GEOGRAPHICAL ORGANIZATION OF BANKING SYSTEMS AND INNOVATION DIFFUSION

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1 Introduction

The objective of this chapter is to examine the impact of the geographical distribution of a country's banking system on the diffusion of process and product innovations across firms.

Innovation is the first pillar of the Lisbon strategy for boosting the competitiveness of the European Union and achieving the target of full employment. In a globalized and fast–changing economy, it is argued, European companies must increase R&D spending in order to ride competition successfully and they have to speed up the diffusion of new technologies and the introduction of new products. To this end, the removal of all impediments to the creation and adoption of innovation is a key policy issue.

A frequently mentioned hindrance to the diffusion of innovation is access to external financial resources. As argued, investments aimed at changing the firm's production process, introducing a new technology or launching a new product are typically riskier than investments in the established activity of the firm. Moreover, they are characterized by a great content of proprietary information on future profitability, are firm–specific and contain a large part of intangible assets which can hardly be pledged as collateral to secure loans. All such features make the information gap to banks (as non–specialized financiers) wider, dissuading them from funding innovative projects on fair terms.

The empirical literature is largely supportive of the importance of financial constraints for the adoption of innovation by firms[1]. A number of recent studies have considered the finance–innovation nexus by using the first, second and third "Community Innovation Survey" carried out by the European Union and Eurostat on firms in EU area countries. From these studies it emerges that the decision of a firm to introduce and complete an innovation is positively correlated with its cash–flow and negatively correlated with the lack of appropriate sources of finance as perceived by firms (Canepa and Stoneman 2002, Mohnen and Roller 2005, Savignac 2006, Mohnen et al. 2008). Moreover, insufficient finance shows a high degree of complementarity with other hampering factors like the perceived risk by firms, innovation costs (Galia and Legros 2004) or insufficient skilled personnel, lack of cooperation with other firms and regulatory obstacles (Mohnen and Roller 2005).

However, by focusing on the effects of financial constraints on the firm's choice of innovating, such studies do not tell us whether the difficulties of funding innovative projects are demand–

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[1] See Hall (2005) for a review

or supply–driven and, consequently, do not provide insights on how to remove financial impediments to innovation.

Closely related to our research question, three major contributions by Ferri and Rotondi (2006), Herrera and Minetti (2007) and Benfratello et al. (2008) attempt to sort out to what extent the supply of finance affects the adoption of innovation by a representative sample of Italian manufacturing firms. Since these studies identify local banking development and relationship lending as possible determinants of firms' propensity to innovate and extract the firm–level information from the same source we use — the surveys run every three years by the Observatory of Small and Medium Enterprises affiliated to the Italian banking group Unicredit —, their findings are directly comparable with ours.

Benfratello et al. (2008) measure the degree of development of the local banking system with the number of branches divided by population at the provincial level and find that, over the period 1992–2000, the probability of introducing an innovation is significantly higher for firms headquartered in provinces where the branch density is higher. Such a positive effect of branch density proves to be more robust for process than for product innovation and greater for small, financially dependent, high–tech firms. Moreover, it maintains its statistical significance once the endogeneity of branch density is addressed by using instrumental variable estimations.

However, Benfratello et al. (2008) do not control for any other characteristics of the local banking system (e.g., the degree of market concentration) or for other aspects of the bank–firm relationship. The latter is the focus of the study conducted by Herrera and Minetti (2007). The authors consider only the 8th Unicredit survey covering the period 1998–2000 and document that, once instrumented, the length in years of the credit relationship with the main bank is positively correlated with the probability of a firm introducing innovation. Unlike Benfratello et al. (2008), Herrera and Minetti find that it is the likelihood of product innovation which is more sensitive to relationship banking. Moreover, they find that the branch density and degree of credit market concentration in the province, as well as regional financial development, do not significantly affect the decision to innovate[2].

Ferri and Rotondi (2006) extend the study by Herrera and Minetti by adding data from the most recent Unicredit survey (covering the period 2001–2003), augmenting the model with the firm's financial structure and other control variables and distinguishing between firms operating in or outside industrial districts. On the whole, their findings confirm results obtained by Herrera and Minetti (2007), suggesting in addition that the duration of the bank relationship also strongly affects the likelihood of process innovation. They also find that branch density is slightly positively correlated with process innovation, while the Herfindahl–Hirschman index computed on bank loans reduces the probability of introducing product innovation.

Summing up, after controlling for the specific bank–firm relationship, empirical evidence gives limited support to the positive effect of the size and performance of the local banking system on the diffusion of innovation across local firms in Italy.

In this chapter we further investigate the role of the geographical distribution of banks and argue that what matters for boosting innovation is not the number of branches working in the province but their organizational structure and distance from banks' decisional centres. In particular, our contribution with respect to the existing literature is twofold.

First, we estimate the likelihood of a firm introducing an innovation by controlling for the functional distance of the local banking system in addition to the provincial branch density and the length of the bank relationship. In our approach, we define "functional distance" as the distance between local branches and headquarters of their parent banks (Alessandrini et al.

[2]Herrera and Minetti (2007) measure the financial development of Italian regions as the (estimated) relative easiness of local households of accessing credit, following Guiso et al. (2004)

2005)[3]. Our hypothesis is that such a distance internal to a bank matters for firms wishing to fund informationally opaque projects as is the introduction of an innovation. The larger the number of small firms in the economy and the greater the heterogeneity across local productive systems, the greater this adverse effect is expected to be. On this ground, the empirical evidence of the Italian bank-firm relationship presented in this chapter can be viewed as a representative case-study.

Our second contribution concerns the issue of causality. Although Ferri and Rotondi (2006), Herrera and Minetti (2007) and Benfratello et al. (2008) already addressed this issue by using instrumental variable estimation methods, they only instrumented their own key explanatory variable, that is either the size of the local banking system or the length of the bank relationship, and not the other financial variables. Since both the size and the distance of the local banking system, as well as the duration of the ties with the main bank, are all potentially endogenous to the innovation propensity of firms, in this chapter we estimate a model in which the three financial variables are jointly instrumented.

These are the main results we obtain. While branch density and the length of the credit relationship have the positive causal effect on innovation found by Herrera and Minetti (2007) and Benfratello et al. (2008) when considered singularly, after controlling for functional distance they lose statistical significance in favour of the former. This is especially true when we focus on the adoption of new technologies which typically entails fixed investments and a large amount of external finance, and attributes great importance to secrecy. Product innovations, which require a lower degree of secrecy and expose firms to hold–up problems to a lesser extent than process innovations, are also driven by a long relationship with the main bank.

The rest of the paper proceeds as follows. Section 2 provides a selective review of the literature on geographical distribution of banks and lending policies. Section 3 illustrates the recent evolution of the geography of the Italian banking system. Section 4 presents the data set and the variables employed in the empirical analysis. In Section 5 we discuss our results and draw conclusions in Section 6.

2 Why should the geographical distribution of banks' decisional centers matter? Theory and evidence.

Consolidation and globalization of banking industry experienced all over the world in the last decades has conducted to the agglomeration of main banks' decisional centers in few large metropolitan areas within each country. There are two kind of network externalities that lean towards clustering decisional centers of large, global enterprises: the exchange of formal and informal information on market opportunities and the availability of high–quality human, firm and transport services (Henderson and Davis 2004, Strauss-Kahn and Vives 2005, Bel and Fageda 2008).

The intense debate that preceded and accompanied the process of financial integration of the European and U.S. banking industry in the 1990s mostly emphasized the benefits of strengthened competition in credit markets, greater efficiency and expanded lending capacity of banks. By contrast, the costs of the predictable geographical concentration of decisional centers that came with the wave of bank mergers and acquisitions were greatly neglected. In fully integrated markets, it was typically claimed, the geographical reach of banking groups through affiliated banks and branches, as well as the mobility of financial flows would have assured an adequate response to the needs of local economies, leaving no room for the location of bank decisional

[3] Others have suggested the alternative labels of organizational and hierarchical distance (Jimenez et al. 2007, Mistrulli and Casolaro 2008).

centers. Admittedly, there could have been episodes in which liberalization and consolidation of banking structures negatively should have impacted on small firms operating far from financial centres. However, these episodes would have been limited in size and temporary, almost completely offset by the reaction of other local banks increasing the supply of relationship lending to small firms and the entry of de novo banks tapping market segments given up by consolidated banks. The distance between the lending office and the "thinking head" of its own parent bank should not have had any appreciable adverse consequence on credit allocation and the development of local economies[4].

The current view of the effects of bank consolidation is less clear–cut and optimistic than it was at the beginning of the '90s. A growing body of research emphasizes the importance of banking organizational form for lending policies (Berger and Udell (2002) and Udell, chapter 2 in this volume). What drives credit allocation, it is typically claimed, is not only the availability of effective information technologies or the possibility of personal face–to–face contacts with borrowers by dislocating branches in the same borrowers' area, but also the organizational complexity of the institution to which the loan office belongs. Put differently, the local branch of a large, nationwide bank competes and allocates resources differently from the branch of a small, local bank.

