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The transition to a marketing orientation in banking: cross-selling, screening incentives and information synergies

Abstract

In the last two decades a growing number of banks have started to implement cross-selling programs across their branch network in an effort to become sales-driven organizations. What are the consequences of cross-selling on the traditional role of banks as producers of imperfect information about borrowers? The authors show that the answer to this question crucially depends on the ability of banks to exploit synergies between the screening and the cross-selling activities. The paper proposes a tentative classification of services according to their degree of customer-specificity and information-intensity. On the one hand, information about the services bought by a customer, such as insurance or payment services, may lower banks' total and marginal screening costs. On the other hand, information collected about a potential borrower may be used to increase the probability of selling to her services other than loans. The authors show that the exploitation of these synergies is essential if banks want to prevent the negative impact of cross-selling on banks' optimal screening effort.

Keywords: banking, cross-selling, information synergies, screening.
JEL Classification: G2, G21.

1. Introduction

The recent financial crisis, that originated in the United States in 2008 and then diffused to all European countries, has raised attention on the consequences of banks' shift towards financial services for their capability to perform the traditional role of producers of valuable information about their borrowers. The process of banks' diversification from lending activities to the provision of a set of various financial services has been favored by the relaxation, starting from the Eighties, of the Glass-Steagall Act (that, in the US, prevented commercial banks from engaging in investment banking) and by the increasing competition in the banking system due to deregulation that made it possible, both in the US and in Europe, the entrance of new subjects in markets where previously only banks operated.

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. Banks have managed to prosper, both in Europe and in the US, by shifting from traditional intermediation functions to fee-producing activities such as trusts, annuities, mutual funds, mortgage banking, insurance brokerage and transaction services. As a result the importance of net interest income in the banking sector has fallen and non-interest bearing income has risen (Boyd and Gertler, 1994). 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 the large regional and money center banks earn more than half of their income from fees and trading income (Allen and Santomero, 2001). In Europe, while in 1997 non-interest revenues accounted for 33% of total revenues, in 2003 the ratio reached a level higher than 40% (ECB, 2004).

Even if the progressive transition to a marketing orientation in banking had been recognized since the Seventies (Rathmell, 1974), it is in the last two decades that a growing number of banks have started to implement cross-selling programs across their branch network in an effort to become sales-driven organizations. The objective of cross-selling programs is to increase the number of products and services sold to existing customers of a bank (Akşin and Harker, 1999), by improving both sale effectiveness and the number of sevices sold per sale at the bank. It is apparent that switching costs play an important role in providing companies with opportunities to cross-sell their products to their customers. Li, Sun and Wilcox (2005) argue that some customers may be "trapped" by the bank because of the substantial implicit costs a given customer might face in switching to another provider and this offers substantial opportunities for companies to cross-sell other products and services to their existing customer base. Lepetit, Nys and Tarazi (2008) test the hypothesis that banks have used traditional lending activities as a loss leader and find that the price banks charge for loans is a decreasing function of non-interest income.

Banks provide working capital credit, commercial loans and leasing, jointly with transactions, payroll, cash management and foreign exchange services. Production economies lower unit cost by spreading fixed expenses over a broader output mix and exploiting production complementarities. Synergies are also the justification for the formation of the so-called financial supermarkets, where savings, instalment and credit cards loan, insurance, real estate,

and securities services were all offered jointly by retail firms[1].

But what are the consequences of cross-selling on the traditional role of banks as producers of imperfect information about borrowers? Will banks be able to exploit information synergies between lending and selling other services or, on the contrary, will the cross-selling activity lead to a decrease in banks' screening effort?

In the literature we find several interesting studies taking into account the multiproduct nature of financial institutions and investigating on the existence of product-specific economies of scale and scope between deposits and loans (Mester, 1987; Mester, Nakamura and Renault, 2007; Boot, 2003). Other theoretical models explain why it may be optimal to offer tied sales contracts by which banks propose bundles of credit and deposit services instead of selling loans and deposits separately (Chiappori, Perez-Castrillo and Verdier, 1995; Kashyap, Rajan and Stein, 2002). This literature focuses on bundling as a strategic device aimed at retaining existing customers or at acquiring new customers. Finally, some studies look at the benefit of combining underwriting services and lending due to informational economies of scope that can lead directly to a potential cross-selling benefit if a firm needs debt and equity and the cost of monitoring or building a relation is lower when lending and underwriting are provided by the same financial institution at the same point in time (Kanatas and Qi, 1998, 2003; Drucker and Puri, 2005; Laux and Walz, 2009).

This paper differs from the cited literature in that the focus is on the relationship between the multiproduct nature of the bank and the more traditional screening activity. We refer to cross-selling rather than bundling since the emphasis is on the marketing value of the customer relationship: 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[2]. Therefore, 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. This can lead to a trade-off between screening and cross-selling (Cosci, Meliciani and Sabato, 2009).

However the trade-off between screening and cross-selling activities crucially depends on the efficiency of banks to exploit interactions between them. The existence of a sort of "information reusability", like in the model of Millon and Thakor (1985), where the bank by gathering information about one project gets indirectly information about similar projects, may give rise to relevant information synergies between the provision of loans and that of other services. On the one hand, information about the services bought by a customer, such as insurance or payment services, may lower banks' screening costs. On the other hand, information collected about a potential borrower may be used to increase the probability of selling to her services other than loans. This interdependence between screening costs and cross-selling activities may be very important in order to increase the bank's efficiency. We show that if banks are able to create information synergies between screening and cross-selling activities, cross-selling is less likely to reduce the role of banks as producers of "information-intensive" loans.

The paper is organized as follows. Section 1 provides a tentative classification of services based on the degree of interdependence with the screening activity. Section 2 presents the general set-up of the model. Section 3 derives the equilibrium results. Section 4 analyzes the impact of the cross-selling activity on banks' screening incentives in the cases of null, high and intermediate degree of interdependence between screening and cross-selling activities. The final section draws the main conclusions.

