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The Role of Screening and Cross-Selling in Bank-Firm Relationships*

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Abstract

This paper presents a monopolistic competition model of a bank choosing the optimal level of the screening effort in the presence of cross-selling activities. We demonstrate that, in absence of informational synergies, the larger is the range of services that the bank produces, the lower is the optimal screening effort. The paper also analyses the impact of competition in the lending market on cross-selling activities and finds that, for sufficiently low levels of transportation costs, an increase in competition in the lending market increases the expected profitability of services, thus increasing banks' incentives to engage in cross-selling activities.

Keywords: bank-firm relationships, screening, cross-selling, spatial competition

JEL Codes: G21, L15, D83

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1 Introduction

Commercial banks are changing with the rapid development of financial services. They are no longer only lending institutions but they are becoming complex organisations involved more and more in the provision of a set of related services, such as trusts, annuities, mutual funds, mortgage banking, insurance brokerage and transaction services. According to Allen and Santomero (2001), banks have managed to develop new lines of business to compensate for the decline in the traditional intermediation business both in Europe and in the United States. Berger and Mester (2003) find that during the Nineties cost productivity in the banking industry in the US worsened while profit productivity improved substantially and explain this result by the fact that US banks offered a wider variety of financial services. Also in Europe non interest income has been the most dynamic component of banks' income, which contributed significantly to the overall rise of banks' profitability (ECB, 2005).

Stiroh and Rumble (2006) find evidence of a "a dark side of diversification". According to the results of their analysis, the observed shift toward activities generating fees, trading revenue, and other non interest income has not improved the performance of US financial holding companies from 1997 to 2002. One of the explanations proposed by the authors is that financial holding companies may have pointed to "cross selling" as a key strategic mean to lower costs, increase income and diversify revenue but selling many products to the same customer has reduced potential diversification benefits. Lepetit et al (2007) also find limited gains from diversification for a large sample of European banks from 1996 to 2002. Furthermore they find evidence that banks have used traditional lending activities as a "loss leader": the price banks charge for loans is a decreasing function of non interest income and particularly commission and fee income. They suggest that banks tend to underprice credit risk as granting a long term loan increases the probability of actually selling fee generating products to a core customer.

These results raise some concern on the traditional role of banks as producers of imperfect information about borrowers. In particular we may ask what are the consequences of banks' shift towards financial services for their screening activity. While there is empirical evidence of increasing diversification in the

banking sector, we are not aware of any theoretical model investigating its impact on the traditional role of banks as providers of screening services. The first aim of this paper is to fill this gap by analysing the impact of cross-selling on banks' screening incentives in the context of a spatial imperfect competition model of the banking sector where we assume that positively evaluated loan applicants are more likely to buy other services from their lending bank.

We define “cross-selling” as a bundling strategy based on the assumption that, once a loan applicant gets a loan, he becomes a warm customer, i.e. it becomes easier to sell to that customer other services different from loans. In the standard industrial organisation literature bundling can serve as a price discrimination device either in a “pure bundling” strategy, when the firm sells two or more goods only in package, or in a “mixed bundling” strategy, when the firm sells the same goods separately as well as packaged (Adams and Yellen, 1976; Mc Afee, Mc Millan and Whinston, 1989). In the model of Chiappori, Perez-Castrillo and Verdier (1995) “pure bundling” between loans and deposits is not a price discrimination device but an optimal strategy to get around the regulation.

In our model we have neither a “pure bundling” strategy, since when the bank sells a loan to a customer he is not obliged to buy other services, nor a true “mixed bundling” strategy since services other than loans are not sold separately. All the loans are packaged with other services that will be bought by the customer with a positive probability so that the relationship with a borrower has a marketing value for the bank and the bank must consider the cost of rejecting loan applicants when choosing the optimal level of the screening effort. Under these assumptions we show that cross-selling has a negative impact on the optimal screening effort. By reducing the proportion of information based credit, cross-selling has the same implication for the screening activity of collateral in the model of lazy banks proposed by Manove, Padilla and Pagano (2001) and of credit rationing on monitoring in the model of Caminal and Matutes (2002).

The effect of cross-selling on screening incentives may be mitigated by the existence of relevant information synergies between the different activities performed by the bank. There are several theoretical and empirical studies analysing information synergies among loans and deposits. Nakamura (1993) argues that the joint provision of loans and deposits makes bank lending special by allowing the bank to learn from deposits

about its borrowers. Mester, Nakamura and Renault (2007) provide detailed evidence of how a commercial bank uses information about current accounts to determine its credit ratings of borrowers and adjust the intensity of its monitoring activity. This literature demonstrates that selling services different from loans may decrease substantially bank's screening costs. In our model information about the services bought by a customer may lower banks' screening costs and information collected about a potential borrower through the screening activity may be used to increase the probability of selling him services other than loans.

The second aim of this article is to study the effect of a more competitive environment on the profitability of cross-selling. Could cross-selling be an optimal response to the increasing competition in the European lending market caused by the progressive capital market liberalisation and the diffusion of Information and Communication Technologies (ICTs)?

In the literature we find several studies investigating the impact of more competition in the lending market on relationship lending. A recent literature (Caminal and Matutes, 2002; Freixas, 2005) analyses how competition in credit market may lower the optimal monitoring effort. Bank monitoring generates soft information that allows parties to implement more efficient outcomes. Since the "interim monitoring" effort (the effort that allows the bank to prevent the firm from investing in inefficient projects) increases with the expected excess return on banks' investment, more competition in the banking industry decreases the monitoring effort. From an ex-ante perspective Gehrig (1998) shows that the relationship between the degree of competition and the screening effort is ambiguous. Boot and Thakor (2000) and Yafeh and Yosha (2001) demonstrate that, when competition increases, the profitability of market finance decreases more than that of relationship loans so the bank is induced to increase "relationship" lending at the expense of "transaction" lending.

In our model we show that, for sufficiently low levels of transportation costs, an increase in competition in the lending market increases the expected profitability of services, thus increasing the incentive for banks to engage in cross-selling activities. We can, therefore, also suggest another possible indirect effect of competition on screening, via the increase in services, whose sign depends on the degree of information synergies between screening and cross-selling. More competition increases the profitability of services and

more services induce the bank to perform less screening in the absence of information synergies. Overall the results of our model on the impact of competition on cross-selling are consistent with the view that the shift of banks towards non traditional activities can be the response to a more competitive banking industry.

The paper is organised as follows. Section 2 presents the basic set-up of the model. Section 3 analyses the impact of cross-selling on screening. Section 4 focuses on the effect of competition in the lending market on the profitability of cross-selling. Section 5 extends the model to the case of the existence of information synergies between screening and selling services and analyses the empirical implications of the model; finally the last section draws the main conclusions of the paper.

2 The theoretical model

We analyse a spatial competition model of the banking sector where banks have the possibility to sell to their customers other services different from loans. In what follows we will present the basic set-up of the model describing the assumptions on the borrower's behaviour, the bank's behaviour, the screening activity, and the cross-selling activity.

Borrowers

We use a Salop model of spatial competition (Salop, 1979), so we consider an economy with a continuum of potential risk neutral borrowers located uniformly (with density 1) around a unit circle, each having an investment project to be financed with one unit of loanable funds that they can borrow from a bank. Each borrower has a transportation cost $\gamma > 0$ for unit of length.

