CROSS-SELLING, INFORMATION SYNERGIES AND THE QUALITY OF BANKS' LOANS

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ABSTRACT

Commercial banks 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. Recently several studies both in the United States and Europe have found that non interest income is becoming an increasing share of banks' earnings. In this paper we model and empirically test the impact of banks' shift towards financial services on their screening activity and on the quality of banks' loans in the presence/absence of information synergies. In a setting where the probability of selling a service to a positively evaluated loan applicant is higher than the probability of selling a service to a rejected potential borrower, we show that the impact of cross-selling on the optimal screening effort depends on banks' ability to exploit information synergies between the cross-selling and the lending activities. We also test the prediction of our model on a sample of banks from six European countries over the period 2001-2006. We distinguish between potentially "synergic" banks (on the basis of their size, their typology (being cooperative) and the amount of employees per deposits) and other banks. We find that, consistently with our predictions, for "synergic" banks the higher is the banks' share of commission income (a proxy for banks' diversification into non interest income, and in particular, services' income) the higher is the quality of banks' loans while the opposite occurs for "non synergic" banks.

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1. Introduction

The propensity of banks to supply services other than deposits and loans, such as foreign services, trusts, annuities, mutual funds, insurance brokerage and transaction services, increased in a relevant way during the Nineties first in the United States and then in Europe[1]. A bank may obtain significant economies in marketing and advertising by offering a set of related services to its borrowers. 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.[2] The relationship with a borrower may therefore have a "marketing value" for the bank.

In the economic literature we find studies taking into account the multiproduct nature of financial institutions and investigating 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. 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). Le Petit, 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.

Most of the literature on the transformation of banks has looked at complementarities between different kinds of services, but this is not the only relevant aspect of banks' diversification: the banks' shift toward selling services other than loans and deposits may also have important consequences on banks' screening incentives.

We want to deepen the analysis of the relationship between the multiproduct nature of the bank and the more traditional screening activity. Cosci, Meliciani and Sabato (2009) developed a model on the effect of cross-selling on the optimal bank's screening effort (and therefore on the quality of the project pool financed). That model refers to cross-selling rather than bundling since the

[1] According to Allen and Santomero (2001) in the US non interest income increased from about 20% of bank earnings at the beginning of the Nineties to more than 50% at the end of the decade. In Europe non interest revenues increased from 33% of total revenues in 1997 to more than 40% in 2003 (ECB, 2004).
[2] See Li, Sun and Wilcox (2005).

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). In this context the relationship with a borrower has a "marketing value" for the bank. The bank must consider the cost of rejecting loan applicants when choosing the optimal level of the screening effort, that decreases when the number of services sold to the borrower by the bank increases. The model prediction is consistent with the empirical evidence. In fact the econometric analysis, using banks' balance sheet data for a sample of six European countries over the period 2001-2006, found that the higher is the banks' share of commission income (a proxy for banks' diversification into non interest income, and in particular, services' income) the lower is the quality of banks' loans. This result causes some concern since it implies that the more the banking system evolves towards non traditional activities, the less is the information-based credit, with a negative influence on the quality of the pool of investment projects financed. We can therefore ask whether there are some ways in which banks can reduce the negative impact of cross-selling on risk, without inverting the trend towards an increasing share of non interest income.

The trade-off between screening and cross-selling activities crucially depends on the efficiency of banks to exploit interactions between them. Cosci, Meliciani and Sabato (2012) developed a theoretical model demonstrating that in the presence of information synergies the trade-off disappears: 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 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.

The capability of a bank to exploit information synergies depends on its information system: product customization requires banks to operationally support the whole process from the client information gathering to the identification of products and services consistent with their needs. When this process is seen in terms of customization, data cannot be used as a mere instrument for managing relationships between the client and the supplier (De Laurentis, 2005). Information synergies are more likely to be better exploited by a bank adopting a relationship-lending strategy than by a bank adopting a transaction-lending strategy, and in general by banks relying more on soft

than on hard information. In a large bank processes of collecting and treating information, needed for credit decision, are separated, so the information must be easily transmissible to superior hierarchical levels. Hard information is associated with centralized organizations because it facilitates its transmission to superior hierarchical levels where funds' allocation decision is made. Large banks tend therefore to use almost exclusively hard information. On the opposite soft information is associated with decentralized organizations because they provide the agent more power and authority. Small, less hierarchical and decentralized organizations are more suitable to use soft information (Berger and Udell, 2002; Berger et al., 2007). The larger is the bank the less is likely that it adopts a ship-banking strategy and the more difficult may be the exploitation of information synergies.