Underlying this hypothesis are the assumptions that information is widely dispersed throughout the bank organization and that communicating it is a costly and imperfect process. A crucial part of information on local borrowers is non–codified and recoverable only by loan officers of local branches with detailed knowledge of the particular environment within which they operate. It is the loan officer who has personal contacts with the borrower, lives in the same community, knows people and firms who do business with the latter, shares a common set of cultural values, social norms and business language. The capacity of selecting worthy projects depends on the officer's effort to combine hard with soft information. However, the amount of resources a loan officer devotes to acquiring soft information is not observable (Milbourn et al. 2001, Novaes and Zingales 2004) and, once collected, the available soft information cannot be inexpensively and unambiguously passed on to the upper layers of the parent bank (Garicano 2000, Stein 2002, Liberti and Mian 2006). Unobservability of information investments and shortfalls in communication channels within the bank generate incentive problems and agency costs (Berger and Udell 2002, Stein 2002, Takáts 2004) which make local branches of hierarchical banks shy away from allocating resources to activities absorbing a lot of soft information, such as small business lending or innovation financing.

Recently, a number of studies have suggested that much organizational friction stems from the geographical dispersion of the bank organization from branches and subsidiaries, and that communication and incentive problems increase with the distance between hierarchical levels[5].

Functional distance reflects different physical and cultural factors. For example, it is reasonable to believe that the costs of monitoring loan officers per visit increase with geographical distance from the bank's headquarters where loan reviewers are employed. Similarly, reliability of communication and trust between managers at the parent bank and local loan officers decrease with the physical distance between the bank head office and the local branch, but also with the socio–cultural distance between the geographical areas where the staff of the bank's decisional center and operational peripheries work and live (Ichino and Maggi 2000).

Indications of the existence of agency and communication costs related to the functional

[4]Notable exceptions were Chick and Dow (1988), Martin (1989, 1994), Dow (1994, 1999) and Alessandrini and Zazzaro (1999) who forcefully argued that the costs of bank consolidation and agglomeration of decisional centers would have been not at all temporary and could trigger vicious circles entrapping peripheral areas and local firms in low growth equilibria.

[5]Complementary reviews of this literature are presented in this volume by Udell (chapter 2) and by Cerqueiro et al. (chapter 4)

distance between the parent bank and its lending offices can be gained from several different pieces of research. A number of studies, for example, have provided evidence that both foreign and out–of–market owned banks have a disadvantage in screening small businesses and allocate fewer resources to such companies than domestic and in–market owned banks (Keeton 1995, Cole et al. 2004, Carter et al. 2004, Alessandrini et al. 2005, Carter and McNulty 2005, Mian 2006).

Other studies, consistent with the presence of incentive problems in geographically dispersed banks, found that: (i) the average time spent by a loan officer of nationwide banks in a specific branch is significantly lower (Ferri 1997); (ii) empowering loan officers increases the effort they devote to screening and monitoring borrowers, and improves the performance of the bank (Liberti 2003); (iii) the resources that the parent bank spends on loan reviewing activities is positively correlated with the organizational complexity of the bank and the degree of autonomy of local loan officers (Udell 1989).

More direct indications of the importance of distance–related bank organizational frictions were made available by a number of recent studies concerning different countries at different levels of financial and economic development. Looking at the U.S. multi–bank holdings, Berger and DeYoung (2006) found that cost and profit efficiency of affiliated banks are negatively correlated with the kilometric distance from the parent bank suggesting that geographic dispersion reduces the capacity of the bank holding to keep the resource allocation of each component of the bank group under control, even if advances in information and communication technologies seem to have reduced this deficiency over time.

Liberti and Mian (2006) analyzed a large multinational bank operating in Argentina and documented that the sensitivity of the amount of credit facility granted to soft (hard) information is lower (greater) for credit lines approved at a distant hierarchical level, consistent with the idea that communication frictions increase with distance between the communicating parties of the bank.

Using loan–level data from Pakistan, Mian (2006) found that the degree of engagement in relational contracts and lending to informationally opaque firms is greatest for branches of domestic banks, next greatest for branches of Asian banks and least for branches of non–Asian foreign banks. By contrast, he could find no significant effect of bank size on credit allocation and relational lending.

Consistent with the hypothesis that functionally distant banks specialize in lending to more transparent borrowers, Jimenez et al. (2007) showed that, for Spanish banks, the likelihood of the usage of collateral decreases with the distance between the province where the bank is headquartered and the province of the borrower, irrespective of the level of experience accumulated by the bank in the local market.

Working on Italian data, Alessandrini, Presbitero and Zazzaro (2008) found that small firms are relatively more financially constrained if they are located in provinces where a greater percentage of branches belong to banks headquartered in distant provinces and in provinces with different social and economic environments. Furthermore, Alessandrini, Calcagnini and Zazzaro (2008) found that in Italian bank acquisitions, the greater the cultural distance between the provinces where the dealing partners are headquartered, the greater are the changes in acquired banks' asset allocation in favor of large borrowers and transaction-based financial activities, at the expense of small, opaque borrowers.

Table 1: Italy: Number of banks

	Centre–North					South				
	Independent			In groups		Independent			In groups	
Year	*of which:*	*Mutual banks*	*Foreign banks*	*of which:*	*Mutual banks*	*of which:*	*Mutual banks*	*Foreign banks*	*of which:*	*Mutual banks*
1995	566	425	52	132	4	250	194	0	28	0
1996	536	406	50	135	4	235	186	0	30	0
1997	537	406	55	147	5	216	178	0	32	0
1998	534	396	59	155	5	192	169	0	45	0
1999	504	381	58	168	7	165	150	0	39	0
2000	479	366	58	180	7	144	133	0	41	0
2001	476	354	62	188	7	131	121	0	39	0
2002	462	346	60	197	8	124	116	0	33	0
2003	446	335	64	198	11	117	110	0	30	0
2004	437	329	60	196	11	118	110	0	29	0
2005	437	329	66	201	11	118	110	0	29	0

Notes: Our calculations on Bank of Italy data.

3 The changing geography of the Italian banking system

3.1 Branch diffusion and bank consolidation

Two contrasting spatial trends emerge from the evolution of the banking system over the last two decades in Italy. On the one hand, the number of branches has increased steadily over time, the 2007 total being twice that of 1990. Moreover, the birth and success of new distributional channels contributed to boost the spatial diffusion of the banking system[6]. On the other hand, the banking industry has been affected by a tough process of consolidation which ended up with a dramatic reduction in the number of banks and with the creation of large banking groups. The total number of banks gradually decreased, dropping from 1,156 in 1990 to the low of 780 at the end of 2004, then slightly increasing in recent years up to 808 banks in 2007. Moreover, the pace of decline in the number of banks was particularly fast for independent banks, especially in the South. This trend was partially contrasted by the rise in the foreign presence in the Italian banking market and by a growing number of banks affiliated to large banking groups (Table 1).

The first wave of mergers and acquisitions was strictly connected with the crisis of the major banks operating in southern Italian regions (Mattesini and Messori 2004, Zazzaro 2006). Since the mid–nineties, instead, most of the M&As in the Italian banking industry have been market–driven, aimed at reaching the economies of scale and scope required to combat the growing national and international competition in a globalized banking market (Messori and Zazzaro 2003). The peak of the consolidation process happened in the early years of the new millennium, when a number of major operations created nationwide distribution networks able to offer a full range of products. Subsequently, the banking industry underwent a process of reorganization, through the rationalization of distribution channels, branches, networks of sales staff and the introduction of new organizational models (Bank of Italy 2004)[7].