The project generates a random return $y(z)$ which is characterised by a random binary variable $y(z) \in \{0, z\}$. There are two types of projects, good and bad. The good project generates the positive outcome z with probability p_h while the bad project generates the positive outcome z with probability $p_l < p_h$. The outcome z is borrowers' private information and is 'large enough' so that all borrowers, good and bad, will always apply for loans at the prevailing interest rate (since borrowers are protected by limited liability, the

participation constraint requires the net expected outcome to be larger than the transportation cost).

The proportion of good projects (for which $z \cdot p_h > r_f$, where r_f is the risk-free interest rate) in the population is $\theta \in [0, 1]$ and is common knowledge. Bad projects have a mean expected rate of return less than the cost of loanable funds, so that $z \cdot p_l < r_f$ (i.e. bad projects are dominated by the safe capital market investment) and they are observationally indistinguishable from good ones without some screening activity.

Banks

There are n banks located around the unit circle and market power derives from transportation and location costs. Each bank has a fixed cost of installation K . Banks are risk neutral and maximise their expected profits. They have access to competitive capital markets, where they issue bonds at the risk free interest rate r_f .

Each bank may get some information on which of the projects is expected to fail by using a creditworthiness test that we model following Devinney (1986) and Gehrig (1998). Each bank i must decide the optimal screening effort, e_i^* and the optimal loan interest rate, r_i^* . Banks sell also services other than loans to loan applicants.

The screening activity

Each bank's screening activity can be described in terms of a creditworthiness test. Only borrowers that pass the test get the loan. The bank observes noisy signals of the borrowers' quality, good or bad, and the signal characteristics correspond to the pool characteristics. The test imperfectly assigns firms to one of the two risk classes, respectively good and bad borrowers.

If e is the effort of the bank in the screening activity, we may define $\alpha(e) = \text{prob}(s = G | \text{type} = \text{good})$ as the probability of correctly observing a good signal where $s \in \{B, G\}$ denotes the signal, $(1 - \alpha(e)) = \text{prob}(s = B | \text{type} = \text{good})$ as the probability of erroneously observing a bad signal; $\beta(e) = \text{prob}(s = G | \text{type} = \text{bad})$ as the probability of erroneously observing a good signal and $(1 - \beta(e)) = \text{prob}(s = B | \text{type} = \text{bad})$ as the probability of correctly observing a bad signal. We assume that banks accept borrowers when they observe

a good signal and reject borrowers when they observe a bad signal (see table 1).

The higher is the per applicant effort $e \in [0, 1]$ in the screening activity, the higher is the ability of the bank to recognise good projects with $\alpha'(e) \geq 0$, $\beta'(e) \leq 0$, $\alpha''(e) \leq 0$, $\beta''(e) \geq 0$.

Since screening is costly the bank must choose the optimal level of effort given the screening cost $C(e)$ that we assume to be strictly convex with $C'(e) > 0$, $C''(e) > 0$, $C(0) = 0$, and $\lim_{e \rightarrow 1} C'(e) = \infty$. This last assumption implies that $e = 1$ will never be optimal for the bank.

We define $A(e) = [\alpha(e)\theta + \beta(e)(1 - \theta)]$ as the selection ratio (i.e. the percentage of loan applicants that is positively evaluated by the bank). We will see that the properties of this ratio are important for understanding the way in which cross-selling affects the optimal screening effort and lending. In particular we will be interested in the effect of an increase in the screening effort on the selection ratio (the sign of $A'(e)$). This depends on the proportion of good and bad projects in the population and on the properties of the screening technology. The selection ratio increases with the screening effort whenever $\alpha'(e)\theta > -\beta'(e)(1 - \theta)$ and this is more likely the higher is the proportion of good projects in the population, the higher is the marginal positive impact of the screening effort on the probability of correctly observing a good signal and the lower is the marginal negative impact of screening on the probability of erroneously observing a bad signal. Since there is no reason to expect a large difference between $\alpha'(e)$ and $\beta'(e)$ we will refer to good (bad) periods when the selection ratio increases (decreases) with the screening effort. In fact we expect that in good periods, i.e. when there is a high proportion of good projects in the population, the more accurate is the screening activity the more likely it is that banks recognise truly good projects, thus increasing lending, while the opposite is true in bad periods.

We also define $B(e) = [\alpha(e)\theta p_h + \beta(e)(1 - \theta)p_l]$ as the expected ratio of successful projects (i.e. the percentage of loan applicants, good and bad, that are positively evaluated and successful)¹. We will see that the sign of the impact of the interest rate on the screening effort will depend on the sign of the impact of the screening effort on the expected ratio of successful projects (the sign of $B'(e)$).

¹In the rest of the paper we will use indifferently the terms "ratio" or "number" of successful projects. The term "ratio" depends on the fact that we have normalised the population of potential borrowers to one.

In good periods, since an increase in the screening effort increases the number of financed projects ($A'(e) > 0$) it also increases the expected number of successful projects $B'(e) > 0$. In bad periods an increase in the screening effort leads to a decrease in the number of financed projects and this can lead to both an increase or a decrease in the expected number of successful projects depending on the degree of heterogeneity between good and bad projects. In particular in bad periods with "enough" heterogeneity among projects ($A'(e) < 0$ and $B'(e) > 0$)² more screening leads to a lower number of financed projects but to a higher expected number of successful projects, while in bad periods with "enough" homogeneity among projects ($A'(e) < 0$ and $B'(e) < 0$) more screening leads to a lower number of financed projects and to a lower expected number of successful projects. Finally we can introduce a measure of the expected quality of the pool of financed projects $Q(e) = \frac{B(e)}{A(e)}$ (i.e. the expected share of successful projects over all financed projects). In all states of the world an increase in the screening effort increases the expected quality of the pool of financed projects:

$$Q'(e) = \frac{B'(e)A(e) - A'(e)B(e)}{A(e)^2} = \frac{(p_h - p_l)\theta(1 - \theta)(\alpha'(e)\beta(e) - \beta'(e)\alpha(e))}{A(e)^2} > 0.$$

²Notice that when $A'(e) < 0$, we have $B'(e) > 0$ when $\frac{p_l}{p_h} < \frac{\alpha'(e)\theta}{-\beta'(e)(1-\theta)} < 1$. For given θ , $\alpha'(e)$, and $\beta'(e)$, this is more likely to happen the higher is the difference in the success probability of good and bad projects. We therefore refer to bad periods with enough heterogeneity among projects when $A'(e) < 0$ and $B'(e) > 0$ and to bad periods with enough homogeneity among projects when $A'(e) < 0$ and $B'(e) < 0$.

