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THE INTERACTION BETWEEN FACE-TO-FACE AND ELECTRONIC DELIVERY: THE CASE OF THE ITALIAN BANKING INDUSTRY

by Emilia Bonaccorsi di Patti, Giorgio Gobbi and Paolo Emilio Mistrulli*

Abstract

We empirically investigate the relevance of demand-side complementarity between electronic and traditional provision of banking services. Since no systematic data on prices for the two types of services is available, it is not possible to estimate cross-elasticities of demand. We resort to two indirect tests. The first test is based on estimating the relationship between branches and the diffusion of e-banking services in local markets, controlling for individual bank and market characteristics employing new data for Italian banks referring to 1998-2001. We find that banks expanded relatively more in the e-business in those local markets where they had relatively fewer branches, with the exclusion of markets where the banks were chartered. The second test is based on measuring the impact of the joint provision of banking services - electronically and at traditional branches - on banks' revenues per customer. We estimate a non-standard revenue function that relates revenues from asset management, brokerage and payment services to the share of customers employing e-banking, given the total number of bank customers. Our results show that a high share of e-customers is associated with a reduction in revenues per customer. This evidence suggests that banks did not extract substantial consumer surplus from the joint provision of electronic services and traditional services at the branch. We interpret the results of both our test as not consistent with the hypothesis of complementarity between stores and e-commerce in the banking industry.

JEL classification: D12, G21, O32.

Keywords: commercial banks, e-banking, electronic transactions, store proximity.

Contents

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1. Introduction[1]

Recent developments in information processing, telecommunications and related technologies (IT) have significantly changed the way firms sell their products and services. Retail banking is an example of an industry that has been deeply affected by the evolution of IT. Since the early 1980s an increasing volume of cash management services has been serviced through automated teller machines (ATMs) and cash dispensers. Several countries have experienced a widespread adoption of point-of-sale terminals for electronic funds transfer (POSes) and other electronic cash-less instruments for retail payments (BIS, 2003). Home-banking services through private proprietary networks were launched, although with mixed success (Radecki, Wenninger and Orlow, 1997).

In the late 1990s one of the most important innovations in the financial industry was the provision of information and transaction financial services over the Internet. The change from restricted proprietary systems to a widely adopted open network has greatly enhanced the potential development of remote banking activities.[2] The standardization provided by the world-wide-web has cut the communication costs of reaching customers electronically, stimulating the adoption of new marketing and commercial strategies.

The consensus view is that in the medium term the Internet will produce extensive changes in the structure of the banking industry but there are different views on the pattern of these changes. On the one hand, electronic delivery is expected to increase the degree of competition among financial intermediaries because it lowers entry costs (Clemons and Hitt, 2000). In addition, the standard advertising theory (e.g. Stigler, 1961) suggests that the substantial increase in publicly available information about prices over the Internet should reduce both prices and price dispersion. On the other hand, the Internet offers banks the possibility of developing new

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[1] The opinions expressed do not necessarily reflect those of the Banca d'Italia or its staff. We thank Mattew Shum and two anonymous referees for their comments and suggestions.

[2] Remote banking is usually defined as the provision of banking services without face-to-face contact between the bank employee and the customer (ECB, 1999). Generally speaking, remote banking services include self-banking such as multi-purpose ATMs, telephone banking and PC or electronic banking. In this paper we use the term remote customer to indicate customers connected either by phone or computer.

products, based on the use of personal information on individual customers at relatively low costs (Claessens, Glaessner and Klingebiel, 2000). A consequence of product tailoring and price discrimination could be a reduction in competition.

Making more accurate predictions is difficult because of the lack of data on the provision of e-banking services. In particular, it is unclear to what extent e-banking services are substitutes or complements with respect to traditional transactions delivered at branches from the point of view of customers. A second issue is the impact of different pricing strategies on consumer choices and, ultimately, on bank profits, especially when there are cost rigidities due to difficulties in cutting the branch network. Banks have combined traditional and electronic operations to different degrees. At one end of the spectrum, some banks provide only remote services, either on the phone or the Internet; at the other, many institutions have chosen not to provide remote services at all. The most common strategy is to offer a limited set of information or transaction services electronically together with traditional branch transactions (the so called "click and mortar" strategy).

Such variety of choices corresponds to the complex pattern of supply and demand forces, which has driven the first wave of Internet banking. On the supply side, e-banking is characterized by a large initial investment and substantial reputation advantages. These factors imply scale economies and very low marginal costs. Pure "virtual banks" have relied on aggressive pricing to build up a large customer base to exploit the economies of scale Econometric evidence shows that pure electronic banks face a longer and flatter learning curve than traditional de novo banks, suggesting that "virtual" banking may not be an inferior business model in the long run (DeYoung, 2001) even if in medium term "virtual" banks are at a disadvantage with respect to their "click and mortar" competitors.

Traditional banks started to offer remote services under the threat of competition by pure electronic banks.[3] Given their large customer base, they have been able to afford the large initial investment and cross-subsidize their e-banking operations as part of a global expansion strategy.

[3] Surveyed banks supplying e-banking services or intending to do so in the US generally referred to a need to remain competitive and retain customers, rather than increase revenues to cover the costs (Furst, Lang and Nolle 2001, 2002, Sullivan , 2000 and 2001).

The success of the "click and mortar" business model will depend on the importance of economic complementarity between electronic and physical delivery. One opinion largely held in the industry is that demand-side complementarities are substantial because customers perceive electronic access as an additional feature of traditional banking services, thus preferring the "click and mortar" bank (JP Morgan, 2000; Bank for International Settlements, 2001). If complementarities are substantial, banks can extract the surplus generated by the preference of consumers for a single provider with multiple delivery channels and cover the costs of maintaining a branch network. If customers attribute great value to the option of accessing branch services, the surplus that can be extracted from e-banking is larger because competition in e-banking is less effective due to a form of "lock-in".

To date the direct impact of the "click and mortar" strategy on bank profitability has not been encouraging. In Europe traditional banks have developed e-banking services without substantially reducing their branch networks. The result has been that they experienced an increasing cost pressure, which in turn led to a reduction in investments required to further develop their electronic sales (ECB, 2002).

The viability of the "click and mortar" model, in which the provision of services electronically is compatible with large branch networks, depends on consumers' willingness to pay for the availability of a variety of delivery channels from the same bank, i.e. on the extent to which they perceive e-banking and face-to-face services as close complements.[4] In this study we test if electronic and face-to-face provision of banking services are perceived as complements by consumers in two ways. The first way is to estimate the empirical relationship between the number of e-customers a bank has and the size of its branch network. We employ a large sample of "click and mortar" banks and focus on their e-banking connections in a number of local markets. The second way is to assess the impact of the provision of e-banking services on revenues of banks that have also a branch network. We estimate a non-standard revenue function relating bank revenues not only to output and input quantities but also to the number of customers with e-banking accounts, given the total number of bank customers.

Complementarity between the electronic provision of goods and traditional stores is largely unexplored since systematic and detailed data on prices and use of electronic services are not available. Such data do not exist for the banking industry either but Italian banks have filed unique information on the number of customers connected electronically, since the late 1990s. The data include information on each bank, the number of customers by type of connection (electronic, phone), type of customer and geographical location. In the analysis presented below, we employ this data for the first time. The first test is performed on bank-market observations, hence we control for differences in local demand by including local market variables and focus on the effects of bank i in market j branch density on the number of e-customers. In the second test the bank-level information on the number of customers is matched with the balance sheets and income statements of banks and other banking data from Supervisory Reports to estimate the revenue function.

Results from the first test show that banks expanded relatively more in the e-business in those local markets where they had relatively less branches, with the exclusion of markets where the banks were chartered. Consistently, our second test suggest that banks with a high share of e-customers had lower revenues per customer. We interpret these results as not supportive of the hypothesis that face-to-face services and e-banking are complements.

The paper is structured as follows. Section 2 illustrates the data and describes the main features of electronic banking in Italy. Section 3 discusses the main issues and summarizes the previous literature. Section 4 presents the empirical model of the relationship between e-banking and bank branches; Section 5 contains the analysis of revenues. Section 6 concludes.

2. E-Banking in Italy: Stylized Facts

Data on e-banking and other remote connections (e.g. phone) have been collected systematically by the Bank of Italy since 1996. The data include the number of customers, sector

[4] The notion of complementarity we refer to is more general than the text book definition and is close to that of scope economies in consumption (e.g. Berger, Humphrey and Pulley, 1996).

of economic activity (household or corporate) and location[5]. To our knowledge, the information is the most comprehensive at the international level because it combines geographical with bank-level detail. Customers are classified according to their use of the remote connections between those who only have access to information and those who have actually performed at least one transaction. Banks also report the number of customers that use phone banking or other services, for example those that a bank offers to its employees through the internal network.