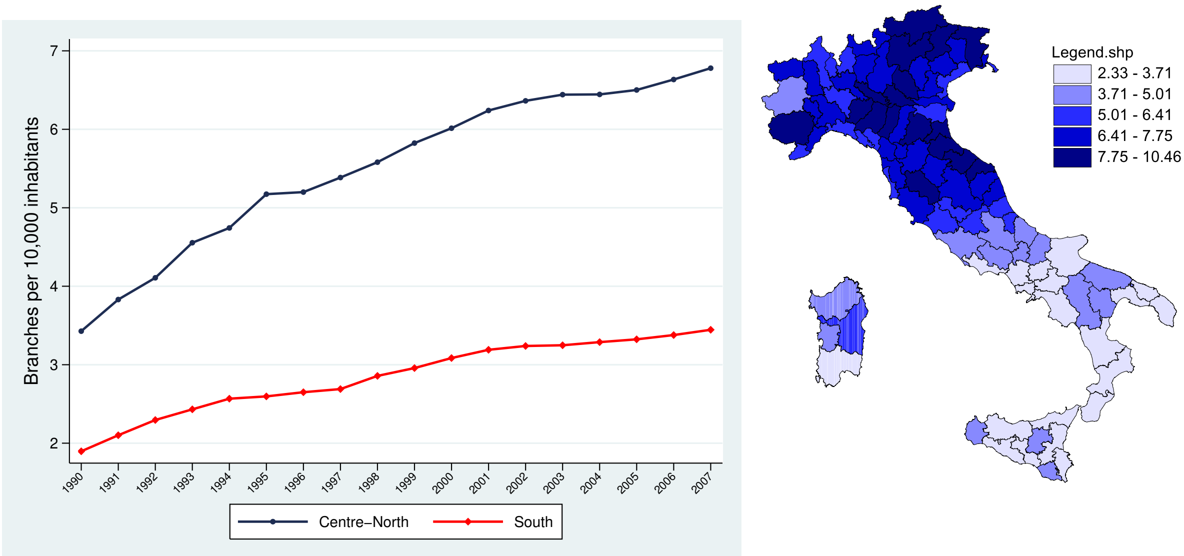
[6] According to the data drawn from the statistical database (BIP on–line) of the Bank of Italy, available at http://www.bancaditalia.it/statistiche, the number of ATMs in operation augmented from 25,546 in 1997 to 43,809 at the end of 2007 and, over the same time period, the number of the online retail (corporate) costumers increased from 65 (251) thousand to almost 12 (1.8) million and the number of phone banking costumers passed from one to 11 million

[7] In 2007, the consolidation process experienced another acceleration. The two largest operations gave birth to two big players, Intesa–San Paolo and Unicredit Group, with a national market share equal, respectively, to 20.2% and 17.3 and with a significant presence in Europe (Bank of Italy 2008). However, consolidation interested also affected the world of cooperative banks (*Banche Popolari*), with the creation of two very large mutual bank groups, Banco Popolare and UBI Banca, both with a large geographical spread with a network of 2,000 branches

The consequence of this twin process of geographical diffusion of branches and consolidation of bank organizations has produced an increase both in the size of the local banking systems and in their functional distance from the local economies. As shown in panel (a) of Figure 1, branch density has steadily grown all over the country during the period 1990–2007, but in southern regions at a lower pace than in the Centre–North. In fact, the number of branches per capita almost doubled during the observed period in the Centre–North, reaching almost 6.8 branches per 10,000 inhabitants, while the slower increase in southern provinces resulted in around 3.4 branches per 10,000 inhabitants in 2007. This has widened the gap between the two areas making the banking systems of almost all the provinces of the South still more undersized with respect to the served population (panel (b)).

More importantly, the number of branches working in the south of Italy and belonging to independent southern banks underwent a dramatic reduction from around 3,500 in the mid–1990s to about 1,000 in the new century. This has been the consequence of the acquisition of all the major southern banks by banking groups headquartered in the Centre–North that has caused the virtual disappearance of banking decisional centers from the South by greatly increasing the functional distance of the local banking systems[8].

Figure 1: Branch density in Italy



(a) Branch density: evolution (b) Branch density: 2007

Notes: Our calculations on Bank of Italy data and from ISTAT. Panel (a) plots the number of branches per 10,000 inhabitants over the period 1990–2007 in Centre–North and Southern regions. Panel (b) shows branch density in 2007 in the 95 Italian provinces, classified in quintiles.

3.2 Functional distance

As discussed in Section 1, functional distance concerns the distance between the local branch, where face–to–face dealings with borrowers take place, and the bank's decisional center (typ-

each.

[8] At the end of 2005, the number of banks in the South was equal to 147, of which 110 were mutual banks and 21 were affiliated to banking groups headquartered in the Centre–North (Table 1).

ically the registered office), where lending policies are fixed and the loan officer's work has to be reviewed. At the aggregate level, the functional distance of a banking system from a certain area (in our case defined according to the Italian administrative provinces) could be measured by the average physical or cultural distance separating local branches from their headquarters. More formally, $F\text{–}DISTANCE$ in province j can be calculated as:

$$F - DISTANCE_j = \frac{\sum_{b=1}^{B_j}[Branches_b \times \ln(1 + D_{j,z_b})]}{\sum_{b=1}^{B_j} Branches_b} \quad \text{with} j, z = 1, \ldots, 95 \qquad (1)$$

where B_j is the number of banks operating in province j and D_{j,z_b} is, alternatively, the kilometric and cultural distance separating the the branches belonging to the bank b ($Branches_b$) from the headquarter of its own parent bank located in province z (with $D_{j,j_b} = 0$)[9]. In particular, kilometric distances are calculated with a Jenness (2005) extension of the ArcView GIS software, while social capital is computed as the average voter turnout at the 21 referenda held in Italy in 1993, 1995 and 2001 as published by the Home Office[10].

Panels (a) and (c) of Figure 2 illustrates, respectively, the evolution of functional distance weighting branches with kilometric distance ($F\text{–}DISTANCE\_KM$) and with social capital differences ($F\text{–}DISTANCE\_SC$), in the Centre–North and in the South over the period 1990–2007.

Even if functional distance has increased almost in all provinces during the last twenty years, it reveals a large geographic heterogeneity. On average, $F\text{–}DISTANCE$ is much greater in the South that in the Centre–North, especially when measured in terms of social capital, and this regional disparity generally grew throughout the period[11]. In particular, the functional distance of the banking system from the South augmented significantly in the years before and after 2000, when the last medium–sized banks headquartered in the South were acquired by banks headquartered in the Centre–North, and then remained almost stable.

Finally, panels (b) and (d) point out the great degree of spatial heterogeneity of functional distance across Italian provinces, especially when considering differences in social capital. Notwithstanding the clear North–South divide, there are provinces in the North where local banking systems are as functionally distant as in the South. Besides, even in the "Mezzogiorno", the picture is not homogeneous, with some provinces exhibiting values of the functional distance indicators much lower than the regional average[12].

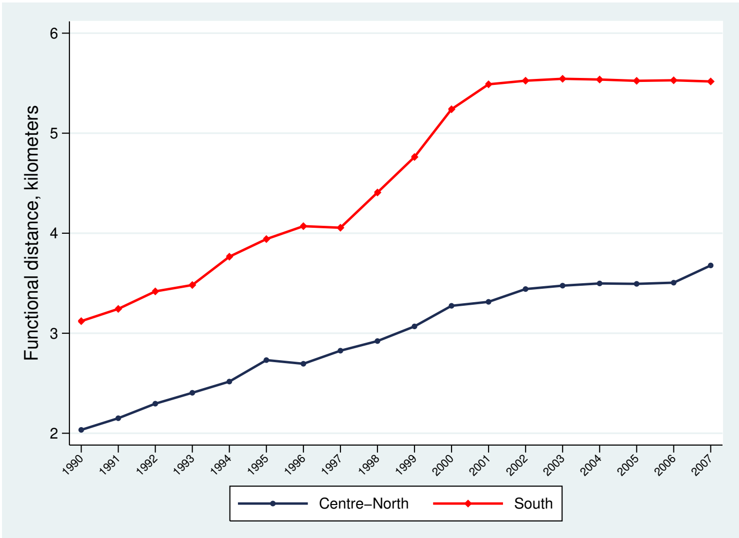
[9] Actually, our data do not allow us to disentangle how much decisional autonomy a chartered bank loses when it enters a banking group. In what follows, we assume that the ultimate control of local branches of affiliated banks is in the hands of the lead bank of the holding company. For robustness, we reproduce our empirical analysis building $F\text{–}DISTANCE$ indicators on the opposite assumption that the ultimate control on lending decisions is taken by the chartered bank. Estimation results remain substantially unaltered and are available on request from the authors. Finally, Italy is currently divided into 107 provinces, which are grouped into 20 administrative regions. However, since some provinces were recently constituted, we use the old classification of 95 provinces.

[10] Participation at referenda as indicator of social capital has been introduced by Putnam (1995) and employed in the banking literature amongst others by Guiso et al. (2004), Alessandrini, Calcagnini and Zazzaro (2008) and Alessandrini, Presbitero and Zazzaro (2008)

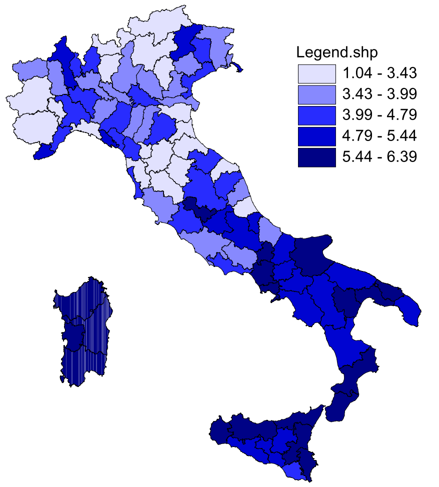
[11] More precisely, in 2006, $F\text{–}DISTANCE$ measured in term of social capital (kilometers) in the South was 2.4 (1.6) times greater than in the Centre–North, compared to a ratio of 1.9 (1.5) in 1990.