Table 1 The creditworthiness test

EVALUATION\REALITY	Good	Bad
Good	<i>Correct</i> <i>Prob = $\alpha(e)$</i>	<i>False positive</i> <i>Prob = $\beta(e)$</i> (type II error)
Bad	<i>False negative</i> <i>Prob = $1 - \alpha(e)$</i> (type I error)	<i>Correct</i> <i>Prob = $1 - \beta(e)$</i>

The cross-selling activity

Each bank is a multiproduct firm selling loans and a given number S of other services different from loans. For each service other than loan the bank pays fixed and variable costs. We assume that the variable cost is negligible so that we can consider only the fixed cost that is included in the bank installation cost K^3 . Firms that are not financed by banks, i.e. firms borrowing from the capital market, buy services from other suppliers. The banking system competes with other institutions (like insurance companies, investment companies and so on) in the market for services. Since there are many specialised institutions selling services, we assume that the bank is price taker in the service market and we denote the price of the service with v_s . We assume that the probability to sell a service to a customer, p_s , is larger than the probability of selling a service to a non-customer which, for simplicity, we normalise to zero. The expected revenue from selling services for the bank is therefore equal to $p_s v_s S$. We also assume that the revenue from services is not state dependent (the borrower pays for services also in case of default out of the loan)⁴. Since we are interested in studying the interaction between screening and cross-selling, we assume that the expected revenue from

³In this model services are exogenous. We can, therefore, imagine that the bank chooses ex ante how many services to sell and incurs the fixed costs of organising the service activity. The first aim of the paper is to assess if banks having a different number of services to sell have different screening incentives.

⁴We are aware that some financial services like, for example, underwriting activity are state contingent but this is not the case for many other services.

services is small enough that banks will never be willing to finance bad projects: $p_l z + p_s v_s S < r_f$.⁵

The structure of the game

We study the following extensive form game: in the first stage banks maximise expected profits and simultaneously set the equilibrium screening effort, e_i^* and interest rate, r_i^* ; in the second stage each firm applies at exactly one bank; in the third stage banks screen loan applicants and extend credit at the announced rate to positively evaluated borrowers or not at all.

3 The impact of cross-selling on the optimal screening effort

Assume that n banks located symmetrically around a circle have entered the market, if r_i is the interest rate offered to borrowers by a typical bank and r_0 is the interest rate offered by its neighbour competitors (the banks $i + 1$ and $i - 1$), a borrower located at distance $x \in [0, 1/n]$ from the bank i will be indifferent between bank i and bank $i + 1$ if:

$$p_j(z - r_i) - \gamma x = p_j(z - r_0) - \gamma \left(\frac{1}{n} - x \right) \quad (1)$$

where p_j is p_h for a good borrower and p_l for a bad borrower. Since in the population there are θ good borrowers and $1 - \theta$ bad borrowers, the demand function faced by each bank ($2x$) will be given by

$$\left[\frac{1}{n} - (r_i - r_0) \frac{p}{\gamma} \right] \quad (2)$$

where $p = \theta p_h + (1 - \theta) p_l$. The lower is transportation cost for unit of length γ , and the higher is the average success probability p the higher is the sensitivity of demand to interest rate differentials.

We first characterize the symmetric equilibrium and then analyse the impact of services on the optimal screening effort. The optimal screening effort of the bank, and the optimal loan interest rate depend on the

⁵Note that $z \gg r_i$ is a necessary condition for the borrower's participation constraint to be satisfied, therefore $p_l z + p_s v_s S < r_f$ is a sufficient condition for ensuring that the bank is not willing to finance bad borrowers and, therefore, is induced to screen loan applicants in order to reject bad borrowers.

maximisation of the following expected profit function:

$$\pi^e = \left[\frac{1}{n} - \frac{p}{\gamma}(r_i - r_0) \right] [B(e)r_i - A(e)(r_f - p_s v_s S) - C(e)] - K \quad (3)$$

where:

$$A(e) \equiv [\alpha(e)\theta + \beta(e)(1 - \theta)],$$

$$B(e) \equiv [\alpha(e)\theta p_h + \beta(e)(1 - \theta)p_l],$$

$$p \equiv [\theta p_h + (1 - \theta)p_l].$$

Profits depend on both the lending and the cross-selling activities. The bank receives the interest rate from successful borrowers while for all positively evaluated borrowers (good and bad) she pays the risk free interest rate and she gets the revenue from services with a positive probability $p_s > 0$.

Maximising (3) with respect to the screening effort and the interest rate we find the equilibrium values of the two endogenous variables.

Proposition 1 *The optimal level of effort e^* in the symmetric equilibrium (for $r_i = r_0$) satisfies:*

$$\frac{1}{n} [B'(e^*)r^* - A'(e^*)(r_f - p_s v_s S) - C'(e^*)] = 0 \quad (4)$$

where $B'(e)r - A'(e)(r_f - p_s v_s S)$ is the marginal expected benefit of screening and $C'(e)$ is the marginal cost of screening.

Proposition 2 *The equilibrium lending rate r^* in the symmetric equilibrium (for $r_i = r_0$) is given by:*

$$r^* = \frac{\gamma}{pn} + \frac{A(e^*)}{B(e^*)}(r_f - p_s v_s S) + \frac{C'(e^*)}{B(e^*)} \quad (5)$$

The equilibrium interest rate is increasing in the bank's monopolistic power (i.e. total transportation costs γ/n), it is decreasing in the average success probability, p (i.e. in the sensitivity of demand to interest rate differentials), and, given the equilibrium screening effort, it is decreasing in the equilibrium mean expected

project quality, $B(e^*)/A(e^*)$, it is increasing in the equilibrium screening costs per successful borrower, $C(e^*)/B(e^*)$ and in the cost of loanable funds net of the expected revenue from services, $r_f - p_s v_s S$. The total impact of services on the equilibrium screening effort is given by:

$$\frac{de^*}{dS} = \frac{p_s v_s [A'(e^*)B(e^*) - B'(e^*)A(e^*)]}{-[B''(e^*)r^* - A''(e^*)(r_f - p_s v_s) - C''(e^*)]B(e^*) - (\gamma/pn)[B'(e^*)]^2} < 0 \quad (6)$$

Corollary 1 *Screening incentives are a decreasing function of the range of services (S) offered by the bank*

Proof. See Appendix A

An increase in services has a direct impact on screening (see equation 4) and an indirect impact through the equilibrium interest rate (see equation 5). The sign of the impact of services on the equilibrium screening effort is the sign of the sum of these two effects (see a) and b) in Table 2). First, with more services banks are induced to increase the selection ratio in order to increase the revenue from services and this might lead to a higher or lower screening effort depending on how screening affects the selection ratio (the sign of $A'(e)$). Since the impact of screening on the selection ratio is positive in good periods and negative in bad periods, via this channel, banks are induced to increase the screening effort in good periods and to decrease the screening effort in bad periods. Secondly, an increase in services, for a given screening effort, leads to a decrease in the optimal lending rate since, when services increase, the net cost of loanable funds decreases and each bank maximises profits with a lower interest rate. The impact of the change in the interest rate on the equilibrium screening effort depends on how screening affects the expected ratio of successful projects (the sign of $B'(e)$). When the expected ratio of successful projects increases with screening the lower interest rate leads to a lower effort⁶, while when the expected ratio of successful projects decreases with screening the

⁶From equation 4 we can observe that when $B'(e) > 0$ the expected marginal benefit of screening increases with the interest rate while when $B'(e) < 0$ the expected marginal benefit of screening decreases with the interest rate. This is because, since only successful projects pay the interest rate, an increase in the interest rate makes screening more profitable when the expected ratio of successful projects increases with screening and vice versa.

lower interest rate leads to a higher effort. However Corollary 1 states that the total impact of an increase in services on the marginal expected benefit of screening and, therefore, on the equilibrium screening effort is always negative. The intuition is that, with more services, since screening is costly while both good and bad borrowers pay for services, the expected marginal benefit of screening decreases and the bank maximises profits with a lower screening effort and a lower quality of the project pool.