While the method used to collect hard information is impersonal, collecting soft information is personal. Hard information allows to separate the processes of collecting and using the information, so it is easy to delegate collection, production and treatment functions and its treatment technology is easily automated. Soft information, on the opposite, is tightly linked to the environment and context where it was produced. In general, we may assume that the larger is the number of employees per unit of deposits the more it is likely that a bank supplies a personalised service to the borrower and that it is able to exploit information synergies (DeYoung and Rice, 2004). Finally, cooperative banks tend to adopt a business model emphasizing personalized services and relationships based on soft information. In conclusion, we may identify as potentially "synergic banks" those that are not large, that are characterized by a large number of employees per deposits or that are cooperative.

Our empirical analysis is devoted to test on a sample of European banks over the period 2001-2006 the hypothesis that the impact of cross-selling on screening (and, therefore, on the quality of the financed project pool) depends on the capability of banks to exploit information synergies. To this end we distinguish between "synergic" and "non synergic" banks and we test whether the relationship between the share of revenues coming from commission and fee income (a proxy for the importance of services in banks' balance sheets) and the quality of banks' loans (the ratio of impaired loans to total loans) differs among the two typologies of banks. In particular we expect that a higher share of commission and fee income will lead to a lower quality of banks' loans for "non synergic" banks while this will not necessarily occur in the case of "synergic" banks.

The paper is organized as follows. Section 2 reports the main empirical literature about the impact of non interest income on banks' risk. Section 3 derives the theoretical predictions of the impact of cross-selling on screening with and without information synergies following Cosci,

Meliciani and Sabato (2012). In Section 4 we carry out an empirical analysis aimed at testing the theoretical predictions. The final Section draws the main conclusions of the paper.

2. The impact of non-interest income on banks' risk: the empirical evidence

Banks are experiencing a change in the composition of their income, with an increasing share of income deriving from non traditional activities. Gorton and Rosen (1995) describe the traditional activity of a bank as the financing of loans with deposits. Non traditional activities include all other fee-generating activities of a bank, such as underwriting activities, cash management, custodial services, the brokerage or underwriting of derivative activities: a common feature of non traditional activities is that they produce fee income rather than interest income. According to Roger and Sinkey (1999) some traditional activity, such as letters of credit and lines of credit, generate non interest income, so all fee-generating activities would not be classified as non traditional. Nevertheless, empirically, the shift toward non traditional banking is proxied by an increase in the share of banks' non interest income. Several empirical studies have investigated the consequences of banks' diversification on risk, using different methodologies. Here we consider only studies focussing on income diversification and distinguishing between interest and non interest income.

According to the portfolio theory, diversification benefits could arise from undertaking different uncorrelated activities: whenever interest and non interest income are uncorrelated (or negatively correlated) banks with a high share of non interest income are less exposed to income variability, as periods characterised by negative shocks to interest income could be compensated by stable or increasing non interest income. Another diversification benefit derives from the greater stability of fee-based earnings with respect to loan-based earnings, because they are less sensitive to movements in interest rates and to economic downturns[3]. However the empirical evidence has shown positive correlation between non interest and interest income and more variability (at least for some components) of non interest income than interest income (DeYoung and Roland, 2001; Stiroh, 2004).

Most studies directly investigating the impact of high shares of non interest income on banks' profitability and risk using different samples and different methodologies have found little evidence of diversification gains. DeYoung and Roland (2001) find on a sample of U.S. commercial banks that revenue volatility increases with the share of revenues generated by both fee-based and trading activities. DeYoung and Rice (2004) find that marginal increases in non interest income are associated with poorer risk-return tradeoffs on average for US banks.

[3] For a survey on the effects of diversification on banks' performance see Stiroh (2007).

Also Stiroh (2004) finds that trading activities and fees show a positive impact on net income growth variability (measured by the standard deviation of net income growth). Stiroh and Rumble (2006) distinguish between two effects of non interest income on risk-adjusted performance: the direct effect of an increase in non interest income and an indirect effect through the increase in diversification. They find that diversification has a positive impact on several variables of risk-adjusted performance while the share of non interest income has a negative impact. Distinguishing between the various components of non interest income, fiduciary income shows a positive and highly significant impact on risk-adjusted performance variables, while the trading income coefficient is not statistically significant[4]. Also Lepetit et al. (2007), focussing on banks established in 14 European countries, find that banks which exhibit high degrees of diversification display higher risk and insolvency measures. When focussing on the different sources of non traditional income their results also show that greater reliance on fee-based activities is associated with higher default risk whereas higher dependence on trading activities does not necessarily imply higher risk levels.