[12] Considering $F\text{–}DISTANCE\_SC$, the provinces of Aosta, Imperia and Trieste are examples of the former phenomenon, while Chieti, Matera, Sassari, Cosenza and Ragusa are amongst the southern provinces with level of functional distance below the average.

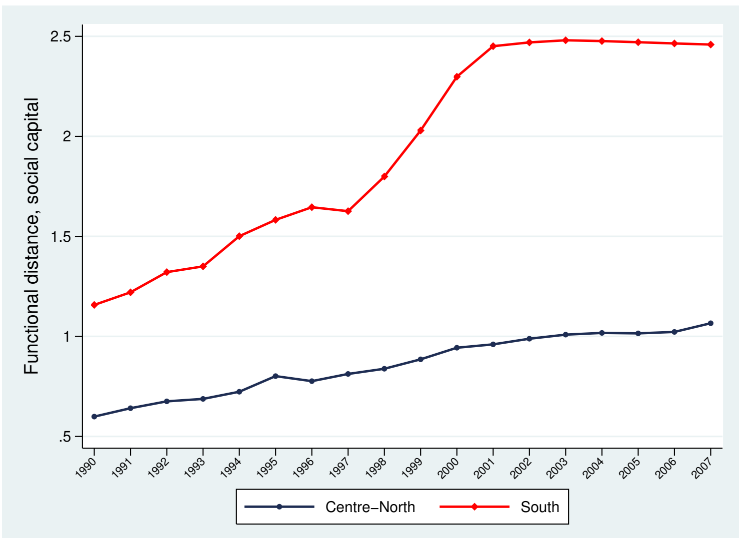
Figure 2: Functional distance in Italy



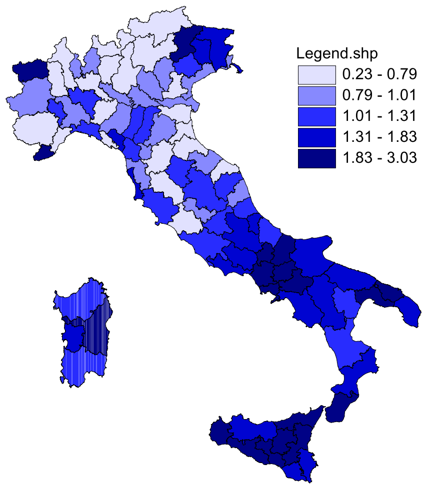
(a) Functional distance, kilometers: evolution



(b) Functional distance, kilometers: 2007



(c) Functional distance, social capital: evolution



(d) Functional distance, social capital: 2007

Notes: Our calculations on Bank of Italy data. Panels (a) and (c) plot the evolution of functional distance calculated, respectively, weighting branches by kilometers and social capital, over the period 1990–2007, in Centre–North and Southern regions. Panels (b) and (d) show, respectively, $F\text{–}DISTANCE\_KM$ and $F\text{–}DISTANCE\_SC$ 2007 in the 95 Italian provinces, classified in quintiles.

4 Data,variables and descriptive statistics

4.1 The dataset

We draw information on innovation adoption, bank–firm relationship and other firm characteristics from the widely used Survey of Manufacturing Firms ("Indagine sulle Imprese Manifatturiere") published every three years by the Italian banking group Unicredit (and formerly by Capitalia and Mediocredito Centrale). The survey collects a large set of information on a representative sample (stratified by firm size, industry sector and firm location) of Italian firms with more than ten employees.

In our empirical analysis, we merge the last three waves of the survey covering the period 1995–2003. The pooling sample has information on 13,004 firms, largely concentrated in the north of Italy and with a predominance of small businesses, in accordance with the structure of Italian manufacturing industries. Due to missing data, misreporting and a trimming procedure that excludes extreme values of all firm–level variables, we are left with 9,806 observations.

Data on the location of bank headquarters, bank holding composition and the provincial distribution of branches by bank come from the Bank of Italy, for the sample period as well as for 1936 and 1971. These two years will serve as benchmarks for our instrumental variable estimation (see below, section 5.1). Finally, data on population and value–added at provincial level are taken from the National Institute of Statistics (ISTAT).

4.2 Innovation variables

Our dependent variables are self–reporting answers to survey questions. With regard to the adoption of innovation, firms had to answer the question: "During the three survey years, did the firm make any product and/or process innovations?". Starting from this question we build three dummy variables: (1) $INNOVATION$, which is equal to 1 if the firm adopted a product and/or a process innovation and 0 otherwise, (2) $PROCESS$, which is equal to 1 if the firm adopted a process innovation and 0 otherwise, and (3) $PRODUCT$, which is equal to 1 if the firm adopted a product innovation and 0 otherwise.

As shown in Table 2, 47.5% of the firms in our sample stated they had adopted process innovation, while product innovation was adopted by only 27% of firms. In both cases, the likelihood of introducing innovations increases with firm size and is higher for firms that make expenditure on R&D.

4.3 Financial variables

Our key explanatory financial variables are: (i) the duration of the bank-firm relationship, $RELATIONSHIP$; (ii) the size of the local banking system, $BRANCHES$; (iii) the functional distance of the local banking system, $F\text{–}DISTANCE$.

$RELATIONSHIP$ is computed as the natural logarithm of one plus the length in years of a relationship between the firm and its main bank. The length of the main relationship is drawn from firms' responses to a survey question which asks for how many years the bank that holds the largest share of the firm's debt *in the last year of the survey* has been its main bank. Since the questions on innovation adoption refer to the whole three–year survey period, we antedate the length of the bank relationship to the first year of the survey by subtracting 3 from the years reported by firms and set at zero the negative values (i.e., bank ties lasting for less than three years)[13]. Specifically:

[13]This specification for the length of the bank relationship is proposed by Gambini and Zazzaro (2008), while Ferri and Rotondi (2006) simply subtract 3 from the number of years of the bank relationship as reported by

Table 2: Variables: Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.
Dependent variables				
INNOVATION	0.570	0.495	0	1
PROCESS	0.475	0.499	0	1
PRODUCT	0.272	0.445	0	1
Financial variables				
BRANCHES	5.741	1.471	1.545	10.268
RELATIONSHIP	2.310	0.989	0	4.779
(in years)	13.747	11.811	0	118
F–DISTANCE_KM	3.420	1.042	0.707	6.497
(linear)	154.9	133.0	20.3	840.6
F–DISTANCE_SC	0.862	0.445	0.051	2.989
Control variables				
VALUE ADDED	9.863	0.252	9.044	10.348
(in euros)	19,786	4,608	8,472	31,190
EMPLOYEES	90.26	258.87	11	10233
AGE	24.74	18.06	0	191
R&D	0.777	1.906	0	14.827
CORPORATION	0.951	0.216	0	1
CONSORTIUM	0.112	0.315	0	1
ISO9000	0.404	0.491	0	1
EXPORT	0.697	0.460	0	1

Notes: Statistics refer to the pooled sample of 9,806 observations, made by 3,194 observations from the first wave, 3,506 from the second one and 3,106 from the last wave.

$$RELATIONSHIP = \begin{cases} T = (\text{Relationship length} - 3) & \text{if } T > 0 \\ 0 & \text{if } T \leq 0 \end{cases} \quad (2)$$

BRANCHES is computed as the ratio of bank branches operating in the province to resident population, while *F–DISTANCE* is computed as indicated in equation (1), by weighing, alternatively, each local branch by the kilometric and cultural distance with respect to the headquarter of its own parent.

Table 2 reports the summary statistics of the financial variables for the pooled sample and shows that the average firm has a relationship with its main bank lasting more that thirteen years and operates in a province where there are 5.7 branches per ten thousand inhabitants and the functional distance of the average branch from its headquarter is approximately 155 kilometers.

4.4 Control variables

In our regression analysis we control for a number of firm characteristics that are expected to affect innovation adoption and, for the sake of comparison, have been already considered by the previous literature on finance and innovation (Ferri and Rotondi 2006, Herrera and Minetti 2007, Benfratello et al. 2008)[14].

To the extent that innovation projects entail fixed costs and high level competencies, large firms should be better equipped than small firms to introduce new technologies and products.

firms.

[14] A detailed description of these and all other variables used in the empirical analysis is reported in Appendix A.

Moreover, large firms are more transparent and less likely to be rationed than small firms. Hence, we control for firm size, measured as number of employees ($EMPLOYEES$). To allow for possible non–linearities, we construct six dummy variables for the classes of employees: 11–20, 21–50, 51–100, 101–250, 251-500, and more than 500, where the first class is taken as reference category. In our sample, the average (median) firm has 90 (32) workers, but there is a predominance of small and medium enterprises, since 67 (82) per cent of the sample has less than 50 (100) employees.

Then we control for firms' age, AGE. In this case the expected association with innovation is ambiguous. Old firms are typically informationally more transparent and can therefore fund innovation projects easier. However, old firms are also in the mature phase of their life cycle when the introduction of innovations, especially of new products, proceeds slowly. Hence we introduce into the regression also the square of age.

