition.

Proof. Immediate

The interpretation is that introducing tied-sales contracts essentially boosts competition between banks. In the short run, this results in lower credit rates, hence smaller profits. In the long run, then, the number of firms decreases. Still, the rent generated by the regulation on deposit rates is only partially dissipated by tougher competition; in particular, the number of firms remains above its value in the unregulated case.

3.4.2. Credit rates (given number of firms)

Tied-sales contracts also affect equilibrium interest rates, and specifically the level of cross-subsidies between deposits and loans. To see how, it is useful to distinguish between short term (the number of firms held constant) and long term (where the number of firms is allowed to vary endogenously). Let us first assume that the number of firms is given, and equal to n. When tied-sales contracts are excluded, we have seen in the previous section that the equilibrium rate r charged on loans is the same, whether deposit rates are regulated or not. It consists of a mark-up above the money market rate ρ; the mark-up is proportional to transportation costs β and inversely proportional to the number of firms and the average amount borrowed. In particular, regulation does not induce short-term cross-subsidies between deposit and loans. Such cross-subsidies, however, do appear when tied-sales contracts are allowed. More precisely:

Corollary 2. With tied-sales contracts, the credit rate $r_{\mathrm{R}}^{\prime \mathrm{S}}$ is smaller than the unregulated equilibrium rate $r_{\mathrm{m}}^{\mathrm{S}}$ by an amount

$$r_{\mathrm{m}}^{\mathrm{S}}-r_{\mathrm{R}}^{\prime \mathrm{S}}=\frac{1}{L}\left[\frac{\rho-\bar{t}-\alpha}{\mathrm{n}}\right]=\frac{1}{L}\left(\mathrm{t}_{\mathrm{m}}^{\mathrm{S}}-\bar{t}\right),$$

where $t_{\mathrm{m}}^{\mathrm{S}}=\rho-\alpha/n$ is the unregulated equilibrium rate on deposits.

The difference $r_m^S - r_R'^S$ is exactly the level of cross-subsidization induced by tied-sales contracts; note that cross-subsidies are proportional to the gap between regulated and competitive deposit rates, and that they increase with the money market rate ρ. Again, the intuition is clear. As long as tied-sales contracts are excluded, holding deposits and lending money are independent activities; whether the second is regulated or not, in the short run, does not change the incentives for cross-subsidizing. On the contrary, tied-sales contracts enable the banks to compete for new depositors through low credit rates. Here, the incentive for introducing cross-subsidies is proportional to the rent perceived upon deposits; should the latter be regulated, then both the rent and the level of cross-subsidies will increase with the opportunity cost of money – i.e., the money market rate ρ. Finally, cross-subsidies decrease with the unitary value of loans. For large values of L the credit market is more competitive (transportation costs are relatively small), and all rates are driven down.

3.4.3. Credit rate (endogenous network size)

We now come to long-term effects. We have seen that, in the absence of tied-sales, regulation, by boosting short-term profits, provided strong incentives to the entry of new competitors – which, in turn, increased competitive pressures and drove interest rates to a lower level. The rent perceived upon regulated deposits was used to subsidize an increase in network size, and ultimately (albeit indirectly) lower credit rates. The same effect also appears under tied-sales contracts – though, as we have just seen, the number of firms does not increase as much as before. Specifically, we have the following result:

Corollary 3. With endogenous number of firms, the credit rate under regulated deposit rates and tied-sales contracts is lower than under regulated deposit rates and independent contracts. Also, both rates are lower than under free competition.

The interpretation of the first result is slightly more complex, since several effects must be considered. Indeed, on the one hand, tied-sales induce direct cross-subsidization, which lowers credit rates. On the other hand the total number of firms is smaller with tied sales; and we know that, all else equal, less firms means higher rates. Corollary 3 indicates that, altogether, the first effect dominates: in the long run as well as for a given market size, tied sales result in lower credit rates. Still, the gap between credit rates with and without tied sales is narrower in the long run than in the short run. Specifically, for any given size n, we have that

$$r_R^s - r_R^{\bar{s}} = \frac{1}{L}(\rho - \bar{t}) - \frac{\alpha}{Ln}.$$

In the long term, however, the difference becomes

$$r_R^L - r_R'^L = (\rho - \bar{t})/L - \frac{\alpha}{LN_R'} + \frac{\beta}{L}\left(\frac{1}{n_R} - \frac{1}{n_R'}\right)$$
$$< (\rho - \bar{t})/L - \frac{\alpha}{Ln_R'} < (\rho - \bar{t})/L - \frac{\alpha}{Ln_R}.$$

To summarize: when the number of firms is given, tied sales imply lower rates because of cross-subsidies. This effect is partly, but not totally compensated by market size effects in the long run. Lastly, in both cases credit rates are lower than under free competition, because the rent on deposits generates, either directly (through cross-subsidies) or indirectly (through network size) tougher competition on the credit market.