2. A classification of services based on the interdependence between screening and cross-selling activities

Banks operate in a market where customers tend to purchase multiple products from the same provider over time. The development over time of the consumer complementary demand for multiple services is particularly important in those markets in which consumers face some uncertainty about the quality of the services offered or need to evolve after some preliminary consumption. The sequential purchase of multiple services from the same provider tends to create a relationship between a provider and its customer, to increase switching costs and to lower uncertainty about additional product purchase. Li, Sun and Wilcox (2005) investigate customer purchase patterns for the products marketed by a large US bank and find that highly educated customers are less likely to be cross-sold other products after they have opened an account with a bank and that in general education and sex influence the customer's ability to patronize multiple financial institutions. Furthermore women and older customers are more sensitive to overall satisfaction with their bank than men and younger customers when they decide whether to purchase additional financial services. Households having higher education or children tend to have a higher cost of time and to spend less time shopping for bank services. A bank may,

[1] Pulley, Berger and Humphrey (1993) pointed out that the belief in synergies was so strong that in the early Eighties thrift institutions and credit unions lobbied for and obtained the power to expand their product mix and became more like banks, offering consumer transaction accounts and broader mixes of consumer and business loans to supplement their historic focus on saving deposits and mortgage loans.

[2] The distinction between a "warm" and a "cold" customer is commonly used in the marketing cross-selling strategies.

therefore, predict the probability that a given borrower buys other products by acquiring information about him. An increase in the screening effort may help bank managers to allocate more efficiently their targeting efforts.

A similar argument has been used by de la Torre, Martínez Pería and Schmukler (2010) to explain banks' incentive to lend to small and medium enterprises (SME). Through questionnaires and interviews to banks and SMEs in developed and developing countries they show that in the recent period (starting from 2006 but also after the financial crisis) lending was a relatively small part of a larger overall package of services that banks provide to SMEs. In effect, banks have developed a wide range of fee-based, non-lending products and financial services for SMEs and this places cross-selling at the heart of the banks' business strategy. These products and services can be so attractive in terms of profitability that banks may offer loans as a way to eventually cross-sell other lucrative fee-based products and services, including payments, savings, and advisory services. Once they establish a client relationship with SMEs, large banks can use their well established retail and consumer units to more easily extend services to the individuals (workers, owners, and their families) linked to those SMEs. The evidence on SMEs financing, therefore, suggests that loans may be provided in order to increase the probability of selling other services[1].

The measure in which the bank can exploit information scope economies crucially depends on the nature of the services sold and on the degree of customization and integration of the form of bundling provided by the bank. Van den Berghe, Verweire and Carchon (1999) distinguish between three different forms of bundling: "cross-selling", "packaged products" and "fully integrated products". "Cross-selling" is defined as the activity with the lowest degree of integration and customization, with a limited scope of different expertise involved and a relative lower level of value added. Here the accent of the supplier's strategy is more on the volume of business and is oriented in a perspective of "transaction marketing". A typical example is the cross-selling of life insurance products by the bank. "Fully integrated services", on the contrary, have a high degree of integration and customization, many experts involved and a high value added for the customer. This is a typical approach for "relationship marketing". An example of this strategy is *Proveniersplan* (certainty for the elderly). This is a product developed in the Dutch financial market by the Achmea Group, consisting of different elements about *integral home care*. All the products of *Proveniersplan* can be considered as variations or complements of existing products such as pensions, annuities, mortgages, general insurance, etc. Finally "packaging" is an in-between solution with intermediate levels of integration, customization, expertise and value added. Here an example is *medical savings accounts*, US bank products that integrate with health insurance. These products allow individuals to obtain health insurance coverage with high deductibles. They use the funds accumulated in the savings account to pay for out-of-pocket medical expenses that fall within the deductible.

The nature of the services sold by the bank has an impact on the possible exchange of information that can make screening and cross-selling two important complementary activities. Table 1 reports a tentative classification of services on the basis of the extent of interdependence between screening and cross-selling captured by the impact of screening on the probability of selling a service and the size of scope economies between the production of information and the range of other services sold to the same customer. When services are customer-specific, i.e. they are bought by customers on the basis of their personal characteristics or the characteristics of the project, the collection of information by the bank can increase the probability of selling a service. For example the bank, by increasing the screening effort (i.e., by carefully studying an investment project), can acquire some information on the borrower's risk propensity 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. At the same time information about the project can be useful to cross-sell a leasing contract.

Table 1. A tentative classification of services

Impact of screening on the probability of selling a service	Impact of the range of services on the marginal cost of screening	
	High	Low
High	Services that are customer-specific and highly informative (e.g., life insurance, health insurance)	Services that are customer-specific but not highly informative (e.g., mutual funds, leasing)
Low	Services that are not customer-specific but are highly informative (e.g., savings and current accounts; payment services)	Services that are neither customer-specific nor highly informative (e.g., auto insurance, credit cards to employees)

[1] De la Torre, Martínez Pería and Schmukler (2010) argue that the cross-selling activity is not necessarily accompanied by an increase in soft information and in relationship lending, in fact banks can use other types of hard information and incentive-compatible mechanisms to increase the likelihood of repayment (e.g., the renting of tangible and marketable assets through leasing can help overcome costly contract enforcement processes) (see also Berger, Rosen and Udell, 2007). In this case, differently from what occurs in our model, even when cross-selling reduces screening it can also reduce risk.

When services are highly informative, in the sense that they provide the bank with some information that can be useful for the screening activity, they can lower the screening costs and increase the screening efficiency. This can be the case, for example, of current and savings accounts or payment services that can provide precious information on the amount of resources available to the borrower even if they are characterized by a low degree of customer-specificity.

In 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, another category of services with potentially important synergies with the lending activity of banks. This is consistent with the trend of banks entering the insurance market.

However it is important to keep in mind that also when the nature of services is such that information synergies between cross-selling and screening are potentially exploitable this does not guarantee that the bank uses this information efficiently.

The degree of interdependence between screening and cross-selling activities also depends 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.

In this respect a problem raised by Frei, Harker and Hunter (1999) is that retail banks collect and process information by product and transaction and not by customer. This makes it difficult to get customer-specific information that is a source of complementarity between the screening and the cross-selling activities.

In our model the potential existence of information synergies and banks' ability to exploit them have important implications for the impact of cross-selling on the screening activity.

3. The set-up of the model

We analyze a spatial competition model of the banking sector where banks have the possibility to sell to their customers other services different from loans. It extends the model of Cosci, Meliciani and Sabato (2009)[1] in order to take into account possible complementarities between screening and cross-selling activities. In what follows we will present the set-up of the model describing the assumptions on the borrower's behavior, bank's behavior, screening activity, and cross-selling activity.