Table 2 The impact of services on the equilibrium screening effort

CASES	Partial effect	Total effect
$A'(e^*) > 0$	a) $S \uparrow A(e^*) \uparrow e^* \uparrow$	b) prevails
$B'(e^*) > 0$	b) $S \uparrow r^* \downarrow e^* \downarrow$	
$A'(e^*) < 0$	a) $S \uparrow A(e^*) \uparrow e^* \downarrow$	a) prevails
$B'(e^*) < 0$	b) $S \uparrow r^* \downarrow e^* \uparrow$	
$A'(e^*) < 0$	a) $S \uparrow A(e^*) \uparrow e^* \downarrow$	a) and b) have the same sign
$B'(e^*) > 0$	b) $S \uparrow r^* \downarrow e^* \downarrow$	

Corollary 2 *For any given number of banks a decrease in transportation costs causes cross-selling to have an even more negative effect on screening.*

Proof. See equation 6.

Therefore more competition caused by more transparency, IT developments, etc. amplifies the negative impact of cross-selling on screening.

Corollary 3 *Services increase lending in bad periods and decrease lending in good periods.*

Proof. In the symmetric equilibrium the total amount of loans financed by the banking system is $A(e^*)$ and the impact of services on lending is given by $A'(e^*) \cdot \left(\frac{de^*}{dS}\right)$ with $\frac{de^*}{dS} < 0$.

When there are many bad (good) projects in the economy, services by decreasing the screening effort lead to an increase (decrease) in the number of financed projects, and therefore on lending.

Overall the model predicts that with more cross-selling banks will spend less resources in the screening activity. By using less accurate screening procedures they will be less able to distinguish good from bad projects. As a consequence, in periods (places) in which there are many bad projects (e.g. recessions, more risky environments) the less accurate screening activity will lead banks to increase lending while the opposite will happen in good states of the world.

In all states of the world services, by decreasing the optimal screening effort, decrease the quality of the pool of financed projects. We will see that this result may be reversed when we assume the existence of relevant synergies between banks' screening and cross-selling activities (Section 5).

4 The impact of competition in the lending market on the profitability of cross-selling

So far we have studied the impact of services on screening for a given number of banks. Now we endogenize entry and we study the impact of a change in transportation costs, interpreted as more competition between existing players (banks), on the profitability of the cross-selling activity. Capital market liberalisation and the diffusion of ICTs in the banking sector in advanced industrial countries have led to an increase in competition in the lending market. We ask whether cross-selling can partly be a response to this increase in competition.

For answering these questions we allow for the number of banks to be endogenous (i.e. we look at the long run solution of the monopolistic competition model) and we then investigate the impact of competition (modelled as a decrease in transportation costs) on the profitability of services.

By substituting into expected profits the optimal level of screening and the optimal interest rate and by equating profits to zero we obtain the equilibrium number of firms:

$$n^* = \left(\frac{\gamma B(e^*)}{pK} \right)^{\left(\frac{1}{2}\right)} \quad (7)$$

As it is standard in this type of monopolistic competition models, the number of firms, at equilibrium, is positively related to transportation costs (larger transportation costs increase the banks' monopoly power, thus increasing profits, for a given number of banks, and inducing more entry) and it is negatively related to the fixed cost of installation K . Moreover, in this model, the equilibrium number of firms increases with the equilibrium expected number of successful projects $B(e^*)$ (this is because the higher is the expected number of successful projects the higher are profits inducing more entry) and decreases with the average success probability p (this is because the higher is the average success probability the higher is the sensitivity of demand to interest rate differentials and the lower is the short run equilibrium interest rate, thus leading to lower profits and less entry).

We can now look at the impact of increasing competition in the lending market (a decrease in the parameter γ) on the profitability of services. The expected profitability of services in the symmetric equilibrium is given by:

$$\pi_S^e = \frac{1}{n^*[e^*(r^*(\gamma)), \gamma]} A[e^*(r^*(\gamma))] p_s v_s S - K \quad (8)$$

where the number of banks is given by (7). Equation (8) shows that the profitability of services increases with the selection ratio and the expected revenue from services and decreases with the number of banks and with the fixed installation costs. In particular the higher is the selection ratio and the lower is the equilibrium number of banks, the higher is the number of customers for each bank and, since the bank has a positive probability of selling services to its customers, the higher is the expected profitability of the cross-selling activity. An increase in competition in the lending market affects the expected profitability of services via several channels. First, by affecting the equilibrium screening effort (through the interest rate) it affects the selection ratio; second it has both a direct and an indirect (through the screening effort) impact on the equilibrium number of banks (see equation 10). In order to compute the overall impact of competition on

the expected profitability of services we differentiate equation (8) with respect to transportation costs, thus obtaining:

$$\frac{d\pi_S^e}{d\gamma} = -\frac{1}{(n^*)^2}A(e^*)p_s v_s S \frac{dn^*}{d\gamma} + \frac{1}{n^*}A'(e^*)p_s v_s S \frac{de^*}{d\gamma} \quad (9)$$

where:

$$\frac{dn^*}{d\gamma} = \frac{1}{2} \frac{n^*}{\gamma} + \frac{n^* B'(e^*)}{2B(e^*)} \frac{de^*}{d\gamma} \quad (10)$$

Corollary 4 *Whenever the expected ratio of successful projects is increasing in the screening effort ($B'(e^*) > 0$) an increase in competition in the lending market (a decrease in transportation costs γ) increases the expected profitability of services. Otherwise ($B'(e^*) < 0$) an increase in competition decreases the expected profitability of services for high levels of transportation costs but, as transportation costs continue to decrease, the expected profitability of services eventually rises.*

Proof. See Appendix B.

What is the explanation for this result? Since in the model the profitability of services per loan customer is fixed, everything depends on whether with more competition a bank has more or less loan customers. This depends on how competition affects the equilibrium number of banks and the selection ratio (see Table 3).

As it is standard in this type of models, an increase in competition (a decrease in transportation costs) leads to lower profits and less entry. Moreover, in our model, a decrease in transportation costs reduces the equilibrium number of banks also through the expected number of successful projects⁷.

While competition always reduces the equilibrium number of banks, the impact on the selection ratio depends on how the interest rate affects the equilibrium screening effort (which depends on the sign of

⁷In fact the lower long run interest rate associated with a lower level of transportation costs induces banks to choose the level of effort so that the expected number of successful projects is decreased thus leading to a lower equilibrium number of banks (see equation 7).

$B'(e^*)$) and on how the screening effort affects the selection ratio (the sign of $A'(e^*)$) (see Table 3). However, also when competition reduces the selection ratio (i.e. when $B'(e^*)$ and $A'(e^*)$ have the same sign: cases b1 and b2 in Table 3), the negative impact on the equilibrium number of banks either prevails (this is the case when $B'(e^*) > 0$ and $A'(e^*) > 0$), or prevails for sufficiently low levels of transportation costs: $\gamma < \gamma_{cr} = \frac{n^* p A(e^*) |F_{ee}|}{B'(e^*) A'(e^*)}$ (this is the case when $B'(e^*) < 0$ and $A'(e^*) < 0$) (see Appendix B).