DeYoung and Roland (2001) argue that non interest income may increase the volatility of total income for three reasons. First, loans are often relationship based, so the borrower face high switching costs, while fee-based activity are not. Second, the main input to produce loans is deposit which involves a variable cost while in order to produce fee-generating activities the bank face mainly quasi-fixed costs, like labour. Third, most fee-generating activities require little or no regulatory capital, so they involve a greater financial leverage.

Finally Cosci et al. (2009) provide a different explanation for the negative impact of commission income on banks' risk, i.e. the fact that banks' cross-selling activity can reduce screening incentives when the probability of selling services to positively evaluated borrowers is higher than the probability of selling services to non borrowers. Using banks' balance sheet data for a sample of six European countries over the period 2001-2006, they find that the higher is the banks' share of commission income the lower is the quality of banks' loans (the ratio of impaired loans to total loans), while the same result is not found for trading income.

In this paper we test whether the impact of commission income on the quality of banks' loans differs between synergic and non synergic banks. Next Section explains why we expect different results for the two typologies of banks.

[4] Goddard, McKillop and Wilson (2008) decompose the impact of diversification on US credit unions performance into a direct exposure effect (given by that difference between interest and non interest bearing activities) and an indirect exposure effect (given by the institution degree of diversification). They find a positive effect on performance for large credit unions and a negative effect for the smaller ones.

3. The theoretical model

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. This result derives from the fact that the relationship with a borrower has a "marketing value" for the bank so that the bank must consider the cost of rejecting loan applicants when choosing the optimal level of screening effort. Also they find empirical evidence of the trade-off between screening and cross-selling: banks characterised by a higher proportion of non interest income (a proxy for the bank's cross-selling activity) are also characterised by a larger proportion of impaired loans (a proxy of the quality of the financed projects pool).

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.

Cosci, Meliciani and Sabato (2012) present a model where, if banks are synergic, i.e. banks are able to create and exploit 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. In what follows we summarise the set-up of the model, the equilibrium results and the impact of cross-selling on banks' screening incentives, and hence on the quality of banks' loans, for non synergic and synergic banks. For a detailed derivation of the theoretical results, see Cosci, Meliciani and Sabato (2012).

3.1 *The set-up of the model*

Cosci, Meliciani and Sabato (2012) model is a Salop spatial competition model (Salop, 1979) where a continuum of firms is located uniformly (with density 1) around a unit circle and *n* banks are located symmetrically around the unit circle. All agents are risk-neutral. Each firm has to finance an investment project with one unit of loanable funds. Since firms have no private funds,

they borrow from a bank. Each firm, when granted a loan, incurs a transportation cost $\gamma > 0$ for unit of length.

Firms' projects generate a random return *y*(*z*) which is characterised by a random binary variable $y(z) \in \{0, z\}$. Projects (firms) can be either good or bad. The probability of success of good firms p_g (i.e. the probability that the good project yields the positive return *z*) is larger than the probability of success of bad firms p_b (i.e. the probability that the bad project yields the positive return *z*). Firms are informed about their types but banks are uninformed, and the return *z* cannot be observed on the basis of ex-ante screening[5]. We assume that the return *z* is large enough so that both good and bad firms will always apply for loans at the prevailing interest rate.

The proportion of good projects (viable projects for which the expected return $p_g z$ is larger than the risk-free interest rate r_f) in the population is $\theta \in [0,1]$ and is common knowledge. Bad projects are not viable ($p_b z < r_f$) and they are observationally indistinguishable from good ones without some screening activity.

Since firms are protected by limited liability, demand for credit occurs if firms' net expected outcome from borrowing and investing is non-negative and each bank's demand for loans is given by:

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

where $p \equiv \theta p_g + (1-\theta) p_b$ is the average probability of success, and r_i and r_0 denote the interest rates offered, respectively, by bank *i*[6] and by bank *i*'s neighbour competitors (banks *i*+1 and *i*-1).

Banks sell loans and a given number *S* of other services different from loans. They have access to competitive capital markets, where they issue bonds at the risk-free interest rate r_f . Each bank has a fixed cost of installation *K*, which is assumed to include the fixed cost of producing services other than loans[7].

Each bank may get some information on which of the projects is expected to fail by using a creditworthiness test that we model as in Devinney (1986) and Gehrig (1998). The bank observes noisy signals of the firms' quality, good or bad, and the signal characteristics correspond to the pool

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

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

[7] Each bank pays fixed and variable costs for each service other than loan. We assume that the variable cost is negligible so that we can consider only the fixed cost. Since in the model services are exogenous, we can imagine that the bank chooses ex-ante the number of services to sell and incurs the fixed costs of organising 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.

characteristics. The test imperfectly assigns firms to one of the two risk classes (good and bad). Only firms that pass the test get the loan.