3.1. Borrowers. The economy is modelled as a Salop spatial competition (Salop, 1979), where a continuum of potential risk-neutral borrowers (firms) is 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[2]. Each borrower, when granted a loan, incurs a transportation cost $\gamma > 0$ for unit of length.

The project generates a random return $y(z)$ which is characterized by a random binary variable $y(z) \in \{0, z\}$. There are two types of projects, good and bad. The good project yields the positive return z with probability P_h while the bad project yields the positive return z with probability $P_l < P_h$, that is the probabilities P_h and P_l denote, respectively, the probability of success of good firms and the probability of success of bad firms[3]. Borrowers are informed about their types but banks are uninformed. The return z cannot be observed on the basis of ex-ante screening[4]. Since firms are protected by limited liability, borrowers' participation constraint requires the net expected outcome from the project to be larger than transportation costs. We assume that the return z is 'large enough' so that both good and bad borrowers will always apply for loans at the prevailing interest rate.

The proportion of good projects (for which, $P_h z > r_f$ 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 $P_l z < r_f$ (i.e., bad projects are dominated by the safe capital market investment) and they are observationally indistinguishable from good ones without some screening activity.

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

Each bank is a multiproduct firm selling loans and a given number S of other services different from

[1] Cosci, Meliciani and Sabato (2009) show that, in a duopoly model of the banking sector with no information synergies between screening and cross-selling activities, cross-selling reduces banks' screening incentives.

[2] Borrowers have no private funds to finance their projects.

[3] Hereafter, we will use the terms projects, firms and borrowers interchangeably.

[4] This assumption prevents banks from offering loan interest rates that induce borrowers self-selection.

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[1].

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 and the optimal loan interest rate.

In the production of services and information some synergies can exist through the screening activity. A first source of complementarity between screening and cross-selling activities derives from the impact that selling services can have on the cost of screening. In particular banks, by selling services, acquire some information on the characteristics of the borrower that they can use to improve the efficiency of the screening activity. A second source of complementarity derives from the impact that information collected through the screening activity can have on the probability of selling services other than loans. The interdependence between screening and cross-selling activities may be very important in order to increase banks' efficiency.

3.3. 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 firms' 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.

Denoting by e the effort of the bank in the screening activity, we define $\alpha(e) = prob\ (s = G|type = good)$ as the probability of correctly observing a good signal where $s \in \{B, G\}$ denotes the signal, $1 - \alpha(e) = prob\ (s = B|type = good)$ as the probability of erroneously observing a bad signal (type I error), $\beta(e) = prob\ (s = G|type = bad)$ as the probability of erroneously observing a good signal (type II error), and $1 - \beta(e) = prob\ (s = B|type = bad)$ 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.

The higher is the per applicant effort $e \in [0, 1]$ in the screening activity, the higher is the ability of the bank to recognize 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 $C(e, S)$ that we assume to be strictly convex with marginal cost of screening $C_e(e,S) > 0$, $C_{ee}(e,S) > 0$, C(0, S) = 0, and $\lim_{e \to 1} C_e(e,S) = \infty$. This last assumption implies that $e = 1$ will never be optimal for the bank.

Furthermore we assume that, since the bank, by selling services, acquires some information on the borrower's type, it is less costly to produce information when services are also produced, so that $C_S(e,S) < 0$, and that the larger is the range of services S sold by the bank the lower is the marginal cost of producing information, so that $C_{eS}(e,S) < 0$.

3.4. The cross-selling activity. Banks also sell services other than loans to loan applicants[2]. 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 specialized institutions selling services, we assume that the bank is price-taker in the service market and we denote by v_S the price of the service. 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 normalize to zero. Furthermore the screening activity can provide the bank with some information that can be used in order to increase the probability of selling a service to the borrower. In particular we assume that $P_s = P_s(e)$ with $p'_s(e) > 0$ and $p''_s(e) < 0$. The expected revenue from selling services for the bank is therefore equal to $P_s(e)v_sS$. 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)[3] and, since we are interested in studying the interaction between screening and cross-selling, that the expected revenue from services is small enough that banks will never be willing to finance bad projects: $p_l z + p_S(e)v_S S < r_f$.

3.5. The structure of the game. We study the following extensive-form game: in the first stage banks simultaneously set the equilibrium screening effort

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

[2] Loan applicants buy services which are not necessarily connected with the project to be financed. As discussed in section 1 banks can use their retail and consumer units to extend services to the individuals (workers, owners, and their families) linked to the firms they are financing.

[3] We are aware that some financial services like, for example, underwriting activity are state-contingent but this is not the case for many services mentioned in section 1.

e_i^* and the equilibrium interest rate r_i^* so as to maximize expected profits; 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. In this stage services are bought, and paid, with probability $p_S(e)$ by positively evaluated loan applicants. Finally firms run their projects, returns are realized, and, in case of success, the loan is paid off, otherwise the loan is defaulted and the bank will receive nothing.

4. The optimal screening and pricing

Assume that n banks located symmetrically around a circle have entered the market. Demand for credit occurs if the net expected outcome from borrowing and investing is non-negative[1] and a borrower j ($j = h, l$) located at distance $x \in [0, 1/n]$ from a typical bank i will apply to bank i if her net expected outcome from borrowing from bank $i + 1$ (or $i - 1$):

$$p_j(z - r_i) - \gamma x \geq p_j(z - r_0) - \gamma\left(\frac{1}{n} - x\right), \qquad (1)$$

where r_i denotes the interest rate offered to borrowers by bank i[2] and r_0 denotes the interest rate offered by bank i's neighbor competitors (banks $i + 1$ and $i - 1$).

Condition (1) with equality gives borrower j's indifference condition between bank i and bank $i + 1$ (or $i - 1$):

$$p_j(z - r_i) - \gamma x = p_j(z - r_0) - \gamma\left(\frac{1}{n} - x\right). \qquad (2)$$

Since in the population there are θ good borrowers and $1 - \theta$ bad borrowers, each bank's demand for loans ($2x$) is given by:

$$L_i = \frac{1}{n} - \frac{p}{\gamma}(r_i - r_0), \qquad (3)$$

where $p \equiv \theta p_h + (1-\theta)p_l$ is the average probability of success.