Our analysis focuses only on households because the aim of the paper is to study the interaction between physical and electronic delivery in the retail market, that is the market for banking services to small businesses and households. As our data do not allow us to distinguish small businesses from large firms, we focus on households.

Descriptive statistics on Italian e-banking are reported in Tables 1-2. The data reported refer to the years 1998-2001. As shown in Table 1, the adoption of phone and e-banking – also known as home banking - by banks has increased substantially in the last three years among all bank size categories.

At the end of 2001, 529 banks supplied e-banking services to households. The number of banks offering phone banking services in 2001 was much lower (186) than of those offering e-banking services. The expansion of e-banking was relatively slow until 1999. In 2000 and 2001 the rate of growth was higher than in the previous years, especially for e-banking services. This was partly due to the entry of a number of small banks belonging mostly to banking groups and highly focused on e-banking services supplied through the Internet. As reported in Table 2, at the end of 1998 only 0.2 per cent of households could access their bank via their PC and perform some transactions. In 2001 this percentage was 7.6. The share of phone banking accounts was significantly higher at the beginning of the period (3.5 per cent) but increased less rapidly afterwards. In 2001, 7.2 per cent of households could access their bank by phone calls for transactional purposes.

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[5] Customers are classified by province of residence. In Italy there are 103 provinces. According to the antitrust regulation deposit markets for households are considered as large as the province.

Additional information on the electronic supply of financial services in Italy is contained in the report on the annual survey of Internet banking conducted by the Bank of Italy, starting in 2000. The survey covers banks and non-bank financial intermediaries. The number of non-bank financial intermediaries that offer electronic services is small (Banca d'Italia, 2001a). Within diversified financial conglomerates, electronic services are mostly provided by banks because they have the technology for collecting and processing large amounts of data and because the financial services provided electronically are usually bundled with a checking account. In the empirical analysis presented below we only include banks. Nevertheless, we do not expect a large bias due to the exclusion of financial companies.

According to the survey, e-banking has affected only the deposit side of the market and the brokerage/trading business. Banks typically supply a package including the typical set of information and transaction services tied to a checking account (money transfers and other payment services) plus brokerage services. Although information services on loans are provided electronically on the banks' web sites or on portals that compare products of different institutions, loans are not supplied electronically.

Box A: Revenues from Internet transactions of Italian banks in the year 2000

	Investment and asset management	Payment services	Other services	Total
Millions of euros	79.5	7.5	9.2	96.2
As a percentage of the Corresponding Industry revenues	0.8	0.3	-	0.7

Source: Bank of Italy Supervision Bulletin (Banca d'Italia, 2001a) for revenues from Internet transactions and Annual Report on 2000 for total industry revenues (Banca d'Italia, 2001b). Total industry figures are net revenues, i.e. they are obtained as the difference between commissions and fees receivable and commissions and fees payable. Total revenues from Internet transactions have been taken as a percentage of industry net income from services.

Investment and asset management services account for almost 80 per cent of revenues generated by e-banking, while the provision of payment services contributes to less than 8 per cent. Total revenues from Internet transactions amount to less than 1 per cent of total bank net

revenues from commissions and fees. Importantly, the contribution of e-banking to income from services varies considerably among the banks responding to the survey. About one in ten of the banks in the sample reported revenues amounting to more than 2 per cent of total revenues from services and another fifth fell in the range between 1 and 2 per cent. Although no comparable data are available for year 2001, it is reasonable to expect that both the level of revenues from electronic transactions and their dispersion among banks should have increased owing to the increase in the number of customers and active banks. Thus, the data should contain enough information to perform the statistical tests based on the revenue function described in section 5.

3. Theoretical and Methodological Issues

The introduction of e-banking modifies the way banks can enter new markets and reach customers. To our knowledge, no specific theoretical model studies the interaction between traditional (i.e. face-to-face) provision and electronic provision of services in the banking industry, although a number of papers have emphasized the role of accessibility of services to customers in shaping banks' strategies. Accessibility is usually defined as the cost for customers to reach a bank branch as a combination of distance, which entails transportation costs, time to complete a transaction and monetary expenses (Evanoff, 1988). Different combinations of accessibility attributes determine different degrees of convenience, which is valued by customers when they choose where or how to purchase a given financial service. Convenience has been a primary strategic variable for banks competing in markets where regulation prevents price flexibility, as in the case of regulation Q in the United States. More recently, Dick (2003) finds empirical evidence that the staffing and geographic density of local branches remain important determinants in consumers' choices of a depositary institution, even when there are no constraints on price setting.

In general terms, increasing convenience is a way of raising consumers' surplus. If one considers a single highly standardized service, such as the purchase of securities or a money transfer, an electronic transaction is a substitute for a trip to the branch. The two services imply different combinations of accessibility attributes (time, distance, connection costs), ease of use and price. The costs of accessing banking services electronically include investing in the

specialized knowledge needed to use a computer and the necessary software. Knowledge barriers may limit the size of the market to a subset of bank customers in the short term, but tend to weaken at the pace of IT diffusion among consumers. The consensus view is that the convenience of accessing financial services electronically largely outweighs that of accessing it at the branch for computer-literate consumers (Mishkin and Strahan, 1999).

On the bank side, the marginal costs of delivering highly standardized services electronically are far lower than those of delivering them physically. Although systematic evidence is scarce, data from case studies suggests that the difference is at least of one order of magnitude (Sato and Hawkins, 2001). Consequently, competition should drive down prices, letting consumers appropriate of the surplus (convenience) generated by banking on-line. Two factors may prevent competition allowing banks to extract the surplus. The first is that even highly standardized financial services are not standardized enough to be perceived as equivalent to a service supplied at a branch. For example, a significant proportion of the information exchanged between bank employees/officers and customers may be non-standardized (soft information) and therefore most of on-line transactions are part of a bundle of services that includes some kind of physical interaction.[6]

The second factor in determining the magnitude of the surplus that the bank can seize is the relative importance of cross-selling. The bundle of services provided electronically is usually not the same as the one available at a branch. For this reason it is difficult to assess a priori whether electronic delivery competes with branches, even within the same banking organization, or whether it is a way to increase output volumes and banks' profits by selling different baskets of products. For example, in the case of Italy the vast majority of services provided electronically are either brokerage services or payment services, whereas the full set of services offered at a branch is much larger. In the US banks also supply some types of standardized loans

[6] This view seems to be rather common within the banking industry. For example, in Italy some banks have complemented their e-banking facilities with a network of financial salesmen. The distinction between soft and hard information is not independent from the state of the art communication technologies. A fairly general discussion of the issue can be found in Leamer and Storper (2001).

electronically (Berger 2003); in the Scandinavian countries virtually all banking services can be delivered through the Internet (European Central Bank, 2002).

Banks can successfully implement cross-selling strategies if consumers are willing to pay for one-stop banking (scope economies in consumption), namely they experience synergies in consuming different financial services from the same bank. Consumers' synergies in banking have been extensively discussed in Berger, Humphrey and Pulley (1996). The argument is that economies of scope in consumption may arise from reductions in transaction, transportation and search costs. The exchange of soft information may also play a role. For example, personal knowledge and reputation with a bank generated by a deposit account may increase the probability of favorable conditions on a future loan application. Customers would prefer to hold an account with a bank that jointly supplies payments, deposit services and loans, which is currently not the case for pure e-banks in many countries, including Italy. Even if banks do not supply loans over the Internet it is likely that soft information remains important (Berlin and Mester, 1999; Kashyap, Rajan and Stein, 2001).

A full evaluation of the relevance of scope economies in consumption in shaping the developments of e-banking would require detailed information on prices charged by different banks for similar services delivered through different channels, as well a comparison between pricing strategies both of pure Internet banking and "click and mortar" banks.

Ideally, one would want to study the effect of prices for both services on the banks' market shares to measure the cross-elasticities of the demand faced by each bank in the two segments. Unfortunately, data on prices are not available on a systematic basis. In the analysis discussed below we follow two indirect avenues. First, we estimate an empirical relationship between e-banking diffusion and branches by banks in different local markets. We exploit the fact that the supply of e-banking facilities has no geographical boundaries and that banks cannot differentiate their policies and prices across customers located in different areas. Marketing strategies for on-line services and prices cannot be diversified across geographic markets. On the contrary, face-to-face sale through branches has a rather limited geographical reach. We argue, therefore, that once a bank has taken the decision of entering the e-banking business, the location of its customers will be by and large out of its control and will depend on market-specific demand characteristics.

To the extent that branches matter to e-customers, also the density of the bank's branches in each local market should play an important role in how market demand is allocated across banks.

If economies of scope in consumption are important we should observe that "click and mortar" banks are more likely to expand their e-banking business in the same geographical markets where they have a high branch density, servicing the customers they already have or increasing their market share in both segments by exploiting customers' preference for joint accessibility. On the contrary, if complementarities in consumption are relatively unimportant, banks will attract e-banking customers mainly where they do not have branches because of the lower prices. A third possibility is that the set of customers consuming financial services on-line is disjoint from the set of those using physical channels, so that the two markets are completely separated.