Table 3 The impact of competition on the expected profitability of services

		Partial impact on π_S^e	Total impact on π_S^e
a) Impact on n^* :	$\gamma \downarrow \quad n^* \downarrow$	$\pi_S^e \uparrow$	
b) Impact on $A(e^*)$			
b1) $A'(e^*) > 0, B'(e^*) > 0$:	$\gamma \downarrow \quad r^* \downarrow \quad e^* \downarrow \quad A(e^*) \downarrow$	$\pi_S^e \downarrow$	a) prevails
b2) $A'(e^*) < 0, B'(e^*) < 0$:	$\gamma \downarrow \quad r^* \downarrow \quad e^* \uparrow \quad A(e^*) \downarrow$	$\pi_S^e \downarrow$	a) prevails for $\gamma < \gamma_{cr}$
b3) $A'(e^*) < 0, B'(e^*) > 0$:	$\gamma \downarrow \quad r^* \downarrow \quad e^* \downarrow \quad A(e^*) \uparrow$	$\pi_S^e \uparrow$	a) and b) have the same sign

In this model more competition in the lending market between existing banks, by reducing expected profits from lending, leads to a more concentrated banking system. Competition also affects lending (the number of positively evaluated borrowers) in a way that depends on the composition and heterogeneity of the project pool. However for sufficiently low levels of transportation costs, an increase in competition leads to a higher number of each bank's loan customers, thus increasing the expected profitability of services.

This result is consistent with the view that the transition to a marketing orientation in banking documented in the literature is, at least in part, a response to increasing competition in the lending market.

5 Extensions and empirical implications

5.1 The case of information synergies

We now complicate the model by assuming the existence of some synergies in the production of services and information through the screening activity. First, the larger is the range of services sold by the bank, the

lower is the marginal cost of producing information. This is because by selling services the bank acquires some information on the borrower's type. In particular we are assuming that it is less costly to produce information when services are also produced so that: $C = C(e, S)$ with $\partial C/\partial S < 0$ and $\partial^2 C/\partial e \partial S < 0$. Banks, by selling services, acquire some information on the characteristics of the borrowers that they can use to improve the efficiency of the screening activity. This is a first source of complementarity between screening and cross-selling activities. A second source of complementarity derives from the impact that information collected through the screening activity can have on the probability of selling a service other than a loan. In particular, we assume that $p_s = p_s(e)$ with $\partial p_s/\partial e > 0$ and $\partial^2 p_s/\partial e^2 < 0$.

The interdependence between screening and cross-selling activities may be very important in order to increase bank efficiency. We shall see that if banks are able to create information synergies between the screening and the cross-selling activities, cross-selling is less likely to reduce the optimal screening effort. In the case of synergies between cross-selling and screening activities expected profits are given by:

$$\pi^e = \left[\frac{1}{n} - \frac{p}{\gamma} (r_i - r_0) \right] [B(e)r - A(e)(r_f - p_s(e)v_s S) - C(e, S)] - K \quad (11)$$

and the optimal level of the screening effort e^* in the symmetric equilibrium satisfies:

$$\frac{1}{n} \left[B'(e^*)r^* - A'(e^*)(r_f - p_s(e^*)v_s S) + \frac{\partial p_s(e^*)}{\partial e} A(e^*)v_s S - \frac{\partial C(e^*, S)}{\partial e} \right] = 0 \quad (12)$$

In the presence of synergies, the positive impact of screening on the probability of selling services leads to a higher marginal expected benefit of screening with respect to the case without synergies, and, all other things being equal, to a higher equilibrium screening effort.

The impact of selling services on the optimal level of the screening effort is given by:

$$\frac{de^*}{dS} = \frac{\left\{ \frac{p\gamma}{n} \right\} \left\{ p_s v_s [A'(e^*)B(e^*) - B'(e^*)A(e^*)] + B(e^*)A(e^*)v_s (\partial p_s/\partial e) - B(e^*)(\partial^2 C/\partial e \partial S) + B'(e^*)(\partial C/\partial S) \right\}}{|J|} \quad (13)$$

where $|J| > 0$; $[A'(e^*)B(e^*) - B'(e^*)A(e^*)] < 0$; $B(e^*)A(e^*)v_s (\partial p_s/\partial e) > 0$; $B(e^*)(\partial^2 C/\partial e \partial S) < 0$ and $B'(e^*)(\partial C/\partial S) \leq 0$ if $B'(e^*) \geq 0$.

Corollary 5 *In the case of synergies the impact of cross-selling on the optimal screening effort is positive whenever $B(e^*)A(e^*)v_s(\partial p_s/\partial e) - B(e^*)(\partial^2 C/\partial e\partial S) + B'(e^*)(\partial C/\partial S) > p_s v_s [B'(e^*)A(e^*) - A'(e^*)B(e^*)]$*

This is more likely to happen the higher is the impact of screening on the probability of selling services (that increases the marginal benefit of screening) and the higher is the negative impact of services on the marginal cost of screening. Finally the lower cost of screening makes it more likely to have a positive impact of cross-selling on screening when $B'(e^*)$ is negative⁸.

In general, while in the absence of synergies between the cross-selling and the screening activities, cross-selling always reduces screening, when the bank is able to exploit information synergies it becomes less probable that an increase in services induces the bank to decrease its screening effort.

Corollary 6 *When there are enough synergies between the screening and the cross-selling activities so that the impact of services on the optimal screening effort is positive, lending increases in good periods and decreases in bad periods.*

Information synergies may allow to overcome the negative impact of cross-selling on screening incentives, thus increasing the quality of the pool of financed projects.

In the extended model the consequences of the bank's cross-selling activity on the traditional activity of screening loan applicants depend on the degree of information synergies between services and loans. In particular services could be classified according to the extent of interdependence between screening and cross-selling captured by the two parameters $\partial p_s/\partial e$ and $\partial^2 C(e, S)/\partial e\partial S$, i.e the impact of screening on the probability of selling a service and the size of economies of scope between the production of information and services (see Table 4).

In the first row we find those services for which the screening activity is supposed to be important. The collection of information by the bank can increase the probability of selling those services that are

⁸This is because as services increase screening costs decrease and so does the equilibrium interest rate (see equation 5) with a positive impact on the equilibrium screening effort when the expected number of successful projects decreases with the screening effort.

customer-specific, i.e. are bought by customers on the basis of their personal characteristics: for example the bank, by increasing the screening effort (i.e. by carefully studying an investment project), can acquire some information on the propensity to risk of the borrower that can be useful for inducing the customer to sign some insurance contracts. To a lesser extent this information can also be used by the bank for selling to the customer mutual funds with the “right” risk characteristics.