As an additional control for firms' transparency we introduce a dummy variable $CORPORATION$ that takes the value 1 if the firm is a corporation and 0 otherwise. Corporations are required, and are inclined, to disclose a great amount of information on their activity and have a wider access to other sources of external finance alternative to bank credit.

Fourth, we control for the firms' propensity to innovate and export, both expected to affect innovation positively. The former, $R\&D$, is measured by the expenditure on research and development per employee deflated by the ISTAT's price index by industrial sector; the latter, $EXPORT$, is proxied by a dichotomic variable that takes the value of 1 for firms exporting a share of their sales and 0 otherwise.

Finally, as proxies for firm's efficiency and for networking we introduce two dummies. The former, $ISO9000$, takes the value of 1 for firms whose production process and product qualities have been certified by the European Union. The latter, $CONSORTIUM$, takes the value of 1 if the firm belongs to one or more credit, export and/or research consortia and 0 otherwise.

We also add controls for the logarithm of the real value–added at the provincial level ($VALUE\ ADDED$) and for unobserved geographic, technological and cyclical specificities by introducing 17 regional dummies[15], 21 industrial sector dummies (following Ateco2000 2 digit classification) and 3 wave dummies.

5 The evidence

5.1 An empirical model of innovation diffusion

We estimate a pooled probit model for the probability of a firm i located in province j adopting an innovation I during the survey period t as a function of financial variables and the other control variables described in the previous section:

$$Pr(I_{ijt}) = \Phi(RELATIONSHIP_{it}, BRANCHES_{jt}, F\text{–}DISTANCE_{jt}, X_{it}, Z_{jt}, D_t) \qquad (3)$$

where the dependent variable is, alternatively, $INNOVATION$, $PROCESS$ and $PRODUCT$ and Φ is the normal distribution function.

All our three financial variables can be endogenous to innovation and can be jointly affected by unobserved factors. For example, both $BRANCHES$ and $F\text{–}DISTANCE$ could be driven by the level of local economic development, such that they cannot be considered exogenous with respect to firms' innovative capacity: more innovative firms will grow faster, fostering local development and promoting the opening of new branches and the acquisition of local banks.

[15] There are 20 Italian administrative regions but, to avoid the very low number of observations in three regions, Valle d'Aosta, Molise and Basilicata are considered together with, respectively, Piemonte, Abruzzo and Calabria.

Similarly, the length of the bank relationship could be jointly determined with the innovation choice. For example, a firm that is planning the introduction of a new technology during the research period can construct stable and exclusive ties with a bank to give it the opportunity to know the firm and correctly evaluate the innovative projects. Conversely, if a long–lasting tie with the main bank gives it the power to extract rents from innovation projects, when planning innovation the firm can decide to interrupt the relationship. Finally, both financial variables and innovation decision may be jointly driven by another omitted variable.

To address endogeneity and omitted variable problems we estimate equation 3 by instrumenting $F\text{–}DISTANCE$, $BRANCHES$, and $RELATIONSHIP$ with factors that are likely to be correlated with such variables, but not with innovation decisions. We follow Guiso et al. (2004) and impose the regulatory structure of the Italian banking system of 1936 and 1971 as the true exogenous factor. The geographical distribution of banks and branches in 1936 came about as a response to the 1930–1931 banking crisis and did not follow the strict logic of profit. Guiso et al. (2004) show that the number of branches per inhabitant and their distribution by size in 1936 were unrelated to the regional economic development of the time and can therefore be considered strictly exogenous with respect to innovation decisions in subsequent years. Moreover, the geographical distribution of branches in 1936 was significantly correlated with the local banking development in the 1990s.

In this spirit, we construct seven instrumental variables at the provincial level: (1) the number of branches per inhabitant in 1936 ($BRANCHES\_1936$); (2) the share of branches owned by large banks in 1936 (BIG_1936)[16], (3) the share of branches owned by (credit cooperative) mutual banks in 1936 (CCB_1936); (4) the share of branches owned by saving banks in 1936 (SB_1936); (5) a functional distance indicator calculated with respect to the kilometric distance of branches from their headquarters in 1971 ($F\text{–}DISTANCE\_KM\_1971$); (6) the Herfindahl–Hirschman index calculated with respect to branches working in the province in 1971 (HHI_1971); (7) the average annual number of branches opened by entrants in a province over the eight-year period preceding the wave. The choice of 1971 was dictated by the fact that data on the branch distribution by bank were not published before this year. However, since the structure of the Italian banking system remained substantially unaltered until the end of the 1970s (Ciocca 2001), we take the functional distance indicator at 1971 as a valid instrument. Table 3 shows that, in our sample, the financial variables and the proposed instruments are generally significantly correlated.

[16] Since data on bank branches in 1936 are classified by bank institutional type, we consider the “Istituti di Credito di Diritto Pubblico” and the “Banche di Interesse Nazionale” to be large banks.

Table 3: Credit market and instrumental variables: Pairwise Correlations

	BRANCHES	*RELATIONSHIP*	*F–DISTANCE_KM*	*F–DISTANCE_SC*	*F–DISTANCE_KM_1971*	*CCB_1936*
BRANCHES	1					
RELATIONSHIP	0.0734*	1				
F–DISTANCE_KM	-0.4360*	-0.0575*	1			
F–DISTANCE_SC	-0.4847*	-0.0853*	0.7385*	1		
F–DISTANCE_KM_1971	-0.5768*	-0.0502*	0.5419*	0.5985*	1	
CCB_1936	0.1278*	0.0456*	-0.018	-0.1344*	-0.1246*	1
SB_1936	0.3814*	0.0311*	-0.0935*	-0.3291*	-0.2284*	-0.0513*
BRANCHES_1936	0.5479*	0.0480*	-0.3803*	-0.3778*	-0.3436*	0.0338*
HHI_1971	0.0253*	-0.0105	0.1428*	0.1414*	-0.0325*	0.1457*
BIG_1936	-0.6597*	-0.0580*	0.3603*	0.3583*	0.5889*	-0.3763*
ENTRANTS	-0.0141	0.0328*	-0.1211*	-0.1258*	-0.1218*	-0.0777*
	SB_1936	*BRANCHES_1936*	*HHI_1971*	*BIG_1936*	*ENTRANTS*	
BRANCHES						
RELATIONSHIP						
F–DISTANCE_KM						
F–DISTANCE_SC						
F–DISTANCE_KM_1971						
CCB_1936						
SB_1936	1					
BRANCHES_1936	0.2721*	1				
HHI_1971	0.4028*	0.1132*	1			
BIG_1936	-0.2325*	-0.4758*	-0.0310*	1		
ENTRANTS	-0.2645*	-0.1524*	-0.4535*	0.0734*	1	

Notes: * significant at 5%. Correlations refer to the pooled sample of 9,806 observations, made up by 3,194 observation from the first wave, 3,506 from the second one and 3,106 from the last wave.

5.2 Results

Table 4 presents the results of probit estimates of equation 3 regarding the determinants of the likelihood of firms introducing innovation, while the IV estimates are reported in Table 5. At the bottom of that Table, we report the Conditional Likelihood Ratio (*CLR*) test proposed by Rivers and Vuong (1988), which assesses the joint statistical significance of the residuals from the first–stage OLS regression in the structural probit equation (Wooldridge 2002). The test generally rejects the null hypothesis of exogeneity of the financial variables, both when they are added in the model one by one (columns 1 to 4, except for *F–DISTANCE_SC*) and all together, suggesting the need for an IV approach.

Instrumental variable estimation is known to rely on (1) a significant correlation between the instruments and the endogenous variables, and (2) the absence of correlation between the excluded instruments and the error term of the structural equation. We verify the validity of the first assumption from the estimates of the first stage regressions. In particular, referring to specifications in columns 5 and 6 of Table 5, we observe that all the instruments exhibit a significant (at 1 per cent level of confidence) partial correlation with *F–DISTANCE* indicators and *BRANCHES*, while the length of the relationship is significantly correlated only with the Herfindahl–Hirschman index of concentration of banks branches in 1971 and with the share of branches owned by large banks in 1936[17]. In any case, for all the first stage regressions, the F–test rejects the null hypothesis that the instruments are jointly insignificant. Concerning the second assumption, the Sargan overidentification does not reject the null of non correlation between the excluded instruments and the error term of the structural equation. The only exception is for *F–DISTANCE_SC* (column 4), but in this case the *CLR* test fails to reject the null hypothesis of exogeneity.

5.2.1 Financial variables

When considered one by one, financial variables are all significantly correlated to innovation and have the expected signs (Table 5 columns 1-4). Like in Ferri and Rotondi (2006) and Herrera and Minetti (2007), *RELATIONSHIP* has a negative impact on the probability of introducing an innovation, but its effect proves to be positive once the variable is instrumented. Similarly, branch density in the province boosts innovation adoption by local firms confirming the findings of Benfratello et al. (2008). The signs of *F–DISTANCE_KM* and *F–DISTANCE_SC* coefficients are negative both in the probit and IV probit estimates even if, after instrumenting, their magnitude is more than doubled.