The second indirect test of the effects of scope economies in the consumption of financial services is based on the revenue function model used by Berger, Humphrey and Pulley (1996). In particular we test the effect on bank revenues of an increase in the number of customers using e-banking facilities, holding constant the total number of customers. The intuition is that if there are economies of scope in consumption consumers are willing to pay for the convenience of making transactions electronically with the same bank from which they can purchase face-to-face services at branches. In this case banks are able to extract the consumer surplus generated by the provision of services electronically and their revenues should be positively correlated with the share of consumers that have access to e-banking facilities.

4. An Empirical Model of the Diffusion of E-Banking

In this section we analyze how consumers are distributed across banks in local markets, when intermediaries are active both in the traditional and the e-banking business. In particular, we attempt to verify indirectly whether consumers value the option of physical accessibility to the bank when they have the alternative of connecting to their bank remotely. As discussed below, we focus on banks that are joint producers and exclude pure remote banks. We formulate three hypotheses on the reduced-form relationship between bank branches and the diffusion of e-banking in local geographical markets. These hypotheses result from the interaction of demand

and supply effects, although we expect demand factors prevail in our model. The reason is that the bank fixed effects included in the estimation capture e-banking prices, which are the same across all markets, and any other factor which is fixed at the bank level, for example set-up costs for e-business and reputation. The variation in each bank's capacity to attract e-customers – given market level demand – is a function of the services sold by each bank in that specific market. We focus on branch accessibility as the relevant attribute.

The complements hypothesis states that customers value the joint provision of e-banking and face-to-face banking services from the same provider. Given the general propensity to demand e-banking in a local market, a bank will expand in the e-banking segment relatively more in the same geographical markets where it has many branches. An extensive branch network provides additional value to customers in the e-banking segment because the physical and the electronic delivery channels are perceived as complements. The prediction of the complements hypothesis is that the number of customers connected in a local market is positively related to the size of the branch network in that market, everything else being equal.

The substitution hypothesis posits that consumers using e-banking facilities consider the services provided electronically not very different from those provided at the branches, with the exception of the costs of accessing the service (mainly "shoe-leather" costs for the branches). The cost of connecting electronically to the bank is independent of distance; instead, the cost of reaching a branch is higher the lower the density of branches of the bank in the market. Therefore, the relative convenience of establishing an electronic connection to each bank is greater the lower the density of branches of that bank. This hypothesis predicts that the size of the branch network is negatively related to the expansion of electronic connection for each bank, everything else being equal.

Finally, the segmentation hypothesis states that e-banking and traditional services are two different products and customers consuming one or the other do not attribute any value to the joint provision of the two by the same bank. In this case we should not observe any systematic relationship between branches and the diffusion of e-banking in different markets.

With reference to an empirical model where a measure of e-banking customers is regressed on bank branches, the predictions of each hypotheses are the following:

i) Complements hypothesis: ∂E-CUSTOMERS/∂BRANCHES > 0;

ii) Substitution hypothesis that ∂E-CUSTOMERS/∂BRANCHES < 0;

iii) Segmentation hypothesis that ∂E-CUSTOMERS/∂BRANCHES = 0.

However, if we regress the number of e-customers on the number of branches we will not be able to identify the relationship between branches and e-customers because the coefficient will incorporate the effect that an increase in the number of branches will have on the total number of bank customers. The relationship between face-to-face accessibility (branches) and the demand for electronic access has to be purged by the indirect effect that branches have on the diffusion of electronic accounts via their effect on the number of customers that a bank has in a given local market. The identification of the relationship between branch expansion and e-banking expansion requires instrumental variables estimation.

We construct a simultaneous equations model that specifies the relationship between the number of bank customers with electronic connections (e-customers), the total number of bank customers, bank branches, and control variables for demand and supply conditions at the market level. While it is obvious that the total number of customers influences the number of e-customers, we need to control for a potential reverse causation from the number of e-customers to the total number of customers. The reason is that if an existing customer activates an e-banking account, he/she is counted as one new e-customer in our data but the total number of bank customers does not change. Instead, if a customer of bank *i* opens an electronic account at bank *k*, he or she will be recorded both as a new customer of bank *k* and as a new customer with electronic access of bank *k*. Hence, a bank that expands only in e-banking services expands its total customer base, whereas one that switches its customers to e-banking does not.[7]

We model these relationships with the two-equation simultaneous equations model below, exploiting the availability of data at the bank-market level, for a three-year period. The advantage of bank-market level data is twofold: i) we can control for differences in the demand faced by

[7] This is why we do not model electronic accounts as a share of total accounts. We want to emphasize the dynamics of both components and not that of their share.

banks in different markets; ii) we can control for most differences across banks with bank fixed effects.

As shown below, equation (1) specifies the number of e-customers of bank *i* in market *j* in period *t* as a function of the total number of customers of bank *i* in market *j* in period *t*, the branch network of bank *i* in market *j* in period *t* and a vector Z_1 of demand and supply market level controls. Equation (2) specifies the total number of customers of bank *i* in market *j* in period *t* as a function of e-customers of bank *i* in market *j* at time *t*, the bank's branches in market *j*, and a vector Z_2 of demand and supply conditions in market *j* in period *t*:

$$E\text{-}CUSTOMERS_{IJT} = \alpha_{11} + \beta_{11} \bullet TOTAL\ CUSTOMERS_{IJT} + \beta_{12} \bullet G(BRANCHES)_{IJT} + \Gamma_1 \bullet \mathbf{Z_1} + \Phi_1 \bullet BANK\ FIXED\ EFFECTS_I + \Psi_1 TIME\ EFFECTS_T + \varepsilon_{1IJT} \quad (1)$$

$$TOTAL\ CUSTOMERS_{IJT} = \alpha_{21} + \beta_{21} \bullet E\text{-}CUSTOMERS_{IJT} + \beta_{22} \bullet H(BRANCHES)_{IJT} + \Gamma_2 \bullet \mathbf{Z_2} + \Phi_2 \bullet BANK\ FIXED\ EFFECTS_I + \Psi_2 TIME\ EFFECTS_T + \varepsilon_{2IJT} \quad (2)$$

The complements hypothesis predicts a positive coefficient β_{12}, the segmentation hypothesis a nil effect β_{12}, and the substitution hypothesis a negative coefficient β_{12}. Given that the functions *g* and *h* are not know a priori, we test different functional forms (linear and quadratic). We do not exclude a priori the coexistence of more than one effect, with a dominance of one over the other in some range of the size of the branch network. For example, it could be the case that an increase for bank that has very few branches has a positive effect on attracting e-customers, but when the bank has many there is no effect. For this reason we estimate a linear (not reported) and a quadratic function. In both equations the numbers of e-customers, of total customers and branches are transformed in natural logs to reduce heteroscedasticity. Thus, the coefficient β_{12} can be interpreted as an elasticity and its sign identifies which hypothesis holds.

The first endogenous variable, the number of e-customers, is measured by the log of the number of households resident in market *j* having an Internet account to perform transactions with bank *i* at the end of year *t* (LNECUSTMKT). Markets are defined as the 103 Italian provinces, the standard definition of local markets in antitrust policy and empirical research on

Italian data. The second endogenous variable is the log of the end-of-year number of checking accounts (LNTOTCMKT) of each bank in each province. Although a customer could have more than one checking account, we argue that at the local market and bank level this variable should be very close to the number of customers. The key explanatory variable in both equations is the end-of-year log of the number of branches of each bank in each province (LNBRANCHMKT); we include also a second-order term (LNBRANCHMKT_SQ). We denote these three variables with the suffix MKT to distinguish them from their counterparts at the bank level (BK), employed in the revenue analysis in Section 5.

In equation (1) the other variables (the vector Z_1) control for the demand for e-banking services in market *j* and supply conditions. We include also bank fixed effects to capture pricing of e-banking and other factors that do not vary across local markets for the same bank, and time effects to control for the general increase in the diffusion of e-banking over the period studied. The fixed effects are particularly important in controlling the characteristics of e-banking services because they do not vary across markets.