3.4.4. Should tied-sales contracts be forbidden?

Lastly, what are the welfare consequences of introducing tied sales? The answer, of course, depends on whether deposit rates are regulated or not. Under free competition, the point is moot, since tied sales will not modify equilibrium values. When deposits are regulated, however, tied-sales contracts increase competition and decrease market size. Since the regulated economy suffers from insufficient competition and oversized networks, tied-sales contracts clearly increase welfare. Efficiency considerations suggest that tied-sales contracts should not be forbidden. This conclusion should however be qualified, since tied-sales contracts also affect the efficiency of monetary policy, as we shall see in the next subsection.

3.5. Regulation and the efficiency of monetary policy

A final issue we want to analyze deals with monetary policy. As previously discussed, a specificity of the banking industry is that the government is concerned with the level of output – i.e., the total amount of credits. Specifically, monetary authorities may, through interventions in the money market, influence the rate ρ; we assume here that this control is perfect, i.e., that ρ is fixed by the policymaker. Albeit, in our simple model, the demand for credit is assumed to be price inelastic, it is interesting to investigate the transmission mechanism between ρ and the credit rate r; in a more general setting, indeed, we may expect the latter to be negatively correlated to credit demand. Also, monitoring credit through money market rates is primarily a short-term exercise; hence, we shall concentrate here on short-term effects by taking the number n of banks as given. We have the following result.

Corollary 4. (i) Under free competition as well as with independent loan and deposit contracts, monetary policy is fully effective: any increase in money market rates is totally transmitted to credit rates.

(ii) Under regulation of deposit rates and with tied-sales contracts, monetary policy is only partially effective. Specifically, an increase $\mathrm{d}\rho$ *in the money market rate results in an increase* $\mathrm{d}r = (1 - 1/L)\mathrm{d}\rho$ *in credit rates.*

Proof. Immediate from Eqs. (2.3) and (3.1) above.

Hence, in a regulated economy, tied-sales contracts reduce the effectiveness of monetary policy. The interpretation relies on cross-subsidization. Indeed, we have seen above that the level of cross-subsidies is given by

$$r^{\mathrm{S}} - r_{\mathrm{R}}'^{\mathrm{S}} = \frac{1}{L}\left[\rho - \bar{t} - \frac{\alpha}{n}\right].$$

A consequence is that higher money market rates induce larger cross-subsidies. Intuitively, the rent levied upon regulated deposits increases with ρ; when ρ gets higher, the benefits of attracting new depositors through lower credit rates plus tied-sales contracts becomes larger, hence banks are induced to further subsidize their credit activities. As a result, changes in credit rates only partially follow changes in money market rates, a fraction of the latter being dampened by cross-subsidization.

Since, as argued above, tied-sales contract should prevail under regulation, our model suggests that regulation of deposit rates ultimately reduces the effectiveness of monetary policy.

The main conclusions of the analysis are summarized in Fig. 1.

4. Empirical consequences of banking regulation and deregulation: Some insights

In this section, we review some empirical aspects of our model. A crucial assumption is the fact that borrowers are also depositors; we provide formal and informal evidence supporting this hypothesis in the first subsection. Then we sketch and summarize some empirical implications of our framework which we believe to be relevant from a policy point of view; again, supporting evidence is presented.

4.1. Are borrowers depositors as well?

In our setting, a fraction λ of the population are both borrowers and depositors. These agents have an inelastic demand for funds of L, and are endowed at the same time with 1 unit. This situation, however, is not equivalent to a net demand of $L - 1$; rather, we assume that agents deposit the initial unit, while they borrow L on the credit market. The natural interpretation for this is that deposits are necessary for liquidity reasons. For instance, we may be in a cash-in-advance

FREE COMPETITION

n given $\quad t_m^S = \rho - \frac{\alpha}{n}, \qquad r_m^S = \rho + \frac{\lambda\beta}{n}$

n endogenous $\quad n_m = \sqrt{\frac{\alpha+\lambda\beta}{C}}$

hence

$$t_m^L = \rho - \alpha\sqrt{\frac{C}{\alpha+\lambda\beta}}, \quad r_m^L = \rho + \lambda\beta\sqrt{\frac{C}{\alpha+\lambda\beta}}$$