To assess the economic significance of our findings, we calculate the average impact that a change from the first to the third quartile of each financial variable distribution has on the predicted propensity to innovate instead of the more traditional marginal effects Referring to the first four columns of Table 5, we find that the length of the credit relationship has the largest impact: a firm that has operated with a bank for 19 years has a probability of introducing innovation equal to 70.6 per cent, compared with 45.8 per cent for a firm with a credit relationship five years long. The economic impacts of a change in branch density and functional distance are smaller. The former raises the likelihood of innovation adoption by 5 percentage points, while the latter reduces that probability by 6 percentage points (3.4% when functional distance is measured in terms of social capital).

Nevertheless, to really understand the channel through which the financial system boosts innovation, one should compare the effects of the financial variables when they enter simultaneously in equation (3). In this case (columns 5 and 6), only the functional indicators preserve

[17]For the sake of brevity, we do not report the results of the first stage regressions, but they are available on request from the authors.

their statistical and economic significance. Although this finding proves valid regardless of the use of the distance indicator, the effect of these two measures has a different magnitude. In fact, the likelihood of introducing an innovation is reduced by 5.7 percentage points when *F–DISTANCE_KM* increases from the first to the third quartile of its distribution (column 5), while the same change causes a drop in the probability to innovate of four percentage points with *F–DISTANCE_SC* (column 6). Finally, the estimated effect of *BRANCHES* on the probability of firms introducing innovations becomes much smaller and statistically not significant, consistent with the findings of Herrera and Minetti (2007) who, however, do not instrument branch density. Unlike Herrera and Minetti, instead, we do not obtain significant effects even for the length of bank–firm relationship whose coefficient in the IV estimates 5 and 6 appears to be statistically not different from zero and even smaller in modulus.

As a second step, we analyze process and product innovations separately [18]. As suggested by the literature, the former typically aims to reduce production costs and entails new machinery requiring large fixed investments and external finance, while the latter is targeted at improving product characteristics and requires a lower amount of fixed costs, but also need for lower secrecy reducing the risk of informational capture by the main bank.

Consistent with the importance of finance for process innovations, we find that the impact of the financial variables in stimulating the diffusion of this type of innovation is statistically more significant (Table 6). However, once again it is the geographical organization of banking systems that seem to be the main financial factor driving the adoption of new technologies, as testified by the estimates in columns 5 and 6, where only *F–DISTANCE* preserves its statistical significance.

As regards product innovations, on the whole the coefficients on functional distance and branch density are less significant than for process innovation (Table 7). When financial variables are included separately (columns 1-4), they are significantly correlated to the decision of introducing new products, with the exception of *F–DISTANCE_SC*.

With regard to the economic impact of financial variables on the two types of innovation, functional distance is more important for process than for product innovation. By contrast, *BRANCHES* and *RELATIONSHIP* exert a greater effect on the adoption of new products. More precisely, replicating the exercise on the changes from the first to the third quartile of the financial variable distributions we described above, we can observe that a change in *F–DISTANCE_KM* and *F–DISTANCE_SC* reduces the probability of introducing a product (process) innovation by 4.3 (7.8) and by 1.1 (5.0) percentage points respectively. A similar change in *BRANCHES* raises that probability by 3.7 (7.5) percentage points, while when *RELATIONSHIP* is at the third quartile of its distribution the likelihood of observing a product (process) innovation is 26.7 (27.5) percentage points higher than when *RELATIONSHIP* is at the first quartile

In the full specification (column 5), both *RELATIONSHIP* and *F–DISTANCE_KM* are slightly significant at the 10 percent level, while *BRANCHES* does not show any significant effect. In this case, the usual back–of–the–envelope calculations point out that the length of the credit relationship is much more important than functional distance for the decision of introducing new products. Increasing from 5 to 19 years the length of the relationship raises the likelihood of introducing a product innovation by 30 percentage points, while the negative effect due to a comparable change in functional distance is about one sixth of that.

Thus, looking at the effects of the financial variables in the full specification, we find evidence of a differentiated effect on innovation adoption. Functional distance is a major impediment to the introduction of process innovations, but it is a less significant constraint to projects aimed

[18] In order to save space, we report only results for the IV estimates, while the probit estimate are available upon request.

Table 4: Adoption of Innovation: Probit estimates

Dep Var: Pr(INNOVATION)	(1)	(2)	(3)	(4)	(5)	(6)
BRANCHES	0.023				0.009	0.019
	[0.020]				[0.021]	[0.020]
RELATIONSHIP		-0.045***			-0.046***	-0.045***
		[0.016]			[0.016]	[0.016]
F–DISTANCE_KM			-0.057***		-0.056***	
			[0.019]		[0.020]	
F–DISTANCE_SC				-0.118**		-0.115**
				[0.055]		[0.055]
VALUE ADDED	-0.063	-0.066	-0.149	-0.147	-0.149	-0.145
	[0.134]	[0.134]	[0.137]	[0.140]	[0.138]	[0.140]
21-50 EMPLOYEES	0.186***	0.183***	0.188***	0.188***	0.186***	0.186***
	[0.033]	[0.033]	[0.033]	[0.033]	[0.033]	[0.033]
51-100 EMPLOYEES	0.372***	0.368***	0.373***	0.374***	0.368***	0.369***
	[0.044]	[0.044]	[0.044]	[0.044]	[0.044]	[0.044]
101-250 EMPLOYEES	0.447***	0.443***	0.447***	0.450***	0.441***	0.443***
	[0.052]	[0.052]	[0.052]	[0.052]	[0.052]	[0.052]
251-500 EMPLOYEES	0.581***	0.571***	0.582***	0.586***	0.569***	0.573***
	[0.074]	[0.074]	[0.074]	[0.074]	[0.074]	[0.074]
$>$ *500 EMPLOYEES*	0.735***	0.724***	0.735***	0.740***	0.723***	0.728***
	[0.105]	[0.105]	[0.105]	[0.105]	[0.105]	[0.105]
AGE	-0.001	0.002	-0.001	-0.001	0.002	0.002
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
AGE^2	0.001	0.000	0.001	0.001	0.000	0.000
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
R&D	0.168***	0.167***	0.168***	0.168***	0.167***	0.167***
	[0.014]	[0.014]	[0.014]	[0.014]	[0.014]	[0.014]
CORPORATION	0.104*	0.100	0.104*	0.103	0.104*	0.105*
	[0.063]	[0.063]	[0.063]	[0.063]	[0.063]	[0.063]
CONSORTIUM	0.197***	0.197***	0.197***	0.196***	0.198***	0.197***
	[0.044]	[0.044]	[0.044]	[0.044]	[0.044]	[0.044]
ISO9000	0.086***	0.085***	0.087***	0.085***	0.088***	0.086***
	[0.031]	[0.031]	[0.031]	[0.031]	[0.031]	[0.031]
EXPORT	0.190***	0.190***	0.189***	0.189***	0.190***	0.190***
	[0.031]	[0.032]	[0.031]	[0.031]	[0.032]	[0.032]
Observations	9,806	9,806	9,806	9,806	9,806	9,806
Wald test	1,065	1,066	1,070	1,063	1,075	1,068
Pseudo–R^2	0.106	0.106	0.106	0.106	0.107	0.106

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. Probit regressions report coefficients and the associated robust standard errors in brackets. The baseline for *EMPLOYEES* is the size class 11–20 employees. Each regression includes (3) wave, (21) sector and (17) regional dummies and a constant, not shown for reasons of space. As diagnostic, the Table reports the Wald χ^2 statistic for the likelihood ratio test of the goodness of fit of the regression and the Pseudo–R^2. AGE^2 is divided by 100.

at introducing product innovations, especially when the distance is measured in terms of social capital.