The demand variables are the following. The first is the log of per capita value added (LNVADDED) in the local market, capturing economic development and, most likely, also social development. Since we expect the propensity to use e-banking to be related to human capital we include a variable of human capital (EDUCATION), given by the share of population that holds a high school diploma or higher. The number of Points of Sale (stores connected for direct payment with debit cards) divided by population (1,000) in market *j* at time *t-1* is a measure of customers' propensity to use new technologies (POSPOP_1). The variable enters the regression with one lag to avoid endogeneity with respect to the diffusion of e-banking and other new payment technologies. The log of the volume of shares held in households' portfolios at banks in market *j* at time *t-1* (LNSHAREMKT_1) controls for differences in the propensity of consumers to buy shares and in the demand for on-line trading services. Since no variable is available at the local market level to capture the diffusion of computers or Internet usage, we resort to a regional-level measure of the share of households that have a personal computer (PCHOUSE). Differences in transportation costs to reach bank branches, given the number of bank branches in the province, are accounted for by the share of population living in areas that are classified as mountains (more

than 600 metres altitude; POPMOUNTAIN). This variable should be positively correlated with transportation costs and have a positive effect on the demand for e-accounts because customers have a greater incentive to avoid going to the branch. A second variable measuring transportation costs is the ratio of kilometers of roads to the area in square kilometres (ROADS). Since no information is available at the province level we resort to regional measures. This variable should proxy for connectivity in the region, once we control for the composition of the region in terms of mountains by POPMOUNTAIN.[8] We include also the share of population living in the main city (SHURBAN), which should capture network effects in knowledge diffusion and hence have a positive effect on the number of e-customers. The last three variables are observed for one year only.

On the supply-side, competitive conditions in the deposit market are measured by the end-of-previous-year Herfindahl index of deposit market concentration, computed at the province level (HERFDEP_1). We do not have a prior on the sign of the coefficient. Customers may demand more e-banking services where there is less competition in face-to-face services, or banks operating in less competitive environments may have the incentive to compete less actively also in the e-banking or not encourage it because it could erode their rents in the face-to-face market.

In equation (2) some of the control variables in Z_2 differ from those in equation (1) because they are supposed to capture the determinants of the demand of bank checking accounts, and are not specific to e-banking. In particular, we include the volume of mortgages to households (LNMORTGAGE) because a household that has a mortgage is very likely to have a checking account to pay the instalments. We argue that this factor should not affect the demand for e-banking because there is no electronic provision of mortgages in Italy. Even if mortgages could be correlated to e-banking because of common factors – education, wealth - we argue that these factors should be controlled for by the other variables. As in equation (1) we include the log of per capita value added (LNVADDED) as a proxy of wealth and economic activity. We include the log of population in the province (LNPOP) that serves as a scaling variable controlling for

differences in the size of markets. An urbanization variable should capture the general degree of banking development in the province (SHURBAN); the control for human capital (EDUCATION) is included because the demand of banking services is likely to be related to education. This specification is consistent with the existing evidence on variables that affect the demand for checking accounts (e.g. Caskey, 1994). On the supply side we include the lagged Herfindahl index of deposits also in equation (2) to control for competitive conditions in the local market. Also in equation (2) we control for bank level characteristics with fixed effects. Year dummy variables are included.

The model is identified by exclusion restrictions because the variables included in Z_1 are not the same as those in Z_2. In particular, Z_1 includes the variables PCHOUSE, LNSHAREMKT_1, POSPOP_1, POPMOUNTAIN and ROADS measuring computer diffusion, volume of securities, propensity to use technology in payments, transportation costs and factors affecting the demand for electronic services but not the demand for checking accounts. These variables should affect the number of bank customers in a given market only to the extent that they influence the demand for electronic accounts and are excluded from equation (2). The vector Z_2, instead, includes determinants of the number of checking accounts (LNMORTGAGE, LNPOP) not included in equation (1). These variables affect the number of electronic accounts only indirectly, i.e. through their effect on the number of total checking accounts. In the 2SLS estimation they are included in the first stage for both endogenous variables but are excluded from equation (1) in the second stage.[9]

A problem that could arise in our specification is that, even if the supply of e-banking services is fixed across local markets, marketing strategies may be somewhat flexible at the local market level and the bank fixed effects would not control for this factor. In particular, the branch network may be used to advertise the existence and the characteristics of the bank's on-line facilities. In addition, bank reputation may vary across local markets and the "click and mortar"

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[8] Regions with large areas of mountains may have more kilometres of roads simply because of the impossibility of building direct routes between places.

[9] We estimated the model including also LNSHAREMKT_1 in equation (2) and the results were robust.

banks may promote e-banking by exploiting the strength of their brand name more effectively in local markets where they have a relatively large number of branches. In order to control for differences in reputation we include in both equations the variable ORIGIN, equal to 1 in the local market where each bank was originally chartered, 0 otherwise. We also interact ORIGIN with LNBRANCHMKT, to control for differential effects of the size of branches in the area where the bank is likely to have the highest reputation benefits. The definitions of variables and sample statistics are reported in Table 5.

4.1 Results

We employ bank-market observations referring to 103 provinces and 169 banks that employ jointly the traditional and the electronic delivery channels.[10] The adoption of e-banking is negligible prior to 1998 so we employ data referring to the years 1999-2001. We include only the banks whose customers can perform transactions electronically, excluding accounts that give access to information only. We exclude cooperative banks because they are subject to limits in branching that force them to operate only in one or few provinces, which would bias the relationship between branches and e-banking. We exclude also the offices of foreign banks because their product mix is different from that of domestic banks.

The model is estimated with 2SLS with bank fixed effects so that any effect should be interpreted in terms of deviations from each bank's mean across markets. The results (Table 6) show that the number of branches has a non-monotonic effect on the diffusion of e-banking, described by a U-shaped curve. The minimum of the curve, where the elasticity changes sign, is reached at a value of 4.3 branches, which is lower than the sample mean but significantly above the median (1). Around 75% per cent of the observations lie below this value. The finding is consistent with the substitution hypothesis for the relevant range because banks appear to have more e-customers where they have a relatively lower number of branches. However, they cannot fully substitute branches. A positive effect is found for banks that have a very large number of

[10] A larger sample of 259 banks includes also banks that do not supply e-banking services and pure internet banks and was employed for robustness purposes.

branches in certain markets. A possible explanation could be either that there are externalities in marketing or exogenous factors that apply to areas where there is very high density and which are not fully controlled for by urbanization and other characteristics. An interesting finding is the negative effect of the interaction term between LNBRANCHMKT and ORIGIN. The negative effect suggests that the benefit of opening a branch on e-customers is lower in the market where the bank was chartered. This result is likely to depend on the fact that reputation and network effects are marginally declining in branch density, since banks have a high number of branches in their "home" markets. The magnitude of the coefficient of the interaction term is large enough to almost compensate for the positive effect of the quadratic term, suggesting that the positive segment of the relationship between e-banking and branches is not relevant, given that most of the observations with high values of LNBRANCHMKT are those for which ORIGIN is equal to 1. The turning point when LNBRANCHMKT is set equal to 1 corresponds to a number of branches equal to 8.9.

Unexpectedly, the diffusion of e-banking is negatively affected by the share of households that have a PC; the sign of the coefficient is negative and statistically significant. An explanation of this result could be that PCs are measured at the same time as e-banking and endogeneity may produce a bias; in addition, convergence effects may be relevant, as we expect that PC ownership grows faster where initially lagged behind. As expected, e-banking is more developed where banks hold a larger volume of shares in their portfolio. POSPOP_1 is positive, as expected, but not significant. The level of education of the population, measured by EDUCATION, has a positive effect on e-banking, as predicted. E-banking is more present in less concentrated markets, suggesting that banks may promote the use of it as part of competitive strategies in retail markets. In addition, the result could be explained by the fact that highly concentrated markets in Italy are also less financially developed and consumers could be less prone to innovative services. Structural features such as SHURBAN and POPMOUNTAIN do not have a statistically significant effect. Finally, the dummy ORIGIN is positive, showing that on average the proportion of e-customers is higher in the bank's "home" market.

The results for equation (2) show that total accounts are positively correlated to e-customers meaning that an increase in e-accounts implies an expansion of total customers, but

with an elasticity less than unity. The number of branches that a bank has is strongly positively related to the total number of customers with checking accounts, as expected. The benefit of opening an additional branch is declining in magnitude but remains positive in the range observed in the data. The interaction term between ORIGIN and LNBRANCHMKT has a positive cpefficient, indicating that the elasticity of customers with respect to changes in branches is higher in the market where the bank was chartered, partly offsetting the negative quadratic term. Province value added has a negative sign, which may appear counterintuitive. The sign could be driven by the fact that the regression estimates the effect of value added, controlling for branches and for other financial variables (mortgages). In particular, the results indicate implicitly that the ratio of customers with checking accounts per branch is higher in areas with lower value added, which is consistent with the intuition that branches are probably fewer in lower income regions. The log of household mortgages is highly significant and positive, as expected. With the exception of EDUCATION, the other variables are not significant.