Through the screening activity, some synergies can exist in the production of services and information. In fact 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 and/or the information they collect through the screening activity can impact 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.

Denoting by e the effort of the bank in the screening activity, we define $\alpha(e) = prob(s = G \mid type = good)$ as the probability of correctly observing a good signal where $s \in \{B, G\}$ denotes the signal, $1-\alpha(e) = prob(s = B \mid type = good)$ as the probability of erroneously observing a bad signal (type I error), $\beta(e) = prob(s = G \mid type = bad)$ as the probability of erroneously observing a good signal (type II error), and $1-\beta(e) = prob(s = B \mid type = bad)$ 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 recognise good projects with $\alpha'(e) \geq 0$, $\beta'(e) \leq 0$, $\alpha''(e) \leq 0$, $\beta''(e) \geq 0$.

Screening is costly and we assume that the screening cost $C(e, S)$ is strictly convex with marginal cost of screening $C_e(e,S) > 0$, $C_{ee}(e,S) > 0$, $C(0, S) = 0$, and $\lim_{e \to 1} C_e(e,S) = \infty$ [8].

Furthermore we assume that, since the bank, by selling services, acquires some information on the firm's type, and if the bank is able to use this information to improve the efficiency of the screening activity (i.e. if the bank is a synergic bank), 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 $C_{eS}(e,S) < 0$.

Banks sell services other than loans only to borrowers. Firms that are not financed by banks, i.e. firms borrowing from the capital market, buy services from other suppliers. Since there are many specialised 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 positive, while the probability of selling a service to a non-customer is 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

[8] This last assumption implies that $e = 1$ will never be optimal for the bank.

$p_S = p_S(e)$ with $p'_S(e) > 0$ and $p''_S(e) < 0$. Since we are interested in studying the interaction between screening and cross-selling, we assume that the expected revenue from services $p_S(e)v_S S$ is small enough that banks will never be willing to finance bad projects: $p_b z + p_S(e)v_S S < r_f$.

The timing of the model is as follows. In the first stage banks simultaneously set the equilibrium screening effort e_i^* and the equilibrium interest rate r_i^* so as to maximise 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. In this stage services are bought, and paid[9], with probability $p_S(e)$ by positively evaluated loan applicants. Finally firms run their projects, returns are realised, and, in case of success, the loan is paid off, otherwise the loan is defaulted and the bank will receive nothing.

3.2 *The optimal screening and interest rate*

Each bank *i* decides the optimal screening effort and the optimal loan interest rate that maximise expected profits:

$$\pi_i^e = L_i\left[\alpha(e_i)\eta_g(r_i, e_i) + \beta(e_i)\eta_b(r_i, e_i) - C(e_i, S)\right] - K \qquad (2)$$

where L_i is the demand function (1) and $\eta_g(r_i, e_i)$ and $\eta_b(r_i, e_i)$ denote the unconditional expected profitabilities, including the cross-selling activity, from lending, respectively, to the good and bad firms:

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

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

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

$$\frac{1}{n}[\alpha'(e^*)\eta_g(r^*, e^*) + \beta'(e^*)\eta_b(r^*, e^*) + A(e^*)p'_S(e^*)v_S S - C_e(e^*, S)] = 0 \qquad (3)$$

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

In equation (3) the sum of the first three terms is the marginal benefit of screening: given the unconditional expected profitabilities from lending to the good and bad firms, screening increases the proportion of accepted good firms ($\alpha'(e^*) > 0$) and the proportion of rejected bad firms ($\beta'(e^*) < 0$), and, given the selection ratio, screening increases the expected income from cross-

[9] We assume that the borrower pays for services also in case of default out of the loan.

selling, by increasing the probability of selling services ($p'_S(e^*) > 0$). The fourth term in equation (3) 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 incentivised 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:*

$$r^* = \frac{\gamma}{pn} + \frac{A(e^*)}{B(e^*)}[r_f - p_s(e^*)v_s S] + \frac{C(e^*, S)}{B(e^*)} \qquad (4)$$

where the expression $B(e^*) \equiv \alpha(e^*)\theta p_g + \beta(e^*)(1-\theta)p_b$ is the expected ratio of successful projects, measuring the percentage of firms applying for a loan that are positively evaluated by the bank and are successful. 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 screening effort, the higher is the risk-free interest rate r_f and the lower is the expected income from services $p_s(e^*)v_s S$. The negative relation between the optimal lending rate and the income from services results because an increase in the non interest income for the bank, *ceteris paribus*, increases the unconditional expected profitabilities from lending to both good (η_g) and bad (η_b) firms so that, for any given level of screening (and probability of selling services), the optimal lending rate that maximises banks' expected profits is lower.