Denoting by $\eta_h(r_i, e_i)$ and $\eta_l(r_i, e_i)$ the unconditional expected profitabilities from lending, respectively, to the good and bad firms, including the cross-selling activity, bank i's expected profits are:

$$\pi_i^e = L_i\left[\alpha(e_i)\eta_h(r_i,e_i) + \beta(e_i)\eta_l(r_i,e_i) - C(e_i,S)\right] - K, \qquad (4)$$

where L_i is the demand function (3) and the unconditional expected profitabilities of good and bad firms are:

$$\eta_h(r_i, e_i) \equiv \theta[p_h r_i - r_f + p_S(e_i)v_S S] > 0,$$

$$\eta_l(r_i, e_i) \equiv (1-\theta)[p_l r_i - r_f + p_S(e_i)v_S S] < 0.$$

Maximizing expected profits (4) with respect to the screening effort and the interest rate gives the equilibrium values of the two endogenous variables[3].

Proposition 1. The optimal level of effort e^* in the symmetric equilibrium satisfies:

$$\frac{1}{n}[\alpha'(e^*)\eta_h(r^*,e^*) + \beta'(e^*)\eta_l(r^*,e^*) + \\ + A(e^*)p'_S(e^*)v_S S - C_e(e^*,S)] = 0, \qquad (5)$$

where the expression $A(e^*) \equiv \alpha(e^*)\theta + \beta(e^*)(1-\theta)$ measures the percentage of firms applying for a loan that are positively evaluated by the bank (selection ratio).

In equation (5) the sum of the first three terms is the marginal benefit of screening: given the unconditional expected profitability from lending to the good and bad firms, screening increases the proportion of accepted good firms (first term $\alpha'(e^*) > 0$) and the proportion of rejected bad firms (second term $\beta'(e^*) < 0$), and, given the selection ratio, screening increases the expected income from cross-selling, by increasing the probability of selling services (third term $p'_S(e^*) > 0$); the fourth term in equation (5) is the marginal cost of screening.

The optimal screening intensity depends on the unconditional expected profitabilities of the good and bad firms and on the lending rate. Banks are more incentivized to screen applicants the more profitable good firms are and the less profitable bad firms are. The relationship with the lending rate is, on the contrary, ambiguous and it depends on the specific properties of the screening technology. If the benefits from identifying good firms are greater than the benefits from avoiding bad firms, the optimal screening effort is increasing in the lending rate.

Proposition 2. The equilibrium lending rate r^* in the symmetric equilibrium is given by:

$$r^* = \frac{\gamma}{pn} + \frac{A(e^*)}{B(e^*)}[r_f - p_s(e^*)v_s S] + \frac{C(e^*,S)}{B(e^*)}, \qquad (6)$$

[1] Borrower j's participation constraint $p_j(z - r_i) - \gamma x \geq 0$ always holds for sufficiently high levels of z.

[2] Banks cannot determine the location of the loan applicants and therefore no location-based price-discrimination is feasible.

[3] All the equilibrium results discussed in this section are derived in Appendix A.

where the expression $B(e^*) \equiv \alpha(e^*)\theta p_h + \beta(e^*)(1-\theta)p_l$ measures the percentage of firms applying for a loan that are positively evaluated by the bank and are successful (expected ratio of successful projects). The share of successful projects over all financed projects $Q(e^*) \equiv B(e^*)/A(e^*)$ can be interpreted as a measure of the quality of the pool of financed projects. Therefore the optimal lending rate is higher the higher are total transportation costs γ/n, the lower is the average success probability p, the higher is the equilibrium screening costs per successful borrower $C(e^*,S)/B(e^*)$, the lower is the equilibrium mean project quality $Q(e^*)$, and, for given levels of effort, the higher is the risk-free interest rate r_f and the lower is the expected income from services $p_s(e^*)v_s S$.

5. The impact of cross-selling on the optimal screening effort

Cross-selling impacts the optimal screening effort through its effect on the marginal benefit of screening from increasing the proportion of accepted good firms (first term in equation (5)), the marginal benefit of screening from increasing the proportion of rejected bad firms (second term in equation (5)), the marginal benefit of screening from increasing the probability of selling services (third term in equation (5)) and the marginal cost of screening (fourth term in equation (5)). In order to compute the impact of cross-selling on the optimal screening effort note that, from equation (5), the optimal screening effort is a function of the number of services the bank offers and the optimal lending rate, through their effects on the projects' unconditional expected profitabilities, and, from equation (6), the optimal lending rate is, in turn, a function of the number of services and the optimal screening effort, that we can write:

$$e^* = e^*[S, r^*(S, e^*)]. \tag{7}$$

By totally differentiating equation (7) we obtain the total effect of cross-selling on the optimal screening effort[1]:

$$\frac{de^*}{dS} = \frac{\frac{\partial e^*}{\partial \eta_h}\frac{d\eta_h}{dS} + \frac{\partial e^*}{\partial \eta_l}\frac{d\eta_l}{dS} + A(e^*)p'_S(e^*)v_S - C_{eS}(e^*,S)}{1 - \frac{\partial e^*}{\partial r^*}\frac{\partial r^*}{\partial e^*}}, \tag{8}$$

where the numerator is the sum of the above mentioned effects and the denominator accounts for a crossed effect of the variation of the optimal screening effort on the optimal lending rate, which, since the optimal lending rate depends on the optimal screening effort, in turn, impacts on the optimal screening effort. We call this effect "correction effect" ($\frac{\partial e^*}{\partial r^*}\frac{\partial r^*}{\partial e^*}$).

The effect of cross-selling on the marginal benefit of screening from increasing the proportions of accepted good firms and rejected bad firms goes through its effect on the projects' unconditional expected profitabilities.

In particular, an increase in the number of services the bank offers has a direct effect and an indirect effect (via the optimal lending rate) on the unconditional expected profitability from lending to both good and bad firms. The direct effect is positive: an increase in the number of services increases the expected income from services and hence projects' unconditional expected profitabilities; the indirect effect is negative: an increase in the number of services reduces the optimal lending rate (as the expected income from services increases), which, in turn, reduces projects' unconditional expected profitabilities.

The effect of cross-selling on the optimal lending rate is given by:

$$\frac{\partial r^*}{\partial S} = -\frac{A(e^*)}{B(e^*)}p_S(e^*)v_S + \frac{C_S(e^*,S)}{B(e^*)} \tag{9}$$

which is negative: an increase in the number of services, by increasing the expected income from selling services and decreasing the cost of screening, reduces the optimal lending rate.