REGULATION

Independent sales | **Tied sales**

n given

$$\bar{t} \text{ fixed}, < \rho - \alpha\sqrt{\frac{C}{\alpha+\lambda\beta}}$$

$$r_R^S = \rho + \frac{\lambda\beta}{n} \qquad r_R'^S = (1-\lambda)\rho + \lambda\bar{t} + \lambda\frac{\alpha+\beta}{n}$$

n endogenous

$$n_R = \frac{\rho - \bar{t} + \sqrt{(\rho-\bar{t})^2 + 4C\lambda\beta}}{2C} \qquad n_R' = \frac{(1-\lambda)(\rho-\bar{t}) + X}{2C}$$

$$r_R^L = \frac{\rho}{2} + \frac{\bar{t}}{2} + \frac{1}{2}\sqrt{(\rho-\bar{t})^2 + 4C\lambda\beta} \qquad r_R'^L = \rho - \frac{(1+\lambda)(\rho-\bar{t})}{2} + \frac{1}{2}X$$

where $X = \sqrt{(1-\lambda)^2(\rho-\bar{t})^2 + 4C\lambda(\alpha+\beta)}$

OPTIMUM

$$n_s' = \frac{1}{2}\sqrt{\frac{\alpha+\lambda\beta}{C}}, \text{ hence under competition}$$

$$t = \rho - 2\alpha\sqrt{\frac{C}{\alpha+\lambda\beta}}, \quad r = \rho + 2\lambda\beta\sqrt{\frac{C}{\alpha+\lambda\beta}}$$

COMPARISON

$$n_s < n_m < n_R' < n_R \qquad \text{and} \qquad r_m > r_R > r_R'$$

Fig. 1. Summary of the main conclusions of the analysis.

economy, where some transactions cannot be carried out without a minimum amount of money. Then deposits are not a substitute for loans; rather, both constitute different and partly independent commodities.

How realistic is this interpretation? Few economists would dispute the fact that, in 'real life', money (here, current account) is necessary even for indebted agents. The problem, however, is one of order of magnitude. Can we expect the gain on deposits to be important enough to generate the kind of trade-off we described above? We now present some empirical evidence to support this claim.

The easiest case is that of firms. A large majority of firms finance part of their investment out of debt – essentially through medium- or long-term contracts. In the short run, however, many firms do have excess liquidity. Here, behaviour depends very much on size. Large firms will in general manage their asset/liability structure in a very efficient way; in particular, the part of financial assets left on interest-free accounts will be negligible. To the contrary, small firms are often much less efficient. Many of them do have large deposits, which generate considerable profits for the banks. The order of magnitude of these effects can be summarized by two figures. In France, in 1990, the total amount of deposits on a (interest-free) current account by firms was around 600 billions Francs. Even when compared to total bank loans to firms – about 3,000 billions Francs –, this is by no means negligible. In the same way, Spanish data indicate that among small firms, current accounts represent about 25% of consolidated debt (the ratio is below 10% for large firms).

A fact that should be emphasized at this point is that the market for loans is extremely competitive, with very small net margins (frequently below 1% once risk has been taken into account). In contrast, under regulation, the rent on deposits can exceed 10% when nominal rates are high. These figures suggest that not only the benefits on deposits are nonnegligible with respect to those on loans, but they may in fact be predominant. Let us now come to households. The respective figures are 500 billions Francs for interest-free deposits and 2300 billions for loans. Note that, in addition to current accounts, a number of financial assets (e.g., deposits in S&L) pay an interest rate fixed by regulation far below the market rate; the corresponding amounts are around 800 billions Francs. Again, given the difference in margins, these figures confirm the intuition that interest free deposits constitute a major source of profits for the banking system.

A last objection can be raised at this point. Borrowers might not be depositors; i.e., the population might split into two classes, one of non-indebted depositors, the other of debtors with negligible deposits – in which case tied sales would not make much sense. This argument is a priori much less convincing for firms (basically all firms are indebted in the long run, even when they have a positive short-term balance) than for households. Even in the latter case, however, the two-class interpretation is contradicted by facts. Table 1 gives the distribution of interest-free deposits in the population, conditional on the presence of debt. [5] If anything, debtors have higher deposits. For instance, 32% of debtors have at least

[5] We thank L. Arondel for providing these data.

Table 1
Distribution of deposits on current accounts, France. Unit: Thousands of Francs

Deposits	% in the sample	No CA	< 0	0-5	5-10	10-20	20-50	50-100	> 100	?	Total
Debtors	44.8	2.2	4.6	33.0	26.6	18.5	8.9	2.5	1.6	2.0	100
Non debtors	55.2	6.6	3.2	36.0	27.3	14.9	7.7	2.1	1.1	3.0	100

Source: Enquête Actifs Financiers, INSEE.

10 000 F on their current account, while the proportion is 25% for non-debtors. This result is by no means surprising. A bank will not lend money to an household below some minimum level of income; and deposits are strongly correlated with income (for the same reason, the amounts of deposits is positively correlated with the value of the loan).

A final point is that the issue should be put in a life-cycle perspective. When attracting a young household through a subsidized loan, the bank typically begins a long-term relationship. In presence of switching costs (which are not explicitly modelled here), a customer is likely to patronize the bank for several years; what the bank considers is the expected sum of future benefits. These may not appear immediately; for instance, important gains may arise when the household enters the accumulation phase of its life-cycle. Though it may no longer be a debtor by that time, still the low-rate initial loan may have played a key role in the current profit stream. This remark further strengthens the case for the existence of highly profitable tied-sales contracts.