3.3 *The impact of cross-selling on the optimal screening effort*

In order to compute the impact of cross-selling on the optimal screening effort note that, from equation (3), 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 that, from equation (4), the optimal lending rate is, in turn, a function of the number of services and the optimal screening effort, so that we can write:

$$e^* = e^*[S, r^*(S, e^*)] \tag{5}$$

By totally differentiating equation (5) we obtain the total effect of cross-selling on the optimal screening effort:

$$\frac{de^*}{dS} = \frac{\frac{\partial e^*}{\partial \eta_g}\frac{d\eta_g}{dS} + \frac{\partial e^*}{\partial \eta_b}\frac{d\eta_b}{dS} + A(e^*)p'_S(e^*)v_S - C_{eS}(e^*, S)}{1 - \frac{\partial e^*}{\partial r^*}\frac{\partial r^*}{\partial e^*}} \tag{6}$$

Cross-selling impacts the optimal screening effort through its effects on the projects' unconditional expected profitabilities, the expected income from services, and the marginal cost of screening. In equation (6) the numerator is the sum of these effects and the denominator accounts for a crossed effect of the variation of the optimal screening effort on the optimal lending rate, which in turn impacts on the optimal screening effort. We call this effect "correction effect" ($\frac{\partial e^*}{\partial r^*}\frac{\partial r^*}{\partial e^*}$), which is positive and less than 1 for sufficiently low levels of transportation costs as demonstrated in Cosci, Meliciani and Sabato (2012).

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 sign of the total effect of the number of services on the unconditional expected profitabilities of good firms ($d\eta_g / dS$ in equation (6)) and of bad firms ($d\eta_b / dS$ in equation (6)) depends on the relative magnitude of the direct and the indirect effects.

When banks are not able to create and exploit information synergies between screening and cross-selling activities ($p'_S(e^*) = 0$ and $C_{eS}(e^*, S) = 0$), which is the case studied by Cosci, Meliciani and Sabato (2009), cross-selling impacts the optimal screening effort only through its effect on the projects' unconditional profitabilities:

$$\frac{de^*}{dS} = \frac{\frac{\partial e^*}{\partial \eta_g}\frac{d\eta_g}{dS} + \frac{\partial e^*}{\partial \eta_b}\frac{d\eta_b}{dS}}{1 - \frac{\partial e^*}{\partial r^*}\frac{\partial r^*}{\partial e^*}} \tag{6'}$$

In the case of non synergic banks the effect of cross-selling on the optimal lending rate is given by:

$$\frac{\partial r^*}{\partial S} = -\frac{A(e^*)}{B(e^*)} p_S v_S \qquad (7)$$

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

The total effect of cross-selling on the projects' unconditional expected profitability results to be negative for good firms, since the unconditional expected profitability of good firms decreases for the reduction in the optimal lending rate (indirect effect) more than how much it increases with the number of services (direct effect), and positive for bad firms, since the unconditional expected profitability of bad firms increases with the number of services (direct effect) more than how much it decreases for the reduction in the optimal lending rate (indirect effect). 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 so that the resulting optimal screening effort is lower.

Corollary 1. *In the case of non synergic banks increasing the number of services the bank offers reduces her 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.

Services, by decreasing the optimal screening effort, decrease the quality of the pool of financed projects.

When banks are able to create and exploit synergies between screening and cross-selling activities, cross-selling impacts the optimal screening effort through its effects on the projects' unconditional profitabilities, the expected income from services and the marginal cost of screening as set in equation (6).

In the case of synergic banks the direct effect of cross-selling on the unconditional expected profitabilities from lending to both good and bad firms is the same as discussed above for non synergic banks, while the indirect effect is stronger because synergic banks can use the information they get through cross-selling to reduce the cost of screening.

The effect of cross-selling on the optimal lending rate in the case of synergic banks is given by:

$$\frac{\partial r^*}{\partial S} = -\frac{A(e^*)}{B(e^*)} p_S(e^*) v_S + \frac{C_S(e^*, S)}{B(e^*)} \qquad (8)$$

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.

The total (direct plus indirect) effect of cross-selling on the projects' unconditional expected profitability remains negative for good firms[10], and it can be negative also for bad firms because, if banks are able to use the information they acquire by selling services to reduce screening costs, the indirect effect can result dominant on the direct effect. This is more likely to happen the higher is the impact of cross-selling on the cost of screening. While a lower unconditional expected profitability from lending to good firms reduces banks' screening incentives, a lower unconditional expected profitability of bad firms increases the optimal screening effort.

The effect of cross-selling on the optimal screening effort through the expected income from services is positive ($A(e^*)p'_S(e^*)v_S > 0$): 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 optimal screening through the marginal cost of screening is also positive ($-C_{eS}(e^*, S) > 0$): cross-selling reduces the marginal cost of screening.