By contrast, the length of the credit relationship is negatively associated with the probability of introducing product innovations, while it has no significant effect on the likelihood of adopting process innovations. The survival of a positive correlation of *RELATIONSHIP* for product and not for process innovation in the full specification and its greater economic impact on the former confirm previous findings of Herrera and Minetti (2007), who suggest that the lower need for secrecy for product innovation makes relationship lending more effective for financing

Table 5: Adoption of Innovation: IV Probit estimates

Dep Var: Pr(INNOVATION)	(1)	(2)	(3)	(4)	(5)	(6)
BRANCHES	0.098**				-0.003	0.024
	[0.043]				[0.067]	[0.064]
RELATIONSHIP		0.809**			0.691	0.717
		[0.390]			[0.468]	[0.491]
F–DISTANCE_KM			-0.131***		-0.133**	
			[0.048]		[0.063]	
F–DISTANCE_SC				-0.208*		-0.235*
				[0.114]		[0.142]
VALUE ADDED	-0.060	-0.030	-0.262*	-0.209	-0.235	-0.196
	[0.135]	[0.155]	[0.153]	[0.156]	[0.176]	[0.177]
21-50 EMPLOYEES	0.186***	0.230***	0.191***	0.190***	0.228***	0.229***
	[0.033]	[0.043]	[0.033]	[0.033]	[0.045]	[0.046]
51-100 EMPLOYEES	0.370***	0.460***	0.372***	0.375***	0.447***	0.453***
	[0.044]	[0.065]	[0.044]	[0.044]	[0.071]	[0.073]
101-250 EMPLOYEES	0.442***	0.564***	0.446***	0.451***	0.545***	0.553***
	[0.053]	[0.082]	[0.053]	[0.053]	[0.090]	[0.094]
251-500 EMPLOYEES	0.578***	0.802***	0.580***	0.589***	0.768***	0.783***
	[0.075]	[0.135]	[0.074]	[0.075]	[0.152]	[0.160]
$>$ *500 EMPLOYEES*	0.738***	0.963***	0.734***	0.742***	0.929***	0.946***
	[0.102]	[0.157]	[0.102]	[0.102]	[0.170]	[0.177]
AGE	-0.001	-0.044**	-0.001	-0.001	-0.038	-0.039
	[0.002]	[0.021]	[0.002]	[0.002]	[0.025]	[0.026]
AGE^2	0.001	0.030**	0.001	0.001	0.026	0.027
	[0.002]	[0.014]	[0.002]	[0.002]	[0.017]	[0.018]
R&D	0.168***	0.186***	0.168***	0.167***	0.185***	0.184***
	[0.010]	[0.014]	[0.010]	[0.010]	[0.015]	[0.015]
CORPORATION	0.114*	0.121	0.108*	0.104*	0.124*	0.125*
	[0.064]	[0.074]	[0.063]	[0.063]	[0.071]	[0.072]
CONSORTIUM	0.197***	0.181***	0.197***	0.195***	0.183***	0.181***
	[0.044]	[0.051]	[0.044]	[0.044]	[0.050]	[0.050]
ISO9000	0.087***	0.085**	0.090***	0.085***	0.090***	0.086**
	[0.031]	[0.036]	[0.031]	[0.031]	[0.035]	[0.035]
EXPORT	0.192***	0.178***	0.190***	0.188***	0.180***	0.179***
	[0.031]	[0.036]	[0.031]	[0.031]	[0.036]	[0.036]
Observations	9,806	9,806	9,806	9,806	9,806	9,806
Wald test	1,212	985	1,215	1,212	1,038	1,027
CLR test	0.048	0.012	0.092	0.366	0.060	0.087
Sargan test	0.224	0.742	0.317	0.077	0.833	0.537

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. IV probit regressions are estimated with Newey's two–step estimator (IVPROBIT using Stata 10 SE package). Additional instruments include *CCB*_1936, *SB*_1936, *BIG*_1936, *HHI*_1971, *ENTRANTS*, *F–DISTANCE_KM*_1971 (excluding column 2) and *BRANCHES*_1936 (excluding columns 3-4). The baseline for *EMPLOYEES* is the class 11–20 employees. Each regression includes (3) wave, (21) sector and (17) regional dummies and a constant, not shown for reasons of space. As diagnostic, the Table reports the Wald χ^2 statistic for the likelihood ratio test of the goodness of fit of the regression, the p–value of the conditional likelihood ratio (CLR) test of exogeneity of the endogenous regressors and the p–value of the Sargan test for over–identifying restrictions (the null is the validity of the instrument set). AGE^2 is divided by 100.

product than process innovations[19].

[19]When functional distance is measured by social capital, however, the full specification does not provide significant results either for distance or for the length of a bank relationship.

Table 6: Adoption of Process Innovation: IV Probit estimates

Dep Var: Pr(PROCESS)	(1)	(2)	(3)	(4)	(5)	(6)
BRANCHES	0.140***				0.050	0.077
	[0.043]				[0.064]	[0.061]
RELATIONSHIP		0.884**			0.530	0.553
		[0.393]			[0.444]	[0.465]
F–DISTANCE_KM			-0.153***		-0.133**	
			[0.048]		[0.060]	
F–DISTANCE_SC				-0.235**		-0.236*
				[0.113]		[0.135]
VALUE ADDED	-0.016	0.014	-0.257*	-0.189	-0.199	-0.158
	[0.133]	[0.156]	[0.151]	[0.154]	[0.167]	[0.168]
21-50 EMPLOYEES	0.173***	0.221***	0.179***	0.178***	0.207***	0.207***
	[0.033]	[0.044]	[0.033]	[0.033]	[0.043]	[0.044]
51-100 EMPLOYEES	0.355***	0.454***	0.357***	0.361***	0.414***	0.419***
	[0.043]	[0.066]	[0.043]	[0.043]	[0.067]	[0.069]
101-250 EMPLOYEES	0.410***	0.545***	0.416***	0.422***	0.488***	0.496***
	[0.051]	[0.082]	[0.051]	[0.051]	[0.085]	[0.088]
251-500 EMPLOYEES	0.607***	0.853***	0.611***	0.622***	0.752***	0.767***
	[0.071]	[0.134]	[0.071]	[0.071]	[0.143]	[0.150]
$>$ *500 EMPLOYEES*	0.803***	1.046***	0.798***	0.807***	0.949***	0.966***
	[0.095]	[0.155]	[0.095]	[0.095]	[0.159]	[0.165]
AGE	-0.002	-0.050**	-0.002	-0.002	-0.030	-0.032
	[0.002]	[0.021]	[0.002]	[0.002]	[0.024]	[0.025]
AGE^2	0.002	0.034**	0.002	0.002	0.021	0.022
	[0.002]	[0.014]	[0.002]	[0.002]	[0.016]	[0.017]
R&D	0.093***	0.112***	0.093***	0.092***	0.106***	0.105***
	[0.008]	[0.013]	[0.008]	[0.008]	[0.013]	[0.013]
CORPORATION	0.062	0.065	0.053	0.049	0.070	0.071
	[0.064]	[0.075]	[0.063]	[0.063]	[0.068]	[0.069]
CONSORTIUM	0.140***	0.123**	0.140***	0.138***	0.130***	0.128***
	[0.043]	[0.050]	[0.043]	[0.043]	[0.046]	[0.047]
ISO9000	0.114***	0.111***	0.116***	0.110***	0.116***	0.112***
	[0.031]	[0.036]	[0.031]	[0.031]	[0.033]	[0.033]
EXPORT	0.125***	0.108***	0.122***	0.120***	0.116***	0.115***
	[0.031]	[0.037]	[0.031]	[0.031]	[0.034]	[0.035]
Observations	9,806	9,806	9,806	9,806	9,806	9,806
Wald test	1,161	880	1,163	1,159	1,042	1,032
CLR test	0.004	0.006	0.059	0.462	0.021	0.032
Sargan test	0.182	0.387	0.175	0.018	0.643	0.355

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. IV probit regressions are estimated with Newey's two–step estimator (IVPROBIT using Stata 10 SE package). Additional instruments include *CCB*_1936, *SB*_1936, *BIG*_1936, *HHI*_1971, *ENTRANTS*, *F–DISTANCE_KM*_1971 (excluding column 2) and *BRANCHES*_1936 (excluding columns 3-4). The reference category for *EMPLOYEES* is 11–20 employees. Each regression includes (3) wave, (21) sector and (17) regional dummies and a constant, not shown for reasons of space. As diagnostic, the Table reports the Wald χ^2 statistic for the likelihood ratio test of the goodness of fit of the regression, the p–value of the conditional likelihood ratio (CLR) test of exogeneity of the endogenous regressors and the p–value of the Sargan test for over–identifying restrictions (the null is the validity of the instrument set). AGE^2 is divided by 100.

5.2.2 Control variables

Firm–specific control variables are broadly significant and with the signs consistent with the previous studies of Ferri and Rotondi (2006), Herrera and Minetti (2007) and Benfratello et al.