The robustness of the results is tested employing different samples. We estimated the model including the bank-market cells that correspond to zero branches, zero checking accounts and electronic accounts, under the assumption that banks can expand potentially in any market, either remotely or by opening a branch. The results are reported in Table 6-B and are consistent with our previous result, for both the main and the control variables. Finally, in Table 6-C we report the results of another specification, in which we included market fixed effects and removed the control variables that do not vary across time for each market. The motivation is that our main specification may exclude relevant differences across markets, causing omitted variable bias. The results are again consistent with our main estimation. The effect of branches on e-customers in equation (1) is non linear and suggests a dominance of the substitution hypothesis in the relevant range of the data. An interesting result is that PCHOUSE is no longer significant and positive, which provides support for the finding of a negative sign in the main specification, i.e. that without fixed effects the variable captures a mixture of levels and growth effects of the diffusion of computers. We prefer the main specification because with the fixed effects many of the instruments are no longer significant, weakening the identification of the model.

5. The Impact of Electronic Provision on Revenues

5.1 The Empirical Model: A Non-Standard Revenue Function

The goal of our second test is to measure indirectly the extent to which customers are willing to pay for the joint access to banking services electronically and at branches. Our approach is based on estimating the effect of electronic delivery on the revenues per customer. The effect of e-banking is measured by the coefficient of the variables measuring the number of e-banking customers (e-customers), controlling for the total number of bank customers. We hold constant the size of the customer base and output volumes, and study how the share of customers that can purchase the bank's services electronically affects revenues.

We start from a non-standard indirect revenue function following (Berger, Humphrey and Pulley, 1996) specifying bank revenues as a function of output and input quantities. This model is considered more appropriate than the standard revenue function because banks are assumed to adjust output prices in response to given output quantities and maximization is performed over output prices.[11] We modify the non-standard revenue function to take into account the different ways through which the bank sells its services. Revenues are a function of output and input quantities (or prices for robustness purposes), and of the relative importance of face-to-face and e-banking provision of services. Since we do not have data on the number of transactions performed face-to-face or electronically, we use the number of customers as a proxy of quantities sold.

Rather than considering total revenues, we model only the subset of bank revenues generated by those services that are sold also on line in Italy in the relevant period : i) brokerage and asset management services, ii) payment services, iii) checking accounts. These services are standardized and homogeneous, hence a single electronic transaction can be considered a

[11] The standard revenue function is based on the assumption of a price-taking firm choosing the optimal output quantities, given input quantities. This assumption is unlikely to hold for a large number of bank outputs because bilateral contracting in which banks have some bargaining power is a common feature of most intermediation services.

substitute to a branch transaction regardless the issue of complementarity of the entire bundle of banking services.

Information on the first two categories of revenues is directly available from bank income statements in the form of commissions and fees from brokerage, asset management and payment services. Revenues from asset management services include: net income generated by commissions charged on securities transactions, (flat) fees for holding a securities portfolio, transactions on mutual funds shares, and other private banking services.

The revenues generated by checking accounts are included because in the Italian banking system an e-banking account is tied to a checking account and checking accounts generate an implicit income for banks, on top of the fees for payment services and other commissions. The reason is that banks generally pay on these deposits below-market interest rates as a compensation for liquidity services provided to customers and at the same time invest at market rates the liquidity collected. We estimate such implicit return as the difference between the interest flow obtained by applying the money market rate to the volume of checking accounts and the actual interest flow paid by the bank. The share of these revenues on total banks' revenues for different types of institutions is reported in Table 4.

The estimation of the revenue function requires the definition of the outputs. Given that we model only a subset of revenues, we restrict the analysis to those bank outputs that generate these revenues. We resort to measures of the stock of financial assets that determine the transactions because no information on the actual number of transactions is available.

In the case of brokerage and asset management services, we employ as a proxy of the volume of transactions the stocks of assets that customers hold at the bank. Households hold securities at banks under two types of arrangements involving different fees and commissions and different volumes of transactions per customer. The first arrangement implies that the bank hold the securities on behalf of the customer without providing any asset management service (essentially, customers pay a flat fee for the account plus brokerage commissions when the bank places orders on behalf of the holder). We distinguish these securities into shares (SHARES) and other securities (OTHSEC) because the evolution of stock prices in the period considered has been a particularly important determinant of the growth of e-banking.

The second arrangement implies the provision of some portfolio management service. We define the volume of securities managed (SECMAN) as the sum of the value of mutual fund shares held by customers and the value of other assets managed by the bank on behalf of the customers (private banking services). Most mutual funds are owned by banks that place the shares through their branch network or through financial salesmen.

In the case of payment services and revenues generated by checking account transactions we consider two dimensions of output. The first is the yearly average of monthly holdings in checking accounts (DEPBK). The second is the number of checking accounts since there is a large component of revenues from fixed fees, independent of the number of transactions or the size of the account (TOTCBK).

We include three input quantities: the number of employees (STAFF), the number of branches (BRANCHBK), and the number of investment professionals (INVPROF), in natural logs. No financial inputs are considered because asset management and payment services do not modify the levels of bank assets or liabilities. Another relevant input as far as payment services are concerned is the number of Points of Sale (POS) where customers can use debit cards for purchases. In our main specification we prefer to include input quantities rather than prices because prices cannot be measured accurately.

Our key variable is the number of e-banking customers (ECUSTBK). We include also the number of customers with phone banking accounts (PHONEBK) because for some banks phone-banking could be not negligible. In both cases we count only the customers who can perform transactions and exclude connections that provide information only. The coefficient of E-CUSTBK (and of PHONEBK) measure the marginal effect on bank revenues of increasing the number of customers connected by computer, given the total number of customers and the average portfolio composition. A positive effect implies that letting a customer access the bank both by e-banking and at the branch increases the revenues the bank gets from servicing such customer, consistent with the complementarity hypothesis. Consumers are paying more for having the opportunity of buying the same bundle of services using a multiplicity of delivery channels. A negative effects implies that revenues per customer are lower than without connection. Since we control for output quantities, an implication of a negative effect is that the

average price has to be lower when a customer uses both delivery channels This interpretation is consistent with the low marginal cost of the e-banking transactions and that competition is effective because e-banking and branches are substitute rather than complement in the delivery of banking services.

Given the limited number of observations, we choose a very parsimonious functional form.[12] Outputs are expressed in logs with a linear and a quadratic term. Input quantities and the number of customers are in logs with a linear term only.

The resulting equation is:

$$\begin{aligned} LNREV_{it} = {} & \alpha + \beta_1 \bullet LNSHARES_{it} + \beta_2 \bullet LNSHARES\_SQ_{it} + \beta_3 \bullet LNOTHSEC_{it} \\ & + \beta_4 \bullet LNOTHSEC\_SQ_{it} + \beta_5 \bullet LNSECMAN_{it} + \beta_6 \bullet LNSECMAN\_SQ_{it} \\ & + \beta_7 \bullet LNDEPBK_{it} + \beta_8 \bullet LNDEPBK\_SQ_{it} \\ & + \delta_1 \bullet LNSTAFF_{it} + \delta_2 \bullet LNBRANCHBK_{it} + \delta_3 \bullet LNINVPROF_{it} + \delta_4 \bullet LNPOS_{it} \\ & + \gamma_1 \bullet LNTOTCBK_{it} + \gamma_2 \bullet LNE\text{-}CUSTBK_{it} + \gamma_3 \bullet LNPHONEBK_{it} + \mathbf{\Phi}_i + \mathbf{T}_t. \end{aligned} \qquad (3)$$

The vectors $\mathbf{\Phi}$ and $\mathbf{T}$ are bank and time specific effects. We employ bank-specific fixed effects to control for quality differences in the services provided without ruling out that unobservable bank-specific output characteristics are correlated with the regressors.

For robustness purposes, we estimate equation (3) also with a narrower definition of revenues, including only brokerage and asset management services. The motivation is that brokerage commissions are the largest component of revenues from remote transactions. Our main results are unchanged so we do not show the results.

[12] Unlike the more familiar case of cost and profit functions, there are no theoretical reasons for selecting a specific functional form for the (non-standard) revenue function. Estimates obtained with a translog functional form do not improve on the linear-quadratic specification so we show only the latter.

5.2 Results

We employ annual data on virtually all Italian banks from Supervisory Reports for the period 1998-2001 to estimate equation (3). A first estimation is conducted employing all available observations (full sample) referring to banks that have at least one branch, whether they are active or not in the e-banking business. We exclude pure Internet banks because they have no branches other than the headquarters. Descriptive statistics for the full sample are reported in Table 7.

In a second estimation we included only banks with a positive number of customers performing e-banking transactions (click-and-mortar sample). The reason for this regression is to control for potential endogeneity between the size of e-banking operations and revenues if the decision to supply e-banking services is systematically related to past revenues. Banks with lower revenues could have been more active in innovating their product mix to increase their revenues or, on the contrary banks with higher revenues could have been able to invest in the fixed cost of entering the e-banking business. By excluding the banks that have not introduced electronic facilities we study the impact of e-banking only for banks that have already made the decision to supply it.

Finally, we replicate the estimation employing a third sub-sample excluding the small community banks (cooperative banks), which usually have very limited geographical reach since they tend to have branches in a very small number of provinces. In addition, they are organized as mutual banks and are likely to have different incentives in deciding their product mix.