In the case of synergic banks cross-selling reduces the marginal benefit of screening from increasing the proportion of accepted good firms, but it can increase the marginal benefit of screening from increasing the proportion of rejected bad firms, it increases the marginal benefit of screening from increasing the probability of selling services and decreases the marginal cost of screening. The total effect of cross-selling on the optimal screening effort can be, therefore, either positive or negative.

Corollary 2. *In the case of synergic banks increasing the number of services the bank offers may either increase or decrease her screening incentives.*

Differently from the case of non synergic banks cross-selling can increase banks' screening effort and this is more likely to happen: i) the higher is the negative impact of cross-selling on the marginal cost of screening; ii) the higher is the positive impact of screening on the probability of selling services and iii) the higher is the negative impact of cross-selling on the cost of screening[11].

In conclusion, while in the case of non synergic banks cross-selling always reduces banks' screening incentives, when the bank is synergic, the more the bank is able to exploit information synergies the more probable is that an increase in the number of services induces the bank to

[10] The dominance of the indirect effect over the direct one becomes larger because the indirect effect is stronger.
[11] This is the case when the benefits of screening from accepting good firms are smaller than the benefits from rejecting bad firms. See Cosci, Meliciani and Sabato (2012).

increase her screening effort. Therefore cross-selling can increase the quality of the pool of projects financed by synergic banks.

4. The empirical analysis

The theoretical model presented in Section 3 has shown that, in a setting where positively evaluated loan applicants are more likely to buy other services from their lending bank, when banks are not able to create and exploit information synergies between screening and cross-selling, the higher is banks' cross-selling activity the lower is their optimal screening effort and thus the quality of their project pool. On the other hand, when the bank uses efficiently information and thus the cross-selling activity reduces the cost of screening and/or the screening activity increases the probability of selling services other than loans, this result can be reversed. The impact of cross-selling on the quality of banks' loans, therefore, depends on the capability of exploiting information synergies. The empirical analysis is devoted to test this hypothesis on a sample of European banks over the period 2001-2006. To this end we distinguish between "synergic" and "non synergic" banks and we test whether the relationship between the share of revenues coming from commission and fee income (a proxy for the importance of services in banks' balance sheets) and the quality of banks' loans differs among the two typologies of banks. In particular we expect that a higher share of commission and fee income will lead to a lower quality of banks' loans for "non synergic" banks while this will not necessarily occur in the case of synergic banks.

4.1 *Data and variables*

The source of the data is the bankscope database. In order to have a homogeneous sample we focus on European countries (France, Germany, United Kingdom, Italy, Netherlands and Spain) and on banks with a minimum value of assets of 20 billions US dollars in 2006, thus obtaining a sample of 379 banks observed over the period 2001-2006. However many banks have missing data for some of the variables used in the empirical analysis (in particular for impaired loans) so that we end up with a total number of 217 observations (the sample is unbalanced).

Distinguishing between synergic and non synergic banks is not an easy task since it would require information on the organization and on the lending strategy of the bank that is not available in balance sheet data. We, therefore, have to use very "rough" proxies. In particular we will rely on the following three criteria: the size of the bank (measured in terms of its assets), its juridical form (in particular being a cooperative) and the degree of personalization of the services offered to depositors (proxied, following DeYoung and Rice, 2004, by the ratio of employees to deposits).

DeYoung and Rice (2004) distinguish between two typologies of banks (large and small banks), with large banks taking advantage of economies of scale and earning low interest margins (because the products they produce are essentially financial commodities, and the markets they sell them into are extremely competitive) and small banks operating in local markets, developing relationships with their depositors and their borrowers, making loans to informationally opaque borrowers and earning high interest margins (they pay low interest rates to a loyal base of low-cost core depositors, and they charge high interest rates to borrowers over which they have market power). DeYoung and Rice (2004) show that non interest income is essential for large banks while it is less important for small banks.

In our empirical analysis we have a much more homogeneous sample of banks (with a minimum value of assets of 20 billions US dollars in 2006) for which we expect non interest income to be a relevant source of overall income and we ask whether there are some differences in the impact of non interest income on the quality of banks loans on the basis of their potential ability to exploit information synergies.

In general the size of the bank may affect the way in which banks collect information (less hierarchical and decentralized organizations are more suitable to use soft information; see Berger and Udell, 2002; Berger et al., 2007). Moreover we may assume that the larger is the number of employees per unit of deposits the more it is likely that a bank supplies a personalised service to the borrower and that it is able to exploit information synergies (DeYoung and Rice, 2004). Finally, cooperative banks tend to adopt a business model emphasizing personalized services and relationships based on soft information. In conclusion, we may identify as potentially "synergic banks" those that are not large, that are characterized by a large number of employees per deposits or that are cooperative.