Since the direct and the indirect effects have opposite sign, the sign of the total effect of the number of services on the unconditional expected profitabilities of good firms ($d\eta_h/dS$ in equation (8)) and of bad firms ($d\eta_l/dS$ in equation (8)) depends on the relative magnitude of the direct and the indirect effects.

The effect of cross-selling on the marginal benefit of screening from increasing the probability of selling services is positive: an increase in the number of services the bank offers increases the expected income from cross-selling activity.

Finally the effect of cross-selling on the marginal cost of screening is negative: it reduces the marginal cost of screening.

In order to study the sign of the total effect of cross-selling on the optimal screening effort we consider the cases shown in Table 1 separately.

5.1. Not customer-specific and not highly informative services. With no information synergies between screening and cross-selling activities, cross-selling impacts the optimal screening effort only through its

[1] All the results discussed in this section are derived in Appendix B.

effect on the projects' unconditional profitabilities ($p'_S(e^*)=0$ and $C_{eS}(e^*,S)=0$):

$$\frac{de^*}{dS}=\frac{\frac{\partial e^*}{\partial \eta_h}\frac{d\eta_h}{dS}+\frac{\partial e^*}{\partial \eta_l}\frac{d\eta_l}{dS}}{1-\frac{\partial e^*}{\partial r^*}\frac{\partial r^*}{\partial e^*}}. \tag{8a}$$

In the case with no synergies the total effect of cross-selling on the projects' unconditional expected profitability is negative for good firms, since the reduction in the unconditional expected profitability (indirect effect) is dominant on its increase (direct effect) for good firms, and it is positive for bad firms, since the unconditional expected profitability increases with the number of services (direct effect) more than how much it decreases for the reduction in the optimal lending rate (indirect effect) for bad firms. A lower unconditional expected profitability from lending to good firms as an increased unconditional expected profitability of bad firms reduce banks' screening incentives. Basically cross-selling reduces the marginal benefit of screening.

The effect of cross-selling on the optimal lending rate is given by:

$$\frac{\partial r^*}{\partial S}=-\frac{A(e^*)}{B(e^*)}p_S v_S \tag{9a}$$

which is negative: an increase in the number of services, by increasing the expected income from selling services, reduces the optimal lending rate.

The effect of cross-selling on the optimal screening through good projects' unconditional expected profitability is given by:

$$\frac{\partial e^*}{\partial \eta_h}\frac{d\eta_h}{dS}=-\frac{\alpha'(e^*)\beta(e^*)\theta(1-\theta)(p_h-p_l)}{|SOC_e|B(e^*)}p_s v_s \tag{10}$$

which is negative; the effect through bad projects' unconditional expected profitability is given by:

$$\frac{\partial e^*}{\partial \eta_l}\frac{d\eta_l}{dS}=\frac{\alpha(e^*)\beta'(e^*)\theta(1-\theta)(p_h-p_l)}{|SOC_e|B(e^*)}p_s v_s \tag{11}$$

which is negative; finally the correction effect is given by:

$$\frac{\partial e^*}{\partial r^*}\frac{\partial r^*}{\partial e^*}=\frac{[B'(e^*)]^2\gamma}{pn|SOC_e|B(e^*)}$$

which is positive and less than 1.

The total effect of cross-selling on the optimal screening effort is, therefore, negative.

Corollary 1. In the absence of information synergies increasing the number of services the bank offers reduces its screening incentives.

Since the quality of the project pool, as measured by the share of successful projects over all financed projects $Q(e^*)$, is increasing in the optimal screening intensity, when the number of services the bank offers increases, the equilibrium mean project quality decreases:

$$\frac{dQ(e^*)}{dS}=$$
$$=\frac{[\alpha'(e^*)\beta(e^*)-\alpha(e^*)\beta'(e^*)]\theta(1-\theta)(p_h-p_l)}{[A(e^*)]^2}\frac{de^*}{dS} \tag{12}$$

Services, by decreasing the optimal screening effort, decrease the quality of the pool of financed projects. The case with no information synergies between screening and cross-selling activities is the case studied by Cosci, Meliciani and Sabato (2009), who found evidence that banks characterized by a higher proportion of non-interest income, which may be considered as a proxy for the bank's cross-selling activity, are also characterized by a larger proportion of impaired loans, a proxy of the quality of the financed project pool.

5.2. Customer-specific and highly informative services. With information synergies between screening and cross-selling activities from both sources discussed in section 2, cross-selling impacts the optimal screening effort through projects' unconditional profitabilities, the expected income from services and the marginal cost of screening as set in equation (8).

The direct effect of cross-selling on the unconditional expected profitabilities from lending to both good and bad firms does not change with respect to the case without synergies, while the indirect effect is now stronger because of the first source of complementarity between screening and cross-selling activities (cross-selling reduces the cost of screening), which reduces the optimal lending rate more than in the case without synergies[1]. This stronger indirect effect does not change the result on the unconditional expected profitability of good firms, for which the dominance of the indirect effect over the direct one becomes larger so that the total (direct plus indirect) effect of the number of services on η_h is still negative, but also for bad firms the indirect effect can result dominant on the direct effect and this is more likely to happen the higher is the impact of cross-selling on the cost of screening. Thus the total (direct plus indirect) effect of the number of services on η_l can be either positive or negative.

In equation (8) the effect of cross-selling on the optimal screening effort through good projects' unconditional expected profitability is given by:

[1] Compare equations (9) and (9a).

$$\frac{\partial e^*}{\partial \eta_h}\frac{d\eta_h}{dS} = -\frac{\alpha'(e^*)\beta(e^*)\theta(1-\theta)(p_h - p_l)}{|SOC_e|B(e^*)}p_s(e^*)v_s + \\ + \frac{\alpha'(e^*)\theta p_h}{|SOC_e|B(e^*)}C_S(e^*,S) \quad (13)$$

which is negative; the effect through bad projects' unconditional expected profitability is given by:

$$\frac{\partial e^*}{\partial \eta_l}\frac{d\eta_l}{dS} = \frac{\alpha(e^*)\beta'(e^*)\theta(1-\theta)(p_h - p_l)}{|SOC_e|B(e^*)}p_s(e^*)v_s + \\ + \frac{\beta'(e^*)(1-\theta)p_l}{|SOC_e|B(e^*)}C_S(e^*,S) \quad (14)$$

which can be either positive or negative, depending on the magnitude of the negative impact of cross-selling on the cost of screening ($C_S(e^*,S)$); the effect through the expected income from services is positive ($A(e^*)p'_S(e^*)v_S > 0$); the effect through the marginal cost of screening is also positive ($-C_{eS}(e^*,S) > 0$); finally the correction effect is exactly the same as in the case without synergies (positive and less than 1).