4.2. Deregulation and industry size

We now turn to the positive predictions of our analysis. A first important implication is the fact that deregulation of deposit rates leads to a decrease in the size of the banking sector. Hence we should observe, first, that countries with effective regulation on deposit rates (or where effective cartel agreements keep the rates on deposits at a low level) exhibit a higher density of banking networks than countries where competition is effective. This view is consistent with Table 2, that gives, for several countries, the number of inhabitants per branch as of 1988. The figures are suggestive of the impact of regulation on the size of the banking industry. Typically, in Belgium, Germany and France, where deposit rates are close to zero either because of regulation or as a consequence of a cartelized market, we see a high density of the banking network. In contrast, such countries as Italy, Canada or the US are characterized both by (de facto) intense competition on deposits and (relatively) low number of branches.

In the same way, deregulation of deposit rates should, in any country, reduce

Table 2
Banking network density, 1988.

Country	Number of habitants per branch
Belgium	717
Switzerland	835
France	1314
Germany	1000
Canada	1985
Netherlands	1780
United Kingdom	1331
U.S.A.	2214
Sweden	1539
Japan	1850
Italy	1929

Source: BRI report and Banque de France

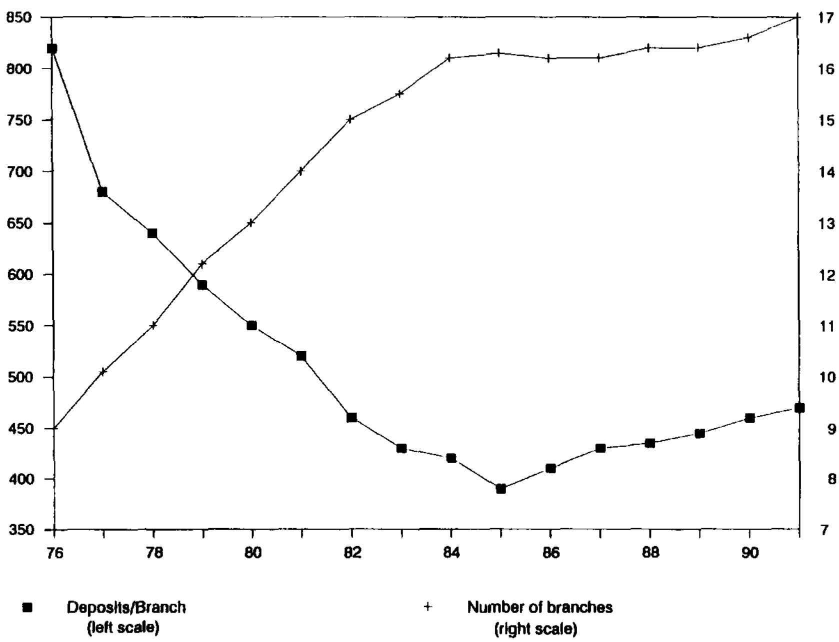

Fig. 2. Total network size (Spain, 1976–91).

the number of branches, as compared to the pre- deregulation trend. The case of Spain is represented in Fig. 2. [6] The consequences of the mid-eighties deregulation is clear. The creation of new branches is stopped, while the average amount of

[6] We thank V. Salas for providing these data.

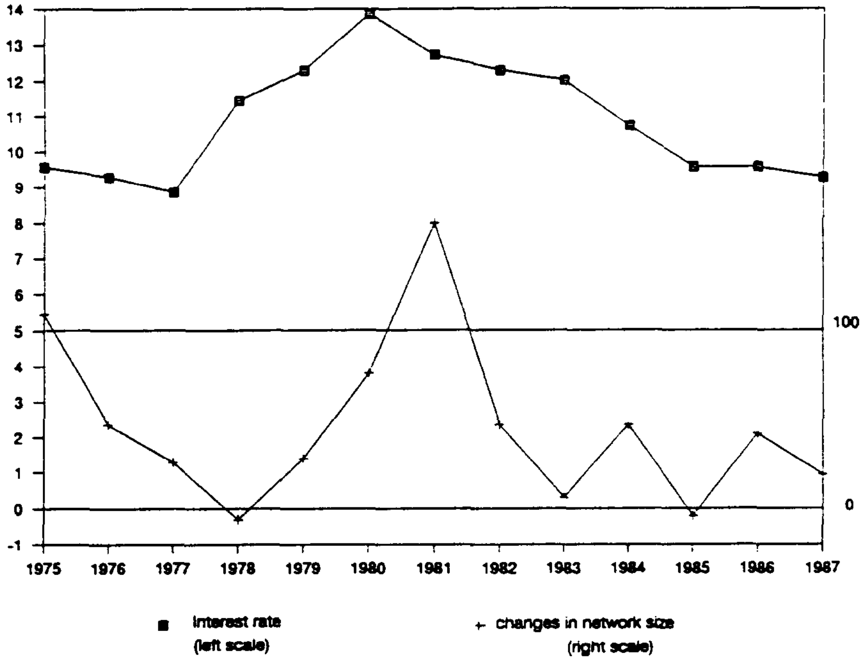

Fig. 3. Interest rate and changes in network size (France, 1975–87).