The results of the estimation for the three samples are reported in Table 8. In all regressions the coefficients of the output terms are estimated with little precision due to the usual multicollinearity problems, even if the signs and magnitudes are plausible. The coefficient of the number of customers is always positive and statistically different from zero, as expected since revenues increase with the number of customers with checking accounts. Expanding the customer base increases revenues even if the volumes of deposits and securities is fixed.

The coefficient of the number of customers with e-banking transaction accounts is small but statistically different from zero. This finding is robust across all three samples. For the full sample an increase in the number of customers using e-banking facilities by 2.5 times, which is

the order of magnitude of the actual increase experienced in 2001, leads to a 1 per cent reduction of revenues, every other thing equal (Table 8, column i). The effect is larger when the sample is limited to "click-and-mortar" banks (Table 8, column ii). In all regressions the coefficient of PHONEBK is negative but not statistically significant. The sign suggests that an increase in the number of customers with phone banking tends to reduce revenues, although the effect is estimated with little precision because the variable takes values that are very close to zero.

For robustness purposes, we estimated the revenue function replacing variable input quantities with variable input prices for all the three samples. We included two variable input prices: the unit cost of labour (PLABOR) and the ratio of other operating costs (non-interest costs excluding labour expenses) to total assets (POTHER). The results are consistent with our previous findings and the negative impact of e-banking on unit revenues is robust (Table 8, columns iv-vi).

The analysis of the non-standard revenue function suggest that the provision of e-banking services has produced a negative effect on per customer revenues. Given the structure of the revenue function, this effect is driven by the lower prices charged to services delivered electronically because the levels of financial assets and the total number of bank customers are held constant. The finding suggests that customers have substituted within the same bank branch transactions with e-banking transactions and that the lower prices charged for e-banking transactions have not been compensated by a large enough increase in the overall number of transactions. This interpretation is consistent with information on the prices charged by "click and mortar banks" for e-banking services, based on case studies and occasional surveys. The survey conducted by the Bank of Italy on Internet banking in Italy indicates that 40 per cent of the banks offering e-banking charge lower prices on all types of on-line transactions than on the equivalent branch transactions. One half of the banks surveyed reported charging lower prices on some of their on-line services. Only one tenth responded that they charged the same price for face-to-face and the corresponding Internet transactions.

A caveat that should be kept in mind in interpreting the results is that the sample period covers the take-off of Internet banking and this may be reflected in very aggressive pricing strategies that do not represent equilibrium conditions. Although we do not have evidence

consistent with this view, in the Bank of Italy survey for 2001 banks reported that marketing financial products with new characteristics was the primary objective of their e-banking strategies.

6. Conclusion

In this study we investigated the existence of complementarities between the physical delivery of banking services at traditional branches and the provision of on-line banking services, employing a new data-set on Italian banks' operations in a large set of local markets. We test the widely held view that electronic delivery is a complement to branches and that the "click and mortar" banking model is in a better position to extract the consumer surplus generated by the new technologies. Due to the lack of data on prices and quantities of services delivered through alternative channels by each bank, we resorted to two indirect testing procedures.

We first analyzed the pattern of diffusion of e-banking customers of "click and mortar" banks across local markets to test three alternative hypotheses. The complements hypothesis predicts a positive relationship between branches and the number of e-customers, once the total number of customers is controlled for, meaning that consumers value the size of the branch network when they make a decision about establishing an electronic connection to a bank. The substitution hypothesis predicts a negative effect of branches on the diffusion of e-banking, meaning that consumers choose more frequently to establish an electronic connection with a bank when that bank has a smaller branch network in the relevant local market. Ceteris paribus, the preference for e-banking is driven by transaction costs. The segmentation hypothesis states that the two bundles of services - traditional and electronic - are perceived as independent by consumers, whose choices on e-banking are unrelated to the quality of the branch network.

Our results are not consistent with complementarity between branch and electronic access to banking services, suggesting the dominance of the substitution hypothesis for most of the range of the data in terms of branches. Consumers tend to demand, ceteris paribus, more e-banking connections from banks that have a smaller number of branches. A different regime

appears to hold in markets where banks have a disproportionately large branch network since the elasticity of e-banking to branches turns positive, possibly because of reputation effects.

In the second part of the analysis we explored indirectly the impact of e-banking on the revenues that banks can extract from each consumer, focusing exclusively on the revenues generated by brokerage and asset management services and payments, which are the services that Italian banks provide electronically. Our results suggest that a high share of e-customers, given the size of the customer base, is associated with a fall in revenues per customer, suggesting that banks did not extract surplus from the joint provision of traditional and electronic services in the period examined.

The two results are consistent with two possible explanations. The first is that e-banking is not strictly characterized by complementarities with traditional banking and that a substantial component of the advantage of the "click and mortar" model depends on the initial customer base of these banks. A second explanation is that past pricing policies have reflected strategic motives and that prices reflected disequilibrium conditions in the industry. In the first scenario e-banking is viable as long as cost reductions follow the expansion of e-accounts and/or higher value added services are supplied. Such scenario is consistent with the overall reassessment of the "click and mortar" model under way in the banking industry, several large European banks having announced major restructuring plans to downsize their branch networks and enhance their e-banking facilities in terms of quality and tailoring of services.

Tables

Table 1
Number of banks offering e-banking and phone banking services to households

Number of banks offering services through personal computer connections (e-banking) or phone calls (phone-banking). Transactional services are those in which the customer is allowed to use the remote connection to send orders that will be executed by the banks. Large banks are those with total assets greater or equal to 20 billion euros, medium-sized banks are those with total assets between 7 and 20 billion euros. Branches of foreign banks are excluded. Figures are end-of-period data.

	1998	1999	2000	2001
Large banks				
e-banking services	6	8	10	13
-transactional	5	6	10	13
phone banking services	7	8	9	9
-transactional	7	7	8	8
Total number of large banks	***16***	***16***	***18***	***18***
Medium-sized banks offering				
e-banking services	11	13	14	17
-transactional	11	12	14	17
phone banking services	6	8	6	9
-transactional	3	4	4	6
Total number of medium-sized banks	***27***	***29***	***26***	***27***
Credit cooperative banks offering				
e-banking services	91	190	299	341
-transactional	82	176	290	334
phone banking services	78	81	107	96
-transactional	2	5	15	14
Total number of credit cooperative banks	***566***	***532***	***498***	***474***
Other small banks offering				
e-banking services	61	73	118	143
-transactional	53	66	115	138
phone banking services	28	35	51	50
-transactional	7	12	22	28
Total number of other small banks	***246***	***234***	***231***	***240***
Total banks				
e-banking services	169	284	441	514
-transactional	151	260	429	502
phone banking services	119	132	173	164
-transactional	19	28	49	56
Total number of banks	***855***	***811***	***773***	***759***

Source: Bank Supervisory Reports.

Table 2
Share of e-banking and phone banking customers by type of bank

Number of customers belonging to the household sector using e-banking or phone-banking services as a percentage of the total number of bank depositors. Data are collected at the bank level so an individual with relationships with more than one bank is counted as many times as the number of relations. Transactional services are those in which the customer is allowed to use the remote connection to send orders that will be executed by the banks. Large banks are those with total assets greater or equal to 20 billion euros, medium-sized banks are those with total assets between 7 and 20 billion euros. Branches of foreign banks are excluded. Figures are end-of-period data.

	1998	1999	2000	2001
Large banks				
e-banking services	0.12	0.76	2.06	6.48
-transactional	0.11	0.72	1.66	5.25
phone banking services	3.04	4.06	7.58	7.12
-transactional	0.03	0.03	0.07	0.07
Medium-sized banks				
e-banking services	0.32	0.49	2.42	8.35
-transactional	0.20	0.28	2.06	6.87
phone banking services	1.17	3.75	2.86	1.75
-transactional	0.01	0.01	0.01	0.01
Credit cooperative banks				
e-banking services	0.08	0.39	1.65	2.85
-transactional	0.06	0.32	1.35	2.51
phone banking services	5.38	5.45	5.73	5.61
-transactional	0.00	0.00	0.00	0.00
Other small banks				
e-banking services	0.52	0.39	6.08	12.82
-transactional	0.41	0.33	5.49	11.31
phone banking services	8.03	10.50	10.85	14.67
-transactional	0.01	0.04	0.07	0.12

Source: Bank Supervisory Reports.

Table 3
Share of e-banking and phone banking customers by geographical area

Number of customers belonging to the household sector using e-banking or phone-banking services as a percentage of the total number of bank depositors. Data are collected at the bank level so an individual with relationships with more than one bank is counted as many times as the number of relations. Figures are end-of-period data and do not include those reported by branches of foreign banks.