In the first column we find services that are highly informative, in the sense that they provide the bank with some information that can be useful for the screening activity: selling those services to a customer can lower screening costs and increase screening efficiency. This can be the case, for example, of deposits that are characterised by a low degree of customer specificity (second row, first column) but can provide precious information on the amount of resources available to the borrower. Some services are at the same time customer-specific and highly informative (first row and first column). This is the case of insurance: not only the service is customer-specific so that information acquired through the screening activity can enhance the probability of selling the insurance, but it is also informative. The fact that the borrower has signed some types of insurance contracts can provide the bank with valuable information on the risk of the project, thus lowering the cost of screening. Insurance is, therefore, a category of services with potentially important synergies with the lending activity of banks. In the last years in Europe a growing number of banks have entered the insurance market, also by cross-sector consolidation, and several empirical studies suggest that “bankassurance” may also help risk diversification (see ECB, 2005).

It is also important to observe that the degree of interdependence between the screening and the cross-selling activities depends, not only on the characteristics of the service, but also on the ability of the bank to use efficiently the information collected. The same service, e.g. insurance, can be offered together with loans by a bank in a simple cross-selling activity, with no exchange of information between loans and insurance services, or as a fully integrated product where the bank makes extensive use of information about the customer (Van den Berghe, Verweire and Carchon, 1999). In our model the two modalities have very different implications for the impact of cross-selling on the screening activity.

Table 4 A tentative classification of services based on information synergies

<i>Impact of screening on the probability of selling a service</i>	<i>Impact of services on the marginal cost of screening</i>	
	High	Low
High	Customer-specific highly-informative services (e.g. life/health insurance)	Customer-specific not highly informative services (e.g. non financial personal services)
Low	Highly-informative not customer-specific services (e.g. payment services)	Not highly informative nor customer-specific services (e.g. auto insurance)

5.2 Empirical Implications

Our model predicts that when there are no synergies between the screening and cross-selling activities, the increase in services leads to a decrease in the equilibrium screening effort. While we are not aware of any empirical work directly investigating this issue, the result is consistent with the evidence that small banks, having a smaller range of services to sell when compared to large banks, are more likely to engage in relationship lending (see for example Berlin and Mester, 1998 and Cole, Goldberg and White, 1999). Small banks in Europe tend to localise where the degree of asymmetric information is higher (Affinito and Piazza, 2005). Consistently with our model, this could derive by the choice of large banks, supplying a large range of services other than loans, to perform a low level of screening, sufficient at achieving only public information about a firm, information that is available only for the more transparent typologies of firms. Small banks, on the opposite, whose profits derive almost exclusively from intermediation, choose to perform a level of screening sufficient at achieving private information about firms and, therefore, are able to grant loans also to opaque firms (Berger et al. 2005).

Other indirect evidence consistent with the results of our model can be found in the empirical research on the impact of banks' diversification on risk. Stiroh and Rumble (2006) find that while there is no significant relationship between the average level of profits and either diversification or non-interest share, an increased

reliance on non-interest income is associated with more volatile profits. Furthermore they find a strong negative correlation between risk-adjusted performance and non-interest share of revenues. The authors explain this result with the high volatility of non-interest income, however it cannot be excluded that the result, consistently with our model, depends on a decrease in the lenders' screening effort.

Furthermore Le Petit et al. (2007) show that European banks which have expanded into non-interest activities present a higher level of risk than banks which mainly perform traditional intermediation activities. In order to test for a possible cross-selling behaviour of interest and non-interest products they analyse the determinants of the risk premium charged by banks and they find that borrowers' default risk is underpriced in lending rates by banks having large fee based activities.

Another prediction of our model is that a decrease in transportation costs (that can be interpreted as an increase in competition between existing banks due for example to ICT developments and more transparency in the banking sector) leads to a more concentrated banking sector and to an increase in banks' expected profitability from offering services other than loans. This is consistent with the evidence that banks have responded to increasing competition in the lending market by partly shifting from more traditional lending activities to other services. In fact in the US, while at the beginning of the Nineties spread income accounted for about 80% of bank earnings, at the end of the Nineties most of large banks earn more than half of their income from fees and trading income (Allen and Santomero, 2001). In Europe during the Nineties the progressive liberalisation of entry conditions to local banking markets fostered the emergence of new intermediaries challenging the position of incumbent banks. European banks are reacting to these pressure on profitability by diversifying income sources': while in 1997 non-interest revenues accounted for 33% of total revenues, in 2003 the ratio reached a level higher than 40% (ECB, 2004). At the end of the Nineties also the Italian banking system, which in the past was characterised by a very low degree of competition, experienced a similar evolution. In June 2000 the Italian Banking Association (ABI, Associazione Bancaria Italiana) reported that in 1999 for the first time revenues from services, dividends and other proceeds exceeded returns deriving from traditional intermediation activity for 91 among the first 130 Italian banks and more recent data confirm this trend.

In our model the consequence of this shift in banks' activity towards the provision of services different from loans is the reduction in the traditional role of banks as providers of information about borrowers. This result may be reversed in the presence of information synergies between screening and cross-selling. The empirical evidence on the exploitation of information synergies by banks is still very limited. Van den Berghe, Verweire and Carchon (1999), studying banks cross-selling activities, find that the use of fully integrated services with a high degree of exchange of information between different financial services is more the exception than the rule. Mester, Nakamura and Renault (2007) report evidence for a Canadian bank that checking account information lowers screening costs, also if they recognise that synergies can be exploited only when the borrower has an exclusive relationship with the bank, and this occurs very rarely in Europe for large banks (see Ongena and Smith, 2000). According to Frei, Harker and Hunter (1998) it may be difficult for banks to exploit information synergies since banks collect and process information by product and transaction and not by customer.

In the context of increasingly competitive financial markets, the empirical evidence, although very limited, suggesting that the exploitation of information synergies between screening and cross-selling is not yet so developed, raises some concern on the impact of banks' income diversification on their screening effort. However the transformation of the banking sector might lead to the development of new technologies allowing banks to exploit the potential synergies between the screening and the cross-selling activities. According to Berger, Frame and Miller (2005) and Berger, Rosen and Udell (2005) transaction technologies exist that may be used to supply funding to very opaque firms even when relationship lending cannot be effectively employed. The results of the model presented in this paper suggest that it is crucial for banks to exploit these technologies if they want to maintain their traditional role of producers of information about borrowers.

6 Conclusions

This paper has examined the impact of cross-selling on the banks' optimal screening effort. We have found that, when there are no information synergies between the cross-selling and the screening activity, cross-

selling reduces the optimal screening effort. This result can cause some concern since it implies that the more the banking system evolves towards non traditional activities, the less will be information based credit, with a negative influence on the quality of the pool of investment projects financed. In our model revenues from cross-selling may induce banks to be lazy and to screen loan applicants insufficiently. However the existence of some elements of interdependence between the cross-selling and the screening activities makes the trade-off between cross-selling and screening less likely.

In our view the recent years' proliferation of transaction oriented banking, that has started to seriously challenge banks' future as relationship lenders, may have been induced by the growing importance of cross-selling strategies but we suggest that the role of information synergies may be crucial in reverting this trend: more cross-selling could be associated to more "relationship lending" and more production of information. Boot (2000) defines as a "relationship lender" the lender who evaluates the profitability of an investment in the acquisition of customer specific information through multiple interactions with the same customer across different products (and/or over time).