deposit per branch, in sharp decline since 1975, starts increasing again. These facts are in line with the predictions of our model.

A second implication of the model is the fact that the size of the banking system under regulation is sensitive to nominal rates, while it is not in the case of free competition. Hence one should observe that, other things been equal, long-term variations of nominal rates should affect the size of the banking industry more in countries with regulation on deposit rates than in countries without such regulatory constraints. As an illustration, Fig. 3 plots the net creation of new branches in France between 1975 and 1987. It is clear that the sharp rise of rates at the end of the 1970s has been followed by an important wave of new installations, whereas the subsequent drop has had the inverse effect.

4.3. Deregulation effects on deposit and credit rates

Under regulation of deposit rates, if banks are allowed to propose tied sales, they will do so, and consequently introduce cross-subsidies between credit and deposit activities. A first empirical consequence is that we should observe, other things being equal, lower credit rates in countries with regulation than in countries without regulation. Our model actually predicts that under regulation, credit rates can even be lower than the money market rate if the latter is very high. With tied

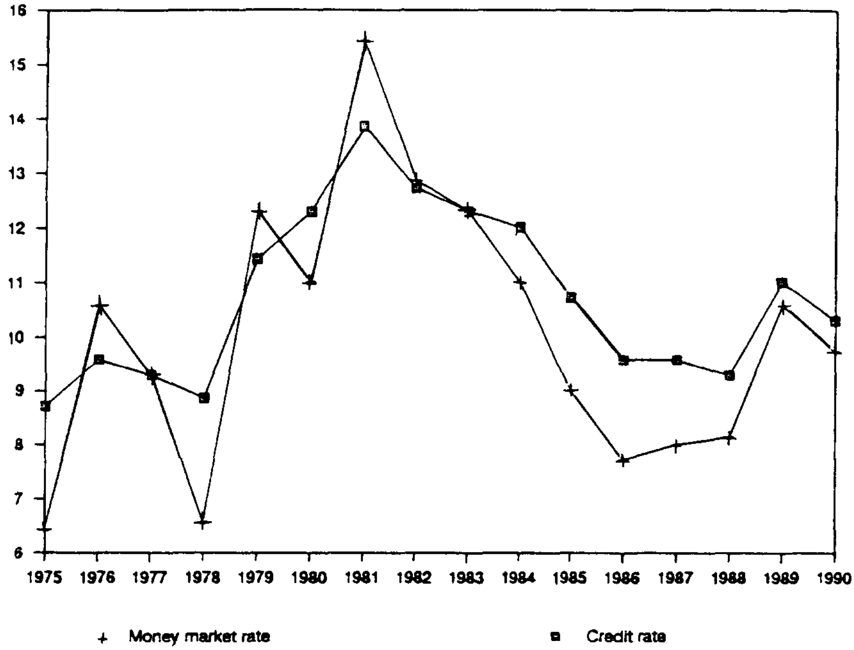

Fig. 4. Credit and money market rates (France, 1975–90).

contracts and regulation on deposits, we have found that the margin between credit rates and the money market rate is equal to

$$r-\rho=\frac{1}{L}\left(\frac{\alpha+\beta}{n}-(\rho-\bar{t})\right);$$

thus the margin will be negative if ρ is higher than $\bar{t}+(\alpha+\beta)/n$. Also, lower rates should benefit depositors only; this suggests that, in regulated economies, borrowing rates should be relatively more favorable for individuals (as compared to, say, governments) than in unregulated countries. Indeed, it has been observed that in some cases *the credit rates for households (financing real estate) were lower than both money market rates and return on government bonds.* A typical illustration is France between 1980 and 1982, as can be seen in Fig. 4. This example is of special interest, since such behavior may seem quite difficult to understand (and as a matter of fact, has often been interpreted as evidence supporting the hypothesis of irrational or 'managerial' decision making from bankers). On the contrary, in our context, this phenomenon is by no means a surprise. The reason why a banker is willing to invest in a risky asset with an apparent return lower than government bonds is simply that the *actual* return includes the rent levied upon the deposits generated by this credit decision. Of course, the higher the money market rate, the larger the rent and the more likely