	1998	1999	2000	2001
Northern regions				
e-banking services	0.36	0.57	3.12	8.38
-transactional	0.26	0.46	2.47	6.92
phone banking services	5.18	6.71	7.15	7.55
-transactional	0.02	0.03	0.05	0.06
Central regions				
e-banking services	0.24	0.78	3.59	10.20
-transactional	0.21	0.73	3.22	8.78
phone banking services	3.47	4.92	7.08	8.25
-transactional	0.02	0.03	0.05	0.07
Southern regions				
e-banking services	0.06	0.46	2.17	6.36
-transactional	0.05	0.41	1.85	5.60
phone banking services	2.19	3.57	5.92	7.77
-transactional	0.02	0.02	0.05	0.07
Italy				
e-banking services	0.26	0.59	2.97	8.22
-transactional	0.20	0.50	2.46	6.95
phone banking services	4.05	5.55	6.81	7.75
-transactional	0.02	0.03	0.05	0.06

Source: Bank Supervisory Reports.

Table 4
Composition of bank revenues

Interest revenues on checking accounts are estimated as the product of the stock of checking deposits and the 3-month money market rate minus the actual interest payments made by the bank to the depositors. Revenues from payment services and from investment and management services are obtained as the difference between fees and commissions receivable and fees and commission payable. Large banks are those with total assets greater or equal to 20 billion euros. medium-sized banks are those with total assets between 7 and 20 billion euros. Branches of foreign banks are excluded. Figures are end-of-period data.

	1998	1999	2000	2001
Large banks				
Net interest income	58.9	54.2	49.1	50.4
- checking accounts (estimate)	16.0	12.6	16.4	13.5
Non interest income	41.1	45.8	50.9	49.6
-payment services	3.7	4.0	4.0	4.6
-investment and asset management	13.1	16.3	16.0	11.5
Gross income	100.0	100.0	100.0	100.0
Medium-sized banks				
Net interest income	58.9	55.6	51.4	57.9
- checking accounts (estimate)	14.4	11.0	17.0	14.9
Non interest income	41.1	44.4	48.6	48.1
-payment services	5.2	5.6	4.8	5.1
-investment and asset management services	11.2	14.8	18.3	12.3
Gross income	100.0	100.0	100.0	100.0
Credit cooperative banks				
Net interest income	72.8	74.4	76.1	78.2
- checking accounts (estimate)	12.0	9.6	16.7	15.1
Non interest income	27.2	25.6	24.0	21.8
-payment services	4.6	5.5	5.9	6.3
-investment and asset management	4.1	5.9	7.9	5.0
Gross income	100.0	100.0	100.0	100.0
Other small banks				
Net interest income	62.4	60.3	58.2	59.5
- checking accounts (estimate)	12.8	9.6	15.1	13.2
Non interest income	37.6	39.7	41.8	40.5
-payment services	4.5	5.0	5.4	6.0
-investment and asset management	9.4	11.5	13.3	9.6
Gross income	100.0	100.0	100.0	100.0
Total banks				
Net interest income	60.6	57.0	52.8	55.2
- checking accounts (estimate)	14.7	11.5	16.3	13.8
Non interest income	39.4	43.0	47.2	44.8
-payment	4.3	4.8	4.5	5.0
-investment and asset management	11.2	14.4	15.5	19.9
Gross income	100.0	100.0	100.0	100.0

Source: Bank Supervisory Reports.

Table 5
Definitions of variables and descriptive statistics

The sample includes only banks that were supplying both e-banking and traditional services. Cooperative banks are excluded. Each observation refers to bank-market-year.

Symbol		Mean	Min	Max	S. dev.
	Dependent Variables				
LNE-CUSTMKT	Natural log of the number of customers with electronic access of bank i in market j at time t.	2.715	0	10.822	2.298
E-CUSTMKT	Number of customers with electronic access of bank i in market j at time t.	331.4	0	50104	1786.1
LNTOTCMKT	Natural log of the total number of checking accounts of bank i in market j at time t.	4.205	0	13.554	4.214
TOTCMKT	Total number of checking accounts of bank i in market j at time t.	6880.9	0	769659	26543.8
	Explanatory Variables				
LNMORTGAGE	Natural log of the volume of household mortgages of bank i in market j	1.533	0	7.789	1.651
LNBRANCHMKT	Log of the number of branches of bank i in market j.	0.947	0	5.583	1.204
HERFDEP_1	Provincial Herfindahl index of deposit concentration at the end of previous year.	0.165	0.049	0.527	0.070
POSPOP_1	Number of Points of Sale of market j at time t-1 divided by population (in 1.000)	9.147	0.738	36.248	5.029
LNSHAREMKT_1	Log of the volume of shares held in households' portfolios at banks in market j, end-of previous year stocks	7.864	0	17.492	3.790
PCHOUSE	Share of households with a PC (regional)	29.64	13.6	42.1	7.231
LNVADDED	Natural log of per capita province value added (1,000 euro).	9.101	7.138	11.627	0.869
LNPOP	Natural log of population in the province (1,000).				
SHURBAN	Share of population living in the main city of the province (1998).	28.545	8.642	15.357	87.638
ROADS	Kilometers of roads to the area in 1,000 square kilometers, regional.	28.87	15.85	42.82	4.89
POPMOUNTAIN	Share of the population living in towns located at more than 600 meters above the sea level (1998).	0.064	0	0.797	0.128
EDUCATION	Natural log of the number of people with a high school diploma or higher (1998).	37.29	22.40	49.459	4.183
ORIGIN	Equal to 1 if bank i is chartered in market j, 0 otherwise.	0.046	0	1	0.209
BRANCHMKT	Number of branches of bank i in market j	6.063	0	265	16.911
N. of banks	169				
N. observations	8023				

Table 6-A
Bank-market test, main results

Bank dummy variables are included. Estimated with 2SLS; robust standard errors below coefficients. Standard errors are corrected for clustering at the local market level. The panel is unbalanced. Bank-market cells with no customers and no branches are dropped.

Equation (1)		Equation (2)	
Explanatory Variables	LNE-CUSTMKT	Explanatory Variables	LNTOTCMKT
LNTOTCMKT	0.406 ***	LNE-CUSTMKT	-0.022
	0.022		*0.348*
LNBRANCHMKT	-0.790 ***	LNBRANCHMKT	4.436 ***
	0.130		*0.352*
LNBRANCHMKT_SQ	0.273 ***	LNBRANCHMKT_SQ	-0.828 ***
	0.022		*0.045*
LNVADDED	-0.014 *	LNVADDED	0.013 **
	0.008		*0.006*
EDUCATION	0.005	EDUCATION	-0.002
	0.004		*0.004*
PCHOUSE	-0.002	LNPOP	-0.093
	0.005		*0.059*
POSPOP_1	0.010 ***	LNMORTGAGE	1.121 ***
	0.003		*0.164*
LNSHAREMKT_1	0.121 ***	SHURBAN	0.001
	0.019		*0.001*
SHURBAN	-0.000	HERFDEP_1	-0.039
	0.001		*0.237*
POPMOUNTAIN	0.025	ORIGIN	-1.241
	0.074		1.190
ROADS	0.003	ORIGIN*LNBRANCHMKT	0.661 *
	0.003		*0.338*
HERFDEP_1	-0.351 *	DU99	-0.124
	0.191		*0.664*
ORIGIN	1.318 ***	DU00	0.168
	0.299		*0.296*
ORIGIN*LNBRANCHMKT	-0.406 ***	CONSTANT	0.685 **
	0.082		*0.300*
DU99	-1.812 ***		
	0.087		
DU00	-0.959 ***		
	0.046		
CONSTANT	0.317		
	0.242		
Adjusted R-squared	*0.775*	Adjusted R-squared	*0.934*
F(14, 7840)	*1040.5*	*F(15, 7839)*	*3276.6*
Number of obs.	*8023*	*Number of obs.*	*8023*

Note: Statistically different from zero, respectively, at: *** 1%. **5% and *10% significance level.

Table 6-B
Bank-market Test, no Restrictions on expansion

Bank dummy variables are included. Estimated with 2SLS; robust standard errors below coefficients. Standard errors are corrected for clustering at the local market level. The panel is unbalanced. Bank-market cells with no customers and no branches are included.