The total effect of cross-selling on the optimal screening effort can be, therefore, either positive or negative.

Corollary 2. In the case of synergies increasing the number of services the bank offers may either increase or decrease its screening incentives.

Differently from the case without synergies cross-selling can increase banks' screening effort and this is more likely to happen: (1) the higher is the negative impact of cross-selling on the marginal cost of screening; (2) the higher is the positive impact of screening on the probability of selling services and (3) the higher is the negative impact of cross-selling on the cost of screening when the benefits of screening from accepting good firms are smaller than the benefits from rejecting bad firms (i.e., when

$\alpha'(e^*)\theta p_h < -\beta'(e^*)(1-\theta)p_l$).

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

5.3. Intermediate cases. In the intermediate cases reported in Table 1, where the bank is able to exploit only one source of complementarity between screening and cross-selling activities, either the first source deriving from the impact that selling services can have on the cost of screening (not customer-specific but highly informative services in Table 1) or the second source deriving from the impact that screening can have on the probability of selling services (customer-specific but not highly informative services in Table 1), the results are not qualitatively different from the case with both sources of complementarity.

With information synergies between screening and cross-selling activities from the first source discussed in section 2, cross-selling impacts the optimal screening effort through projects' unconditional expected profitabilities and the marginal cost of screening:

$$\frac{de^*}{dS} = \frac{\frac{\partial e^*}{\partial \eta_h}\frac{d\eta_h}{dS} + \frac{\partial e^*}{\partial \eta_l}\frac{d\eta_l}{dS} - C_{eS}(e^*,S)}{1 - \frac{\partial e^*}{\partial r^*}\frac{\partial r^*}{\partial e^*}}, \quad (8b)$$

where the effect of cross-selling on the optimal screening effort through the projects' unconditional expected profitabilities of good firms ($\frac{\partial e^*}{\partial \eta_h}\frac{d\eta_h}{dS}$) and of bad firms ($\frac{\partial e^*}{\partial \eta_l}\frac{d\eta_l}{dS}$) are given, respectively, by equations (13) and (14).

With information synergies between screening and cross-selling activities from the second source discussed in section 3, cross-selling impacts the optimal screening effort through projects' unconditional expected profitabilities and the expected income from services:

$$\frac{de^*}{dS} = \frac{\frac{\partial e^*}{\partial \eta_h}\frac{d\eta_h}{dS} + \frac{\partial e^*}{\partial \eta_l}\frac{d\eta_l}{dS} + A(e^*)p'_S(e^*)v_S}{1 - \frac{\partial e^*}{\partial r^*}\frac{\partial r^*}{\partial e^*}}, \quad (8c)$$

where the effect of cross-selling on the optimal screening effort through the projects' unconditional expected profitabilities of good firms ($\frac{\partial e^*}{\partial \eta_h}\frac{d\eta_h}{dS}$) and of bad firms ($\frac{\partial e^*}{\partial \eta_l}\frac{d\eta_l}{dS}$) are given, respectively, by equations (10) and (11).

Conclusions

This paper has examined the impact of cross-selling on banks' optimal screening effort in the presence of synergies between the two activities. We have proposed a tentative classification of services according to their degree of customer-specificity and information-intensity since we think that these two elements are useful for analyzing the potential exchange of information between cross-selling and screening.

In our model the exploitation of information synergies is essential to prevent the negative impact of cross-selling on the optimal screening effort.

Cross-selling may increase the screening effort if banks use efficiently the information from the cross-selling activity for screening loan projects and if they use efficiently the information collected during the screening process for the cross-selling activity. The possibility of exploiting such complementarities depends not only on the bank's ability but also on the type of services the bank tries to sell.

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 recognize 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 (1999) it may be difficult for banks to exploit information synergies since banks collect and process information by product and transaction and not by customer.

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 screening.

Future studies, focussing on this issue, could provide a more comprehensive classification of services that can help to clarify their relationship with the more traditional banking activities. Moreover the existence of such complementarities should be better investigated by future empirical analyses since their exploitation may be crucial for banks to maintain their role of producers of imperfect information about borrowers.

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Appendix A

1. Symmetric equilibrium. The first-order conditions for the maximization problem are given by:

$$\begin{aligned}&\left[\frac{1}{n}-\frac{p}{\gamma}\left(r_i-r_0\right)\right]\{\alpha'(e_i)\eta_h(r_i,e_i)+\beta'(e_i)\eta_l(r_i,e_i)+[\alpha(e_i)\theta+\\&+\beta(e_i)(1-\theta)]p'_S(e_i)v_S S-C_e(e_i,S)\}=0,\\&-\frac{p}{\gamma}[\alpha(e_i)\eta_h(r_i,e_i)+\beta(e_i)\eta_l(r_i,e_i)-C(e_i,S)]+\left[\frac{1}{n}-\frac{p}{\gamma}(r_i-r_0)\right][\alpha(e_i)\theta p_h+\\&+\beta(e_i)(1-\theta)p_l]=0.\end{aligned} \tag{A1}$$

The second-order conditions are given by:

$$\begin{aligned}&\left[\frac{1}{n}-\frac{p}{\gamma}(r_i-r_0)\right]\{\alpha''(e_i)\eta_h(r_i,e_i)+\beta''(e_i)\eta_l(r_i,e_i)-C_{ee}(e_i,S)+\\&+[\alpha(e_i)\theta+\beta(e_i)(1-\theta)]p''_S(e_i)v_S S+2[\alpha'(e_i)\theta+\beta'(e_i)(1-\theta)]p'_S(e_i)v_S S\}\end{aligned}$$

which is assumed to be negative, and

$$\frac{-[\alpha''(e_i)\eta_h(r_i,e_i)+\beta''(e_i)\eta_l(r_i,e_i)-C_{ee}(e_i,S)][\alpha(e_i)\theta p_h+\beta(e_i)(1-\theta)p_l]p}{n\gamma}+$$
$$+\frac{-[\alpha'(e_i)\theta p_h+\beta'(e_i)(1-\theta)p_l]^2}{n^2}$$

which is positive for sufficiently low levels of transportation costs:

$$\gamma<\frac{-pn[\alpha''(e_i)\eta_h(r_i,e_i)+\beta''(e_i)\eta_l(r_i,e_i)-C_{ee}(e_i,S)][\alpha(e_i)\theta p_h+\beta(e_i)(1-\theta)p_l]}{[\alpha'(e_i)\theta p_h+\beta'(e_i)(1-\theta)p_l]^2}\equiv\gamma_0. \tag{A2}$$