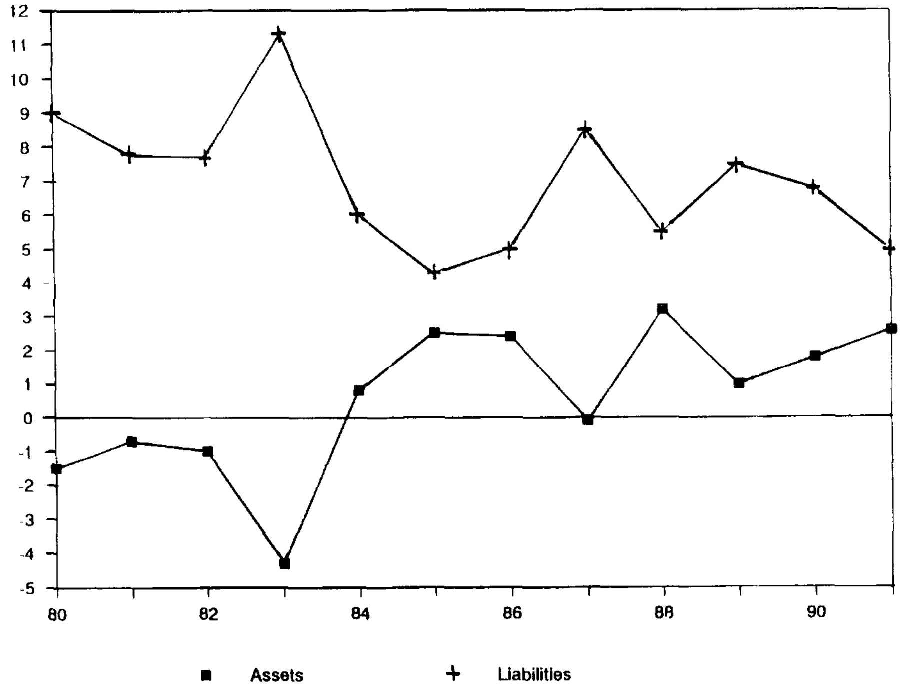

Fig. 5. Net margins (Spain, 1980–91).

this kind of situation is to occur. This is precisely what we observe between 1980 and 1985.

Even more interesting is the case of Spain, as represented on Fig. 5. It can be seen that before deregulation, banks were losing money on the credit side, the loss being compensated by the very high profitability of the liability side. Both phenomena vanish with deregulation. These data, thus, very clearly confirm the existence of huge cross-subsidies generated by regulation.

A second consequence of the model is that in a regulated environment, credit rates should follow money market rates in a smoothed way. Fig. 4 plots both rates for France between 1975 and 1990 (the credit rate is taken to be the 'Taux de base bancaire'). The characteristics of the respective fluctuations are quite in line with our hypothesis.

Regressing credit rates on money market rates should give a positive correlation, but with a coefficient less than one. Empirically, we find that

$$\text{Credit rate} = 0.59 * \text{Market rate} + 4.8$$

with a t-statistic of 8.6. Again, this evidence supports our conclusion. These findings are confirmed by a more detailed investigation by Boutillier and Derangère (1992).

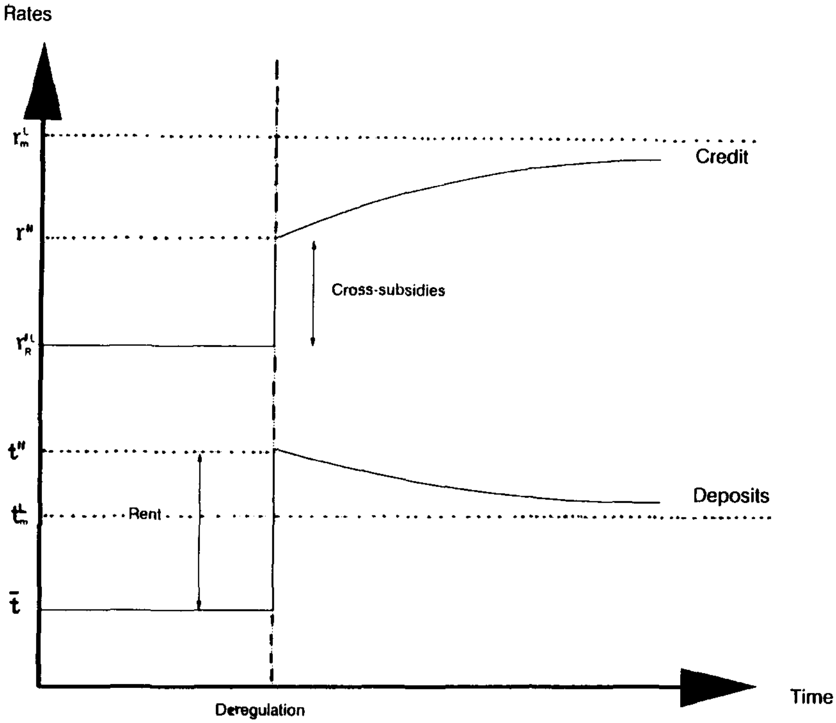

Fig. 6.