Our model has shown that, for sufficiently low levels of transportation costs, an increase in competition in the lending market increases the profitability of services. This is consistent with the view that capital market liberalization and the growing integration of financial markets, by increasing competition in the lending market, may contribute explaining the transition of banks towards non traditional service activities. This transition, according to our model, will bring to the progressive weakening of the Schumpeterian role of banks in fostering economic growth unless banks will be able to exploit information synergies between screening and cross-selling.

Appendix A

The implicit equations that define the optimal screening effort and the optimal interest rate in the symmetric equilibrium are:

$$F_e = \frac{1}{n} [B'(e^*)r^* - A'(e^*)(r_f - p_s v_s S) - C'(e^*)] = 0 \quad (A1)$$

$$F_r = -\frac{p}{\gamma} [B(e^*)r^* - A(e^*)(r_f - p_s v_s S) - C(e^*)] + \frac{1}{n} B(e^*) = 0 \quad (A2)$$

the Jacobian of the system with respect to the endogenous variables calculated at the symmetric equilibrium is:

$$|J| = \begin{vmatrix} F_{ee} & F_{er} \\ F_{re} & F_{rr} \end{vmatrix} = \begin{vmatrix} \frac{1}{n} [B''(e^*)r^* - A''(e^*)(r_f - p_s v_s S) - C''(e^*)] & \frac{1}{n} B'(e^*) \\ \frac{1}{n} B'(e^*) & -\frac{p}{\gamma} B(e^*) \end{vmatrix} \quad (A3)$$

with $F_{ee} < 0^9$, $F_{rr} < 0$ and we assume $F_{ee}F_{rr} - F_{er} > 0$ for the stability of the symmetric equilibrium (this condition also ensures the symmetric equilibrium to be a maximum)¹⁰. Applying Cramer's rule we have:

$$\frac{de^*}{dS} = \frac{\begin{vmatrix} -\frac{1}{n} A'(e^*) p_s v_s & \frac{1}{n} B'(e^*) \\ \frac{p}{\gamma} A(e^*) p_s v_s & -\frac{p}{\gamma} B(e^*) \end{vmatrix}}{|J|} = \frac{p_s v_s [A'(e^*) B(e^*) - B'(e^*) A(e^*)]}{-[B''(e^*)r^* - A''(e^*)(r_f - p_s v_s S) - C''(e^*)] B(e^*) - (\gamma/pn)[B'(e^*)]^2} < 0 \quad (A4)$$

The numerator in (A4) is negative: note that $A'(e^*)B(e^*) - B'(e^*)A(e^*) = -Q'(e^*) [A(e^*)]^2 < 0$, since when the screening effort increases, also the quality of the project pool increases. The denominator must be

⁹ $B''(e^*)r^* - A''(e^*)(r_f - p_s v_s S) - C''(e^*) = \alpha''(e^*)\theta(p_h r^* + p_s v_s S - r_f) + \beta''(e^*)(1 - \theta)(p_l r^* + p_s v_s S - r_f) - C''(e^*)$ with $\alpha''(e^*) \leq 0$, $\beta''(e^*) \geq 0$, $C''(e^*) > 0$, $(p_h r^* + p_s v_s S - r_f) > 0$ and $(p_l r^* + p_s v_s S - r_f) < 0$

¹⁰ Note that $|J|$ differs from the determinant of the Hessian matrix since the Jacobian is derived for a system in which we have imposed the symmetric solution $r_i = r_0$.

positive for the stability of the symmetric equilibrium, therefore as services increase the equilibrium screening effort decreases (Corollary 1).

In order to guarantee the positivity of the denominator in (A4) we assume a sufficiently low level of transportation costs:

$$\gamma < \frac{-[B''(e^*)r^* - A''(e^*)(r_f - p_s v_s) - C''(e^*)]B(e^*)}{B'(e^*)^2} np \quad (A5)$$

Appendix B

In order to compute the overall impact of competition on the expected profitability of services we differentiate equation (7) with respect to transportation costs, thus obtaining:

$$\frac{d\pi_S^e}{d\gamma} = -\frac{1}{(n^*)^2} A(e^*) p_s v_s S \frac{dn^*}{d\gamma} + \frac{1}{n^*} A'(e^*) p_s v_s S \frac{de^*}{d\gamma} \quad (B1)$$

where:

$$\frac{dn^*}{d\gamma} = \frac{1}{2} \frac{n^*}{\gamma} + \frac{n^* B'(e^*)}{2B(e^*)} \frac{de^*}{d\gamma} \quad (B2)$$

Substituting (B2) into (B1) we get:

$$\frac{d\pi_S^e}{d\gamma} = -\frac{1}{2\gamma n^*} A(e^*) p_s v_s S - \frac{A(e^*) B'(e^*) p_s v_s S}{2n^* B(e^*)} \frac{de^*}{d\gamma} + \frac{1}{n^*} A'(e^*) p_s v_s S \frac{de^*}{d\gamma} \quad (B3)$$

The impact of competition on the optimal screening effort can be obtained by applying Cramer's rule to the system of equations that implicitly define the optimal screening effort and the optimal interest rate in the long run. These are:

$$F_e = \left(\frac{pK}{\gamma B(e^*)} \right)^{\left(\frac{1}{2}\right)} [B'(e^*) r^* - A'(e^*) (r_f - p_s v_s S) - C'(e^*)] = 0 \quad (B4)$$

$$F_r = -\frac{p}{\gamma} [B(e^*) r^* - A(e^*) (r_f - p_s v_s S) - C(e^*)] + \left(\frac{pK}{\gamma B(e^*)} \right)^{\left(\frac{1}{2}\right)} B(e^*) = 0 \quad (B5)$$

the Jacobian of the system with respect to the endogenous variables is:

$$|J| = \begin{vmatrix} \frac{1}{n^*} [B''(e^*) r^* - A''(e^*) (r_f - p_s v_s S) - C''(e^*)] & \frac{1}{n^*} B'(e^*) \\ +\frac{1}{2n^*} B'(e^*) & -\frac{p}{\gamma} B(e^*) \end{vmatrix}$$

Applying Cramer's rule we have:

$$\frac{de^*}{d\gamma} = \frac{\begin{vmatrix} 0 & \frac{1}{n^*}B'(e^*) \\ -\frac{B(e^*)}{2\gamma n^*} & -\frac{p}{\gamma}B(e^*) \end{vmatrix}}{|J|}$$

which gives:

$$\frac{de^*}{d\gamma} = \frac{B'(e^*)B(e^*)}{-2pn^*[B''(e^*)r^* - A''(e^*)(r_f - p_s v_s S) - C'''(e^*)]B(e^*) - \gamma B'(e^*)^2} \quad (B6)$$

Substituting (B6) into (B3) and denoting the denominator of (B6) with D we have:

$$\frac{d\pi_S^e}{d\gamma} = -\frac{1}{2\gamma n^*}A(e^*)p_s v_s S - \frac{B'(e^*)^2 A(e^*)p_s v_s S}{2n^*D} + \frac{A'(e^*)B'(e^*)B(e^*)p_s v_s S}{n^*D} \quad (B7)$$