In order to construct this typology of banks we take banks that are in the first quartile in terms of total assets or that are cooperatives or that are in the last quartile in terms of the ratio of employees to total deposits. Table 1 reports summary statistics for synergic and non synergic banks over the estimation period.

Table 1: Summary statistics for synergic and non synergic European banks, 2001-2006

	Synergic (75) Mean	Non synergic (142) Mean	t-test on differences	
Impaired loans/ total loans	0.030	0.028	-0.606	
Net interest income share	0.608	0.561	-1.899	*
Commission and fees income share	0.274	0.250	-1.654	*
Trading income share	0.056	0.107	2.937	***
Loans/assets	0.664	0.523	-5.206	***
Rate of growth of assets	0.095	0.111	0.708	
Interest margin	2.205	1.392	-7.062	***
Assets ($b)	93800	404000	5.266	***
Employees/deposits($m)	0.029	0.014	-7.801	***

Source: bankscope

*, **, *** denote respectively a significant difference in the means of the two groups at the 10, 5 and 1 percent levels.

From table 1 we can observe that, although the two groups of banks have similar shares of net commission income and of impaired loans over total loans, they differ significantly in their lending strategy. In fact synergic banks have a significantly higher interest margin and share of loans over assets; on the other hand non synergic banks have almost a double share of net trading income with respect to synergic banks. Finally, by construction, synergic banks are smaller and have a higher share of employees to deposits. Overall it is interesting to observe that also in our sample of banks that is much more homogeneous than that used in DeYoung and Rice (2004) it emerges that banks that are either not too large or cooperatives or customer oriented follow a different strategy with respect to the other banks in that they make more loans and obtain higher interest margins. It is also interesting to note that, differently from DeYoung and Rice (2004), our "synergic" banks have slightly more commission income than "non synergic" banks, i.e. they give importance to the cross-selling activity. In what follows we will investigate whether their different lending strategy leads to a different impact of the cross-selling activity of the quality of their loans when compared to non synergic banks.

4.2 *The estimated equation*

The main purpose of the empirical analysis is to look at the impact of selling services on the quality of banks' project pool. We measure the quality of the project pool with the share of impaired loans to banks' total loans. This variable is regressed on the share of commission and fees income that is taken as a proxy of the cross-selling activity. We also control for other variables that might affect the quality of banks' loans such as banks' size (banks' total assets), the loan ratio, and the rate of growth of assets (allowing for a non linear effect). Total assets control for any systematic difference in the quality of banks' project pool across size classes such as different strategies to cope with loans' risk. The other variables may be related to banks' attitude towards risk, e.g. risk-

loving banks may make more loans and grow more rapidly. Year dummies and country dummies are also included in order to control for differences in the banking environment over time and across countries. The basic empirical specification is, therefore, the following:

$$ILTL_{it}=\alpha+\beta_1 COMI_{it}+ \beta_2 LASSET_{it}+ \beta_3 LOANASS_{it}+ \beta_4 GRASS_{it}+\beta_5 GRASS^2_{it}+e_{it}$$

where ILTL denotes the ratio of impaired loans to total loans for bank i at time t, COMI is the share of net commission and fees income over total income, LASSET is the logarithm of total assets in constant prices, LOANASS is the ratio of loans to total assets, GRASS is the rate of growth of assets (in constant prices). All coefficients are allowed to vary between "synergic" and "non synergic" banks.

Due to the short time series we pool the observations over time in order to capture both the cross-section and time-series variation in the variables (coefficients are weighted averages of the within and between effects).

4.3 *Regression results*

Table 2 reports the results of the estimation for all banks and distinguishing between synergic and non synergic banks.

We can observe that, for the whole sample, the larger is banks' share of net commission income, the higher is the ratio of impaired loans to total loans. Cosci, Meliciani and Sabato (2009) show that the same result is not found for trading income and argue that the traditional explanation for the evidence that banks' risk increases with the share of non interest income in banks' total income (i.e. the exposure to volatile activities, see Stiroh and Rumble, 2006) is not convincing (since banks receive income from commissions when they sell services, while trading income is not related to banks' cross-selling activity, the negative impact of commission income on the quality of banks' loans supports the hypothesis that banks with a high cross-selling activity have a lower optimal screening effort).

Interestingly we also find that the relationship between commission income and impaired loans differs significantly across synergic and non synergic banks: while for non synergic banks higher income from commissions leads to a higher ratio of impaired loans to total loans, the opposite occurs for synergic banks. It appears that selling services other than loans leads to a lower screening effort and a lower quality of the pool of financed projects for banks that have more difficulties to exploit information synergies, while for potentially synergic banks selling services increases the quality of the project pool. These results are consistent with the model presented in Section 3.