Equation (1)		Equation (2)	
Explanatory Variables	LNE-CUSTMKT	Explanatory Variables	LNTOTCMKT
LNTOTCMKT	0.457 ***	LNE-CUSTMKT	-0.096
	0.023		*0.191*
LNBRANCHMKT	-1.004 ***	LNBRANCHMKT	4.914 ***
	0.148		*0.217*
LNBRANCHMKT_SQ	0.316 ***	LNBRANCHMKT_SQ	-0.907 ***
	0.026		*0.041*
LNVADDED	-0.007 *	LNVADDED	0.003 *
	0.004		0.002
EDUCATION	0.005 **	EDUCATION	-0.002
	0.002		*0.001*
PCHOUSE	0.001	LNPOP	-0.018
	0.002		*0.019*
POSPOP_1	0.003 *	LNMORTGAGE	1.058 ***
	0.002		*0.101*
LNSHAREMKT_1	0.063 ***	SHURBAN	-0.000
	0.007		*0.001*
SHURBAN	0.001	HERFDEP_1	0.013
	0.001		*0.067*
POPMOUNTAIN	0.021	ORIGIN	-0.961
	0.034		1.066
ROADS	-0.001	ORIGIN*LNBRANCHMKT	0.579 *
	0.001		*0.319*
HERFDEP_1	-0.157 *	DU99	-0.079
	0.084		*0.106*
ORIGIN	0.814 *	DU00	-0.003
	0.433		*0.060*
ORIGIN*LNBRANCHMKT	-0.343 ***	CONSTANT	0.178 **
	0.116		*0.090*
DU99	-0.511 ***		
	0.039		
DU00	-0.332 ***		
	0.023		
CONSTANT	-0.287		
	0.133		
Adjusted R-squared	*0.805*	Adjusted R-squared	*0.950*
F(14, 7840)	*818.2*	*F(12,28272)*	*4788.7*
Number of obs.	*28453*	*Number of obs.*	*28453*

Note: Statistically different from zero, respectively, at: *** 1%. **5% and *10% significance level.

Table 6-C
Bank-market test, Model with market fixed effects

Bank dummy variables and market fixed effects are included (coefficients are not shown). Estimated with 2SLS; robust standard errors below coefficients. Standard errors are corrected for clustering at the local market level. The panel is unbalanced. Bank-market cells with no customers and no branches are dropped.

Equation (1)		Equation (2)	
Explanatory Variables	LNE-CUSTMKT	Explanatory Variables	LNTOTCMKT
LNTOTCMKT	0.393 ***	LNE-CUSTMKT	-1.635 **
	0.022		*0.812*
LNBRANCHMKT	-0.662 ***	LNBRANCHMKT	5.985 ***
	0.131		*0.814*
LNBRANCHMKT_SQ	0.246 ***	LNBRANCHMKT_SQ	-0.942 ***
	0.023		*0.065*
LNVADDED	0.117 **	LNVADDED	0.033
	0.049		0.071
PCHOUSE	0.009	LNPOP	4.850
	0.008		*4.618*
POSPOP_1	0.015	LNMORTGAGE	1.840 ***
	0.014		*0.363*
LNSHAREMKT_1	-0.041	HERFDEP_1	-0.056
	0.049		*1.155*
HERFDEP_1	-0.950	ORIGIN	-0.087
	1.417		1.371
ORIGIN	1.157 ***	ORIGIN*LNBRANCHMKT	0.504
	0.309		*0.357*
ORIGIN*LNBRANCHMKT	-0.339 ***	DU99	-3.241 **
	0.085		*1.492*
DU99	-1.584 ***	DU00	-1.211 *
	0.162		*0.646*
DU00	-0.702 ***	CONSTANT	-34.352
	0.098		*35.097*
CONSTANT	-0.437		
	1.277		
Adjusted R-squared	*0.776*	Adjusted R-squared	*0.936*
F(101, 7741)	*10336.7*	*F(15, 7839)*	*92113.9*
Number of obs.	*8023*	*Number of obs.*	*8023*

Note: Statistically different from zero, respectively, at: *** 1%. **5% and *10% significance level.

Table 7
Revenue analysis: definitions of variables and descriptive statistics

All financial variables are measured in thousands of euros. Statistics refer to an unbalanced panel of 809 banks between 1998 and 2001. The number of observations is 2799.

Symbol		Mean	Min	Max	S. dev.
	Dependent Variable				
LNREV	Natural log of the revenues from investment and asset management services, payment services and deposits in checking accounts.	7.699	2.447	14.497	1.891
	Explanatory Variables				
LNOTHSEC	Natural log of the volume of securities held in custody at the bank by customers; shares excluded.	11.084	0	18.606	2.491
LNSHARES	Natural log of the volume of shares held in custody at the bank by customers.	7.275	0	16.103	3.338
LNSECMAN	Natural log of the volume of mutual fund shares and other securities for which the bank provides asset management services	4.907	0	17.943	5.500
LNDEPBK	Natural log of the volume of deposits in checking accounts	10.867	5.482	17.536	1.771
LNSTAFF	Natural log of the number of staff.	4.161	1.098	10.444	1.633
LNBRANCHBK	Natural log of the number of branches.	2.279	0	7.712	1.312
LNINVPROF	Natural log of the number of investment professionals.	0.328	0	9.216	1.040
LNPOS	Natural log of the number of “points of sale” .	3.579	0	11.515	2.612
LNPLABOR	Natural log of the per unit labor expenses.	4.011	2.823	6.528	0.163
LNPOTHER	Natural log of the ratio of non-interest non-staff expenses to total assets.	-4.240	-6.797	-0.349	0.317
LNTOTCBK	Natural log of the number of customers with a checking account at the bank.	8.823	0.693	15.020	1.690
LNE-CUSTBK	Natural log of the number of customers with an account enabled for transactions through a PC connection.	2.036	0	12.955	2.634
LNPHONEBK	Natural log of the number of customers with an account enabled for transactions by phone.	0.347	0	12.583	1.704

Table 8
Non-standard revenue function

Regressions are estimated on an unbalanced panel of individual yearly bank data over the period between 1998 and 2001. Joint producers are banks that are active in both the traditional and remote banking business. The restricted sample is obtained excluding community banks from the full sample.

Dependent variable:	Specification:			Specification:		
LNREV	Input quantities			Input prices		
	Full sample (i)	Joint producers (ii)	Restricted sample (iii)	Full sample (iv)	Joint producers (v)	Restricted sample (vi)
LNSHARES	-0.004	-0.013	-0.022	-0.004	-0.003	-0.022
	0.006	*0.020*	*0.014*	*0.006*	*0.0194*	*0.014*
LNSHARES_SQ	0.001	0.001	0.002	0.001	0.001	0.002
	0.001	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*
LNOTHSEC	-0.029 **	0.012	0.061	-0.041 ***	0.019	0.025
	0.014	*0.042*	*0.064*	*0.014*	*0.040*	*0.065*
LNOTHSEC_SQ	0.004 ***	0.003	-0.002	0.005 ***	0.002	0.001
	0.001	*0.003*	*0.003*	*0.001*	*0.002*	*0.003*
LNSECMAN	-0.001	-0.001	-0.002	-0.001	-0.007	-0.003
	0.004	*0.012*	*0.005*	*0.004*	*0.012*	*0.005*
LNSECMAN_SQ	0.001 *	0.001	0.001 *	0.001 *	0.001	0.002 **
	0.000	*0.001*	*0.001*	*0.000*	*0.001*	*0.001*
LNDEPBK	0.747 ***	0.506 ***	0.697 ***	0.763 ***	0.348 ***	0.690 ***
	0.075	*0.121*	*0.097*	*0.078*	*0.126*	*0.108*
LNDEPBK_SQ	-0.012 ***	-0.001	-0.003	-0.010 ***	0.007	0.001
	0.004	*0.006*	*0.005*	*0.004*	*0.006*	*0.005*
LNTOTCBK	0.128 ***	0.150 ***	0.038 **	0.150 ***	0.136 ***	0.075 **
	0.019	*0.028*	*0.031*	*0.018*	*0.025*	*0.030*
LNE-CUSTBK	-0.004 *	-0.007 *	-0.014 ***	-0.004 *	-0.008 **	-0.014 ***
	0.002	*0.004*	*0.004*	*0.002*	*0.004*	*0.004*
LNPHONEBK	-0.007 **	-0.006	-0.002	-0.007 **	-0.002	-0.003
	0.003	*0.005*	*0.004*	*0.003*	*0.006*	*0.004*
LNSTAFF	0.093 **	-0.065	0.182 **	-	-	-
	0.038	*0.069*	*0.055*	-	-	-
LNBRANCHBK	0.108 ***	0.146 **	0.072	-	-	-
	0.035	*0.060*	*0.049*	-	-	-
LNINVPROF	-0.002	-0.001	-0.004	-	-	-
	0.006	*0.009*	*0.007*	-	-	-
LNPOS	0.008 *	0.016 **	0.012 **	-	-	-
	0.004	*0.007*	*0.006*	-	-	-
LNPLABOR	-	-	-	0.220 ***	0.503 ***	0.010
	-	-	-	*0.039*	*0.071*	*0.054*
LNPOTHER	-	-	-	-0.034	-0.264 ***	0.012
	-	-	-	*0.031*	*0.051*	*0.049*
Adj. R^2	0.996	0.994	0.998	0.996	0.995	0.998
N. of obs.	2799	878	1312	2799	878	1312
N. of banks	809	274	529	809	274	529

Note: Statistically different from zero, respectively, at: *** 1%. **5% and *10% significance level.

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