The solution of system (A1) in the symmetric equilibrium gives the optimal screening effort as a function of the optimal lending rate $e^*=e^*(r^*)$ satisfying:

$$\frac{1}{n}\left\{\alpha'(e^*)\eta_h(r^*,e^*)+\beta'(e^*)\eta_l(r^*,e^*)+[\alpha(e^*)\theta+\beta(e^*)(1-\theta)]p'_S(e^*)v_S S-C_e(e^*,S)\right\}=0 \tag{A3}$$

which is equation (5) in the text, and the optimal lending rate as a function of the optimal screening effort $r^*=r^*(e^*)$ satisfying:

$$-\frac{p}{\gamma}[\alpha(e^*)\eta_h(r^*,e^*)+\beta(e^*)\eta_l(r^*,e^*)-C(e^*,S)]+\frac{1}{n}[\alpha(e^*)\theta p_h+\beta(e^*)(1-\theta)p_l]=0 \tag{A4}$$

which solved for r^* gives equation (6) in the text.

In order to simplify the notation define:

$$SOC_e \equiv \alpha''(e^*)\eta_h(r^*,e^*) + \beta''(e^*)\eta_l(r^*,e^*) - C_{ee}(e^*,S) + [\alpha(e^*)\theta + \beta(e^*)(1-\theta)]p''_S(e^*)v_S S +$$
$$+2[\alpha'(e^*)\theta + \beta'(e^*)(1-\theta)]p'_S(e^*)v_S S < 0.$$

2. The effect of the projects' unconditional expected profitabilities on the optimal screening. From equation (5) in the text:

$$\frac{de^*}{d\eta_h} = \frac{\alpha'(e^*)}{|SOC_e|} \tag{A5}$$

which is positive since the numerator is positive under our assumptions on the screening technology: the optimal screening effort increases when good firms' unconditional expected profitability increases.

Similarly, from equation (5) in the text:

$$\frac{de^*}{d\eta_l} = \frac{\beta'(e^*)}{|SOC_e|} \tag{A6}$$

which is negative since the numerator is negative under our assumptions on the screening technology: the optimal screening effort decreases when bad firms' unconditional expected profitability increases.

3. The effect of the lending rate on the optimal screening. By totally differentiating equation (5) in the text:

$$\frac{de^*}{dr^*} = \frac{\alpha'(e^*)\theta p_h + \beta'(e^*)(1-\theta)p_l}{|SOC_e|} \tag{A7}$$

which is positive when the numerator is positive, i.e., when $\alpha'(e^*)\theta p_h > -\beta'(e^*)(1-\theta)p_l$: the optimal screening effort increases in the lending rate if the benefits from accepting good firms are greater than the benefits from rejecting bad firms; it decreases otherwise.

Appendix B

1. The effect of cross-selling on the optimal screening with no information synergies. The second-order condition on the screening effort is given by:

$$\left[\frac{1}{n} - \frac{p}{\gamma}(r_i - r_0)\right][\alpha''(e_i)\eta_h(r_i) + \beta''(e_i)\eta_l(r_i) - C_{ee}(e_i)]$$

which is always negative under our assumptions ($\alpha''(e) < 0$, $\eta_h(r) > 0$, $\beta''(e) > 0$, $\eta_l(r) < 0$, $C_{ee}(e) > 0$), and the second-order condition on the lending rate is exactly the same as stated in Appendix A.

The expression SOC_e is now defined as:

$$SOC_e \equiv \alpha''(e^*)\eta_h(r^*) + \beta''(e^*)\eta_l(r^*) - C_{ee}(e^*) < 0.$$

From the definition of good projects' unconditional expected profitability and the optimal lending rate equation, the total (direct plus indirect) effect of S on η_h is:

$$\frac{d\eta_h}{dS} = \frac{\partial\eta_h}{\partial S} + \frac{\partial\eta_h}{\partial r^*}\frac{\partial r^*}{\partial S},$$

where the direct effect of cross-selling on good firms' unconditional expected profitability is given by:

$$\frac{\partial\eta_h}{\partial S} = \theta p_S v_S > 0,$$

the effect of cross-selling on the optimal lending rate is given by:

$$\frac{\partial r^*}{\partial S} = -\frac{\alpha(e^*)\theta + \beta(e^*)(1-\theta)}{\alpha(e^*)\theta p_h + \beta(e^*)(1-\theta)p_l} p_S v_S < 0,$$

and the indirect effect is given by:

$$\frac{\partial \eta_h}{\partial r^*}\frac{\partial r^*}{\partial S} = -\theta p_h \frac{\alpha(e^*)\theta + \beta(e^*)(1-\theta)}{\alpha(e^*)\theta p_h + \beta(e^*)(1-\theta)p_l} p_S v_S < 0.$$

Since the indirect effect of S on η_h ($\frac{\partial \eta_h}{\partial r^*}\frac{\partial r^*}{\partial S} < 0$) is dominant on the direct effect of S on η_h ($\frac{\partial \eta_h}{\partial S} > 0$), the overall effect of the number of services on the unconditional profitability of good firms is negative:

$$\frac{d\eta_h}{dS} = -\frac{\beta(e^*)\theta(1-\theta)(p_h - p_l)}{\alpha(e^*)\theta p_h + \beta(e^*)(1-\theta)p_l} p_S v_S < 0. \tag{B1}$$

By equations (A5) and (B1) we obtain the effect of cross-selling on the optimal screening through good projects' unconditional profitability (equation (10) in the text).