Regression results also show that the ratio of impaired loans to total loans increases with banks' size, with the ratio of loans to assets and decreases non monotonically with banks' growth for all typologies of banks. Finally the impact of banks' size (positive) and growth (negative) on the share of impaired loans to total loans is significantly higher for synergic than for non synergic banks.

Table 2: Regression results

Pooled 2001-2006	**All banks (217)**		**Synergic banks (75)**		**Non synergic banks (142)**		**Test on differences**	
	Coef.	t	Coef.	T	Coef.	t	t-test	
COMI	0.013 ***	2.64	-0.071 ***	-5.07	0.023 ***	3.44	-5.60	***
LASSET	0.002 ***	5.76	0.005 ***	3.91	0.002 ***	3.51	2.18	**
LOANASSET	0.015 ***	6.61	0.014 **	2.34	0.020 ***	4.94	-0.70	
GRASSET	-0.019 ***	-6.18	-0.052 ***	-3.94	-0.017 ***	-3.67	-2.33	**
GRASSET-SQ.	0.046 ***	6.47	0.074 ***	2.28	0.051 ***	4.73	0.51	
Wald X^2	2109.46 ***		13706.80 ***		927.65 ***			

Note: *, **, *** denote respectively significant at the 1, 5 and 10% levels. Results are heteroscedasticity consistent. Dummy variables for time periods and countries are included although coefficients are not reported. Banks with zero or very low levels (first percentile) of the ratio of loans to assets have been excluded from the analysis. Test on differences are t-tests on equality in the coefficients of synergic and non synergic banks.

5. Conclusions

The so called "non traditional" banking activity which generates non interest income has nowadays become an important source of revenue for many banks whose main activity has long consisted in granting loans and managing deposits. Several studies have empirically investigated the impact of such activity on banks' performance and on banks' risk finding mostly a negative impact of non interest income on risk-adjusted performance.

Recently Cosci, Meliciani and Sabato (2009) have provided a model showing that, in a setting where 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, the higher is banks' cross-selling activity the lower will be its screening effort. This prediction has found empirical support by detecting, on a sample of European banks, a negative impact of the share of net commission income (a proxy of revenues from cross-selling) on the ratio of impaired loans to total loans (a proxy for the quality of banks' loans).

However, the impact of cross-selling on screening may differ according to banks' capability to exploit information synergies among the two activities. Cosci, Meliciani and Sabato (2012) show that, in the presence of information synergies between screening and cross-selling, selling services may increase banks' screening effort. The "non traditional" banking activity may, therefore, have very different consequences on banks' risk and on the quality of financed projects according to banks' capability to create information.

In this paper we have provided a simple classification of (medium and large) banks into potentially "synergic" and "non synergic" on the basis of their size, their degree of customer orientation and on the fact of being cooperatives and we have shown that the two groups of banks have different lending strategies. Synergic banks have a significantly higher interest margin and share of loans over assets while they have significantly lower shares of net trading income with respect to non synergic banks. Interestingly the two groups of banks do not differ (or differ little) in the share of impaired loans over total loans and in the share of net commission income over total income. We have, then, tested whether the impact of commission income on the quality of banks' loans was different for the two typologies of banks and we have found that, while for non synergic banks revenues from services decreases the quality of banks' portfolio of financed projects, the opposite occurs for synergic banks.

These results are consistent with the model of Cosci, Meliciani and Sabato (2012) and have important implications. In fact, without inverting the trend towards an increasing share of non interest income, banks may maintain their traditional role of producers of imperfect information about borrowers if they are able to exploit information synergies. Information synergies are more likely to be better exploited by a bank adopting a relationship-lending strategy than by a bank adopting a transaction-lending strategy, and in general by banks relying more on soft than on hard information. Our results have shown that banks do not have to be particularly small to be able to exploit information synergies, although very large banks may have some difficulties.

In this paper, we have classified banks into synergic and non synergic on the basis of "rough" proxies (size, ratio of employees to deposits and being cooperatives). Richer information on the way in which banks use information would allow to better test the implications of banks' shift towards non interest income for synergic and non synergic banks. Finally, the possibility of exploiting synergies between the screening and the cross-selling activities can depend also on the characteristics of the service sold. Cosci, Meliciani and Sabato (2012) provide a tentative classification of services on the basis of their customer-specificity and of their informative content. More detailed information on the kind of services sold by the bank will allow testing whether the impact of cross-selling on screening may depend on the type of services sold by the bank.

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