Multiplying each term of (B7) by $D > 0$ ¹¹ and rearranging we have:

$$D \frac{d\pi_S^e}{d\gamma} = B(e^*)p_s v_s S \left\{ \frac{p}{\gamma}A(e^*)[B''(e^*)r^* - A''(e^*)(r_f - p_s v_s S) - C'''(e^*)] + \frac{1}{n^*}[A'(e^*)B'(e^*)] \right\} \quad (B8)$$

and therefore:

$$\frac{d\pi_S^e}{d\gamma} < 0 \Leftrightarrow \frac{p}{\gamma}A(e^*)[B''(e^*)r^* - A''(e^*)(r_f - p_s v_s S) - C'''(e^*)] + \frac{1}{n^*}A'(e^*)B'(e^*) < 0 \quad (B9)$$

The first term in equation (B9) is negative while the sign of the second term depends on the sign of the product between $A'(e^*)$ and $B'(e^*)$ and it is also negative when the two terms have opposite signs. Otherwise we can observe that condition (B9) requires $\gamma < \frac{n^* p A(e^*) |F_{ee}|}{B'(e^*) A'(e^*)} = \gamma_{cr}$ where $|F_{ee}|$ denotes the absolute value of the derivative with respect to the screening effort of the first order condition for the screening effort calculated at the symmetric equilibrium. This is similar to the condition for the stability of the symmetric equilibrium (see A5): $\gamma < \frac{n^* p B(e^*) |F_{ee}|}{B'(e^*)^2}$. When $B'(e^*) > 0$ if the condition for the stability of the symmetric equilibrium is satisfied also (B9) is satisfied. In fact:

¹¹ $D > 0$ when the conditions for the stability of the system are satisfied, see equation A5 in Appendix A.

$$\frac{npA(e^*)|F_{ee}|}{B'(e^*)A'(e^*)} - \frac{npB(e^*)|F_{ee}|}{B'(e^*)^2} = \frac{np|F_{ee}|}{B'(e^*)} \left[\frac{A(e^*)}{A'(e^*)} - \frac{B(e^*)}{B'(e^*)} \right]$$

and the difference is positive with $B'(e^*) > 0$ since, when $A'(e^*)$ and $B'(e^*)$ have the same sign, the expression in square brackets is positive. We are therefore left with only one case in which competition can lower the profitability of services, i.e. the case in which $A'(e^*) < 0$ and $B'(e^*) < 0$. In this case there is a range of transportation costs $\gamma > \gamma_{cr}$ for which a decrease in transportation costs (an increase in competition) leads to a decrease in the expected profitability of services, but as transportation costs continue to fall, the expected profitability of services will eventually increase also in this case.

References

- Adams, W.J. and Yellen, J.L. (1976). "Commodity bundling and the burden of monopoly". *Quarterly Journal of Economics* 90, 475–498.
- Affinito, M., Piazza, M. (2005). "What determines banking structures in European regions?" Mimeo.
- Allen, F., Santomero, A.M. (2001). "What do financial intermediaries do?". *Journal of Banking and Finance* 25, 271–94.
- Berger, A.N., Mester, L.J. (2003). "Explaining the dramatic changes in performance of U.S. banks: technological change, deregulation and dynamic changes in competition". *Journal of Financial Intermediation* 12, 57–95.
- Berger, A.N., Frame W. S., Miller, N.H. (2005). "Credit Scoring and the Availability, Price, and Risk of Small Business Credit". *Journal of Money, Credit, and Banking* 37, 191-222.
- Berger, A.N., Miller, N.H., Petersen, M.A., Rajan, R.G., Stein, J.C. (2005). "Does function follow organizational form? Evidence from the lending practices of large and small banks". *Journal of Financial Economics* 76, 237–269.
- Berger, A.N., Rosen, R.J, Udell, G.F. (2007). "Does market size structure affect competition? The case of small business lending". *Journal of Banking and Finance* 31, 11–33.
- Berlin, M., Mester, L.J. (1998). "On the profitability and cost of relationship lending". *Journal of Banking and Finance* 22, 873–97.
- Boot, A. W. A. (2000). "Relationship lending: What Do We Know?" *Journal of financial intermediation*, 9, pp.7-25
- Boot, A.W.A., Thakor, A.V. (2000). "Can relationship banking survive competition?". *Journal of Finance* 55, 679–713.
- Caminal, R., Matutes, C. (2002). "Market power and banking failures". *International Journal of Industrial Organization* 20, 1341–1361.
- Cole, R.A., Goldberg, L.G. L., White, L.J. (1999). "Cookie-cutter versus character: the micro structure

of small business lending by large and small firms". New York University, Salomon Center , Working Paper S/99/12, New York University.

Chiappori, P.A., Perez-Castrillo, D., Verdier, F. (1995). "Spatial competition in the banking system, localisation, cross-subsidies and the regulation of interest rates". *European Economic Review* 39, 889–919.

Devinney, T. (1986). *Rationing in a Theory of the Banking Firm*. New York: Springer Verlag.

European Central Bank (2004). Accounting for the resilience of the EU banking sector. *Monthly bulletin*, July.

European Central Bank (2005). Consolidation and diversification in the Euro Area banking sector. *Monthly bulletin*, May.

Frei, F.X., Harker, P.T., Hunter, L.W. (1998). Innovation in retail banking. Working Paper 97-48-B, Financial Institution Center, The Wharton School, University of Pennsylvania.

Freixas, X. (2005). "Deconstructing relationship banking". *Investigaciones Economicas* 29, 3–31.

Gehrig, T. (1998). "Screening, cross-border banking, and the allocation of credit". *Research in Economics* 52, 387–407.

Herring, R. J., Santomero, A.M. (1990). "The corporate structure of financial conglomerates". *Journal of Financial Services Research* 4, 417–497.

Lepetit, L., Nys, E., Rous, P., Tarazi, A. (2007). "Bank income structure and risk: An empirical analysis of European Banks". *Journal of Banking and Finance*, forthcoming

Manove, M., Padilla, J., Pagano, M. (2001). "Collateral vs. project screening: a model of lazy banks". *RAND Journal of Economics* 32, 726–44.

McAfee, R.P., McMillan, J., Whinston, M.D. (1989). "Multiproduct monopoly, commodity bundling and correlation of values". *Quarterly Journal of Economics* 104, 371–383.

Mester, L.J., Nakamura, L.I., Renault, M. (2007). "Transaction accounts and loan monitoring". *Review of Financial Studies*, forthcoming.

Nakamura, L. (1993). "Recent research in commercial banking: information and lending". *Financial Markets, Institutions and Instruments* 2, 73–88.

Ongena, S., Smith, D.C. (2000). "What determines the number of banking relationships? Cross-country evidence". *Journal of Financial Intermediation* 9, 27–55.

Salop, S. (1979). "Monopolistic competition with outside goods". *Bell Journal of Economics* 10,141–56.

Stiroh, K. J., Rumble, A. (2006). "The dark side of diversification: the case of US financial holding companies". *Journal of Banking and Finance* 30, 2131-2161

Van den Berghe, L., Verweire, K., Carchon, S.W.M. (1999). *Convergence in the Financial Industry*. OECD, Paris.

Yafeh, Y., Yosha, O. (2001). Industrial organization of financial systems and strategic use of relationship banking. *European Finance Review* 2, 63–78.