Similarly from the definition of bad projects' unconditional expected profitability and the optimal lending rate equation, the total (direct plus indirect) effect of S on η_l is:

$$\frac{d\eta_l}{dS} = \frac{\partial \eta_l}{\partial S} + \frac{\partial \eta_l}{\partial r^*}\frac{\partial r^*}{\partial S},$$

where the direct effect of cross-selling on bad firms' unconditional expected profitability is given by:

$$\frac{\partial \eta_l}{\partial S} = (1-\theta)p_S v_S > 0,$$

and the indirect effect is given by:

$$\frac{\partial \eta_l}{\partial r^*}\frac{\partial r^*}{\partial S} = -(1-\theta)p_l \frac{\alpha(e^*)\theta + \beta(e^*)(1-\theta)}{\alpha(e^*)\theta p_h + \beta(e^*)(1-\theta)p_l} p_S v_S < 0.$$

Since the direct effect of S on η_l ($\frac{\partial \eta_l}{\partial S} > 0$) is dominant on the indirect effect of S on η_l ($\frac{\partial \eta_l}{\partial r^*}\frac{\partial r^*}{\partial S} < 0$), the overall effect of the number of services on the unconditional profitability of bad firms is positive:

$$\frac{d\eta_l}{dS} = \frac{\alpha(e^*)\theta(1-\theta)(p_h - p_l)}{\alpha(e^*)\theta p_h + \beta(e^*)(1-\theta)p_l} p_S v_S > 0. \tag{B2}$$

By equations (A6) and (B2) we obtain the effect of cross-selling on the optimal screening through bad projects' unconditional profitability (equation (11) in the text).

In order to compute the correction effect, $\frac{\partial e^*}{\partial r^*}$ is given by equation (A7) and $\frac{\partial r^*}{\partial e^*}$, from equations (A3) and (A4), is given by:

$$\frac{\partial r^*}{\partial e^*} = \frac{\alpha'(e^*)\theta p_h + \beta'(e^*)(1-\theta)p_l}{\alpha(e^*)\theta p_h + \beta(e^*)(1-\theta)p_l}\frac{\gamma}{pn}. \tag{B3}$$

Hence the correction effect is given by:

$$\frac{\partial e^*}{\partial r^*}\frac{\partial r^*}{\partial e^*} = \frac{[\alpha'(e^*)\theta p_h + \beta'(e^*)(1-\theta)p_l]^2\gamma}{pn\,|SOC_e|\,[\alpha(e^*)\theta p_h + \beta(e^*)(1-\theta)p_l]} \tag{B4}$$

which is positive and less than 1 for sufficiently low levels of transportation costs satisfying second-order condition (A2) for the maximization problem ($\gamma < \gamma_0$).

2. The effect of cross-selling on the optimal screening with information synergies. From the definition of good projects' unconditional expected profitability and the optimal lending rate equation, the total (direct plus indirect) ef-

fect of S on η_h is:

$$\frac{d\eta_h}{dS} = \frac{\partial \eta_h}{\partial S} + \frac{\partial \eta_h}{\partial r^*}\frac{\partial r^*}{\partial S},$$

where the direct effect of cross-selling on good firms' unconditional expected profitability is given by:

$$\frac{\partial \eta_h}{\partial S} = \theta p_S(e^*) v_S > 0,$$

the effect of cross-selling on the optimal lending rate is given by:

$$\frac{\partial r^*}{\partial S} = -\frac{\alpha(e^*)\theta + \beta(e^*)(1-\theta)}{\alpha(e^*)\theta p_h + \beta(e^*)(1-\theta)p_l} p_S(e^*) v_S + \frac{C_S(e^*, S)}{\alpha(e^*)\theta p_h + \beta(e^*)(1-\theta)p_l} < 0,$$

and the indirect effect is given by:

$$\frac{\partial \eta_h}{\partial r^*}\frac{\partial r^*}{\partial S} = \theta p_h \left\{ -\frac{[\alpha(e^*)\theta + \beta(e^*)(1-\theta)]}{\alpha(e^*)\theta p_h + \beta(e^*)(1-\theta)p_l} p_S(e^*) v_S + \frac{C_S(e^*, S)}{\alpha(e^*)\theta p_h + \beta(e^*)(1-\theta)p_l} \right\} < 0.$$

Since the indirect effect of S on η_h ($\frac{\partial \eta_h}{\partial r^*}\frac{\partial r^*}{\partial S} < 0$) is dominant on the direct effect of S on η_h ($\frac{\partial \eta_h}{\partial S} > 0$), the overall effect of the number of services on the unconditional profitability of good firms is negative:

$$\frac{d\eta_h}{dS} = -\frac{\beta(e^*)\theta(1-\theta)(p_h - p_l)}{\alpha(e^*)\theta p_h + \beta(e^*)(1-\theta)p_l} p_S(e^*) v_S + \theta p_h \frac{C_S(e^*, S)}{\alpha(e^*)\theta p_h + \beta(e^*)(1-\theta)p_l} < 0. \quad \text{(B5)}$$

By equations (A5) and (B5) we obtain the effect of cross-selling on the optimal screening through good projects' unconditional profitability (equation (13) in the text).

Similarly from the definition of bad projects' unconditional expected profitability and the optimal lending rate equation, the total (direct plus indirect) effect of S on η_l is:

$$\frac{d\eta_l}{dS} = \frac{\partial \eta_l}{\partial S} + \frac{\partial \eta_l}{\partial r^*}\frac{\partial r^*}{\partial S},$$

where the direct effect of cross-selling on bad firms' unconditional expected profitability is given by:

$$\frac{\partial \eta_l}{\partial S} = (1-\theta) p_S(e^*) v_S > 0,$$

and the indirect effect is given by:

$$\frac{\partial \eta_l}{\partial r^*}\frac{\partial r^*}{\partial S} = (1-\theta) p_l \left\{ -\frac{[\alpha(e^*)\theta + \beta(e^*)(1-\theta)]}{\alpha(e^*)\theta p_h + \beta(e^*)(1-\theta)p_l} p_S(e^*) v_S + \frac{C_S(e^*, S)}{\alpha(e^*)\theta p_h + \beta(e^*)(1-\theta)p_l} \right\} < 0.$$

The overall effect of the number of services on the unconditional profitability of bad firms can be either positive or negative:

$$\frac{d\eta_l}{dS} = \frac{\alpha(e^*)\theta(1-\theta)(p_h - p_l)}{\alpha(e^*)\theta p_h + \beta(e^*)(1-\theta)p_l} p_S(e^*) v_S + (1-\theta) p_l \frac{C_S(e^*, S)}{\alpha(e^*)\theta p_h + \beta(e^*)(1-\theta)p_l}. \quad \text{(B6)}$$

By equations (A6) and (B6) we obtain the effect of cross-selling on the optimal screening through bad projects' unconditional profitability (equation (14) in the text).