Finally, the model is also suggestive of the evolution through time of credit and deposit rates after deregulation. In the case of independent contracts, after the date of deregulation, banking size progressively decreases, and so does competition in the loan market. The consequence is a progressive increase in the credit rate from its long-run value before deregulation to the new long-run value after deregulation. When banks are allowed to propose 'tied-sale' contracts under regulation, the story, however, is a bit different. Fig. 6 shows, in that case, the evolution of credit and deposit rates. Immediately after deregulation, banks drastically reduce cross-subsidies (in our model the latter even disappears). The credit rate, therefore, increases from its initial long-run value before deregulation $r_R'^L$ to some r'', defined as the free-competition level when the number of firms is n_R':

$$r'' = \rho + \frac{\beta}{L n_R'},$$

which means that the immediate drop is

$$r'' - r_R'^L = \frac{1}{L}\left(\rho - \left(\bar{t} + \frac{\alpha}{n_R'}\right)\right) = \frac{1}{L}(t'' - \bar{t})$$

where $t'' = \rho(-\alpha/n'_R)$ is the competitive rate on deposits at the current number of firms.

In particular, *deregulation of deposit rates generates an immediate increase in credit rates*. It must, however, be stressed that this effect, expected as it may be, is in fact quite complex. The increase in credit rates, in particular, should *not* be seen as the consequence of a mark-up upon larger average cost of resources. It rather results from the existence, in the regulated case, of cross-subsidies that are suppressed overnight. As an illustration, the above regression suggests $(1 - 1/L) \simeq 0.6$, implying that each additional percentage point on deposits resulting from deregulation would generate an increase of 0.4 percentage point in credit rates. Note, however, that this amount is probably overestimated, since in most cases regulated deposits represent only a fraction of banks' resources.

Besides this short-term effect, shrinkage of the number of branches progressively occurs as in the previous case. This reduces competition in the loan market, hence inducing a further increase of credit rates. The conclusion from this discussion is the fact that if banks were making 'tied sale' contracts under regulation, one should observe after deregulation a faster increase of credit rates than in the case of independent contracts.

Alternatively soon after deregulation, deposit rates will increase to their market value for the corresponding network size (namely from the regulated level $\bar{t}$ to the level $t'' = \rho - (\alpha/n'_R)$). We should observe then a decrease of competitive deposit rates towards t_m^L because of the reduced competition associated with a smaller number of banking branches.

4.4. Regulation and monetary policy

Finally our model also has empirical implications concerning the effectiveness of monetary policy on credit and deposit rates under free competition and regulation in the banking system. The case of competition is straightforward. Assume that some contraction of money supply leads to an increase of the money market rate $\Delta\rho$. Credit rates and deposit rates increase by the same amount $\Delta\rho$ once for all.

Things are rather different in the case of regulation. Of course deposit rates are insensitive to the increase of money market rates. The plausible time path for credit rates in the cases of independent and 'tied-sale' contracts will be different. In the first case, the direct impact of an increase in money market rates of $\Delta\rho$ gives an equal increase in credit rates. Then, because of the positive impact of increased money market rates on network size of the banking system, competition in the loan market increases and credit rates tend downwards to the long-term value corresponding to the higher money market rate. For the 'tied-sales' contracts case, the short-term impact of higher money market rates $\Delta\rho$ is less than $\Delta\rho$. The time evolution is then similar to the case without 'tied-sales' with a downward convergence towards the new long-term equilibrium credit rate. As an illustration, again, the previous regression suggested that an additional percentage point on money market rates generates an increase of roughly 0.6% in credit rates.

The simple policy implication of this discussion is the fact that monetary policy (represented here by moves of the money market rate ρ) is less effective under regulation of the banking system than under free competition in the banking business. This is so in the long run when competition in the credit market is associated with independent contracts. This is so in the short run as well as in the long run in the case of 'tied-sales' contracts.

Appendix

Let $(r_{\mathrm{m}}, t_{\mathrm{m}})$ be the rates charged by the banks other than i:
$r_m = \rho + (\beta / L n_{\mathrm{m}})$ and $t_{\mathrm{m}} = \rho + (\alpha / n_{\mathrm{m}})$. The rates are offered through independent sales contracts. Suppose that bank i decides to introduce a tied-sales contract $(t_i, (t, r))$ where t_i is the deposit rate for the depositors, and (t, r) are the rates for the consumers who deposit and borrow simultaneously. Without loss of generality, we can choose $t_i = t$. Indeed, any couple of rates (t, r) addressed to simultaneous deposits and loans is equivalent for both the bank and the consumers to another pair (t^1, r^1) as long as $rL - t = r^1 L - t^1$. Hence the contract offered by bank i can be described by a couple (r, t).

We are going to show that the best tied-sales contract for bank i is $(r_{\mathrm{m}}, t_{\mathrm{m}})$ that is unilateral deviations from independent sales contracts are not profitable. We can restrict ourselves to changes in the loan rate r even if changes in t affect both depositors and borrowers. On the one hand, since $(r_{\mathrm{m}}, t_{\mathrm{m}})$ is an equilibrium for independent contracts, the marginal effect on profits extracted from the depositors through a variation $\mathrm{d}t$ of t is zero. On the other hand, this change $\mathrm{d}t$ has the same effect on profits extracted from borrowers as a change $\mathrm{d}r$ on the loan rate r equal to $(-1/L)\mathrm{d}t$.

Let us then analyse changes in r starting from the equilibrium. In equilibrium, the share of the consumers between two branches is graphically represented as

$$
\begin{array}{ccccc}
\text{——}\bigstar\text{————} & & \bigstar & & \text{————}\bigstar\text{——} \\
i & & \dfrac{1}{2\mathrm{n}} & & i+1
\end{array}
$$

Taking into account that the bank i offers a joint contract, three possibilities appear for borrowers if we consider an increase of $\mathrm{d}r$. They can deposit in i and borrow in $i+1$ (case A), operate only with bank i (case B) or operate only with bank $i+1$ (case C). A borrower has not the possibility to borrow in bank i but to deposit in $i+1$.Then it is not difficult to see that for a consumer borrower located t the distance X of bank i:

$$\text{case A is optimal if } 2X \geqslant \frac{1}{n} - \frac{L\,\mathrm{d}r}{\beta} \text{ and } 2X \leqslant \frac{1}{n},$$

$$\text{case B is optimal if } 2X \leqslant \frac{1}{n} - \frac{L\,\mathrm{d}r}{\beta} \text{ and } 2X \leqslant \frac{1}{n} - \frac{L\,\mathrm{d}r}{\alpha+\beta},$$

$$\text{case C is optimal if } 2X \geqslant \frac{1}{n} \text{ and } 2X \leqslant \frac{1}{n} - \frac{L\,\mathrm{d}r}{\alpha+\beta}.$$

Graphically we have the following regions:

$$\cdots(\mathrm{B})\cdots \qquad \cdots\cdots(\mathrm{A})\cdots\cdots \qquad \cdots\cdots(\mathrm{C})\cdots\cdots$$

$$\underset{i}{\bigstar} \text{———} \underset{\frac{1}{2n}-\frac{Ldr}{2\beta}}{\bigstar} \text{———} \underset{\frac{1}{2n}-\frac{Ldr}{2(\alpha+\beta)}}{\bigstar} \text{———} \underset{\frac{1}{2n}}{\bigstar} \text{———} \underset{i+1}{\bigstar}$$

Variations of firm i's profits are given by (we take into account the fact that bank i compete with bank $i-1$ and bank $i+1$)

$$\mathrm{d}\Pi = 2\lambda\left(\frac{1}{2n}L\,\mathrm{d}r - \frac{L\,\mathrm{d}r}{2\beta}L(r-\rho)\right) = \lambda L\left(\frac{1}{n} - \frac{L(r-\rho)}{\beta}\right)\mathrm{d}r = 0$$

because of $r = \rho + \beta/Ln$.

When a decrease in the loan interest rate ($\mathrm{d}r < 0$) is considered, the following situation is obtained:

$$\cdots\cdots(\mathrm{B})\cdots\cdots \qquad \cdots\cdots(\mathrm{C})\cdots\cdots$$

$$\underset{i}{\bigstar} \text{———} \underset{\frac{1}{2n}}{\bigstar} \text{———} \underset{\frac{1}{2}-\frac{Ldr}{2(\alpha+\beta)}}{\bigstar} \text{———} \underset{\frac{1}{2n}-\frac{Ldr}{2\beta}}{\bigstar} \text{———} \underset{i+1}{\bigstar}$$

The increase of firm i's profits through such a change on r is

$$\mathrm{d}\Pi = 2\lambda\left(\frac{1}{2n}L\,\mathrm{d}r - \frac{L\,\mathrm{d}r}{2(\alpha+\beta)}\left(L(r-\rho)+\rho-t\right)\right)$$

$$= \lambda L\left(\frac{1}{n} - \frac{-1}{\alpha+\beta}\left(L(r-\rho)+\rho-t\right)\right)\mathrm{d}r$$

and $\mathrm{d}\Pi = 0$ because of $r = \rho + \beta/Ln$ and $t = \rho - \alpha/n$. Finally note that the proof of this result does not need the assumption $\lambda L = 1$.

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