Table 7: Adoption of Product Innovation: IV Probit estimates

Dep Var: Pr(PRODUCT)	(1)	(2)	(3)	(4)	(5)	(6)
BRANCHES	0.083*				-0.034	0.015
	[0.047]				[0.078]	[0.071]
RELATIONSHIP		0.896**			0.951*	0.821
		[0.425]			[0.537]	[0.540]
F–DISTANCE_KM			-0.118**		-0.123*	
			[0.052]		[0.072]	
F–DISTANCE_SC				-0.129		-0.118
				[0.124]		[0.157]
VALUE ADDED	-0.175	-0.136	-0.359**	-0.269	-0.320	-0.217
	[0.144]	[0.168]	[0.163]	[0.166]	[0.199]	[0.192]
21-50 EMPLOYEES	0.249***	0.297***	0.254***	0.252***	0.305***	0.295***
	[0.038]	[0.049]	[0.038]	[0.038]	[0.053]	[0.052]
51-100 EMPLOYEES	0.371***	0.470***	0.372***	0.374***	0.475***	0.462***
	[0.047]	[0.071]	[0.047]	[0.047]	[0.081]	[0.080]
101-250 EMPLOYEES	0.465***	0.598***	0.467***	0.472***	0.605***	0.588***
	[0.054]	[0.087]	[0.054]	[0.054]	[0.102]	[0.101]
251-500 EMPLOYEES	0.567***	0.814***	0.569***	0.575***	0.828***	0.796***
	[0.071]	[0.142]	[0.071]	[0.071]	[0.170]	[0.171]
$>$ *500 EMPLOYEES*	0.629***	0.879***	0.627***	0.631***	0.893***	0.862***
	[0.089]	[0.159]	[0.089]	[0.089]	[0.183]	[0.183]
AGE	0.004**	-0.044*	0.004**	0.004**	-0.047	-0.040
	[0.002]	[0.023]	[0.002]	[0.002]	[0.029]	[0.029]
AGE^2	-0.003	0.030*	-0.003	-0.003	0.031	0.027
	[0.002]	[0.015]	[0.002]	[0.002]	[0.019]	[0.020]
R&D	0.143***	0.164***	0.144***	0.143***	0.166***	0.162***
	[0.008]	[0.013]	[0.008]	[0.008]	[0.015]	[0.015]
CORPORATION	0.137*	0.148*	0.133*	0.129*	0.152*	0.150*
	[0.076]	[0.086]	[0.076]	[0.076]	[0.088]	[0.085]
CONSORTIUM	0.203***	0.185***	0.202***	0.202***	0.183***	0.186***
	[0.045]	[0.053]	[0.045]	[0.045]	[0.054]	[0.053]
ISO9000	0.051	0.049	0.053	0.049	0.052	0.049
	[0.033]	[0.038]	[0.033]	[0.033]	[0.039]	[0.038]
EXPORT	0.313***	0.298***	0.311***	0.310***	0.297***	0.300***
	[0.036]	[0.042]	[0.036]	[0.036]	[0.043]	[0.042]
Observations	9,806	9,806	9,806	9,806	9,806	9,806
Wald test	1,243	959	1,245	1,244	934	993
CLR test	0.121	0.009	0.044	0.957	0.032	0.086
Sargan test	0.070	0.319	0.318	0.073	0.396	0.148

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. IV probit regressions are estimated with Newey's two–step estimator (IVPROBIT using Stata 10 SE package). Additional instruments include *CCB*_1936, *SB*_1936, *BIG*_1936, *HHI*_1971, *ENTRANTS*, *F–DISTANCE_KM*_1971 (excluding column 2) and *BRANCHES*_1936 (excluding columns 3-4). The reference category for *EMPLOYEES* is 11–20 employees. Each regression includes (3) wave, (21) sector and (17) regional dummies and a constant, not shown for reasons of space. As diagnostic, the Table reports the Wald χ^2 statistic for the likelihood ratio test of the goodness of fit of the regression, the p–value of the conditional likelihood ratio (CLR) test of exogeneity of the endogenous regressors and the p–value of the Sargan test for over–identifying restrictions (the null is the validity of the instrument set). AGE^2 is divided by 100.

(2008). The dummies for size are all positive and increasing in modulus, suggesting that larger firms are more likely to adopt innovations. The coefficients on age and age squared are not always significant, but generally *AGE* has a U effect, suggesting that the transparency benefit of age allows firms to easily fund the introduction of new technologies, overcoming the negative effect on innovation capacity due to the shift towards the mature phase of the firms' life cycle. Only for product innovations, when the length of the relationship is excluded, does AGE exhibits an inverted U effect on product innovations, as found also by Benfratello et al. (2008), indicating that being in the mature phase of the life cycle hampers the introduction of new products by old firms. Corporations, firms that are more efficient ($ISO9000 = 1$), invest more heavily in R&D, export part of their production abroad and are members of a credit, export or research consortium, are more likely to introduce innovations. More specifically, the positive effect of being international competitors, engaged in R&D and part of a consortium boosts both process and product innovations. On the other hand, in contrast with Herrera and Minetti (2007), $CORPORATION$ is slightly significant at 10 percent level for product innovation, while it does not affect process innovation[20].

6 Conclusions

This chapter investigated the channels through which the supply of finance could help spur innovation by firms. The existing literature focuses mainly on the importance of strong ties between the firm and its main bank and on the aggregate size of the local banking system. Relationship lending, measured by the length of the credit relationship, represents a way in which the bank can extract soft information about a firm's innovative projects (Herrera and Minetti 2007). The number of local bank branches serving the resident population, instead, is a measure of the availability of external finance for local firms: where information problems make credit markets geographically segmented, a more developed local banking system improves the selection, assessment and monitoring of opaque investment projects like the introduction of new technologies and products (Benfratello et al. 2008).

In this chapter we argued that the effectiveness of a local banking system in acquiring and processing soft information on local innovative firms depends on the geographical distribution of banks' decisional centres. Since transmitting information across the distant hierarchical levels of a bank is an imperfect and costly activity, a banking system which is functionally close to local firms can be expected to be better suited to overcome information asymmetries and fostering innovation adoption.

We validate this hypothesis by evaluating the relative importance of relationship lending, branch density and functional distance on the propensity to innovate by a large and representative sample of Italian manufacturing firms. Once the endogeneity of these financial variables have been taken into account, we are able to confirm that, considered one by one, the length of the credit relationship and branch density spur innovation, while functional distance represents a hindrance. However, when we include the three variables together, we find that, generally, only functional distance remains statistically significant. Yet, when we distinguish between process and product innovation, the results point to a stronger effect of functional distance on the former, which typically requires a larger amount of lumpy investment in new machinery, and an additional impact of relationship lending on the latter, consistent with the reduced importance of secrecy and the related hold–up problems for product innovation.

Concluding, our results testify to the relevance of external finance for innovation adoption. A well developed banking system can reduce financing constraints and improve resource allocation. However, despite improvements in information and communication technologies, the time elapsed from the beginning of bank consolidation process and the progress in the regulatory integration of credit markets, the geographical organization of banking systems and the spatial

[20]This finding could be interpreted as another piece of evidence in favor of less need of secrecy for product innovation

distribution of banks' decisional centres still represent key variables for the effectiveness of finance in spurring innovation diffusion across a country and the development of local economies. All this suggests that to appraise the changes in the geography of banking industry occurred in the last decades and, mostly, the future prospects of financial integration it is needed to caring mediate the benefits banks' efficiency and competition with the costs of increasing centralization of banking system and the risks of decline in the economic and financial power of peripheral regions[21].

[21] Holloway and Wheeler (1991), Meijer (1993), Pike (2006).

References

Alessandrini, P., Calcagnini, G. and Zazzaro, A.: 2008, Asset restructuring strategies in bank acquisitions: Does distance between dealing partners matter?, *Journal of Banking & Finance* **32**(5), 699–713.

Alessandrini, P., Croci, M. and Zazzaro, A.: 2005, The geography of banking power: the role of functional distance, *Banca Nazionale del Lavoro Quarterly Review* **LVIII**(235), 129–67.

Alessandrini, P., Presbitero, A. F. and Zazzaro, A.: 2008, Banks, distances and firms' financing constraints, *Review of Finance* **Forthcoming**.

Alessandrini, P. and Zazzaro, A.: 1999, A "possibilist" approach to local financial systems and regional development: the Italian experience, *in* R. Martin (ed.), *Money and the Space Economy*, Wiley, Chichester, pp. 71–92.

Bank of Italy: 2004, *Abridged report for the year 2003*, Bank of Italy, Rome.

Bank of Italy: 2008, *Abridged report for the year 2007*, Bank of Italy, Rome.

Bel, G. and Fageda, X.: 2008, Getting there fast: globalization, intercontinental flights and location of headquarters, *Journal of Economic Geography* **8**(4), 471–495.

Benfratello, L., Schiantarelli, F. and Sembenelli, A.: 2008, Banks and innovation: Microeconometric evidence on italian firms, *Journal of Financial Economics* **Forthcoming**.

Berger, A. N. and DeYoung, R.: 2006, Technological progress and the geographic expansion of the banking industry, *Journal of Money, Credit and Banking* **38**(6), 1483–1513.

Berger, A. N. and Udell, G. F.: 2002, Small business credit availability and relationship lending: The importance of bank organisational structure, *The Economic Journal* **112**(477), F32–F53.

Canepa, A. and Stoneman, P.: 2002, Financial constraints on innovation: A european cross country study, *Working Papers 11*, EIFC - Technology and Finance.

Carter, D. A. and McNulty, J. E.: 2005, Deregulation, technological change, and the business-lending performance of large and small banks, *Journal of Banking & Finance* **29**(5), 1113–1130.

Carter, D., McNulty, J. and Verbrugge, J.: 2004, Do small banks have an advantage in lending? an examination of risk-adjusted yields on business loans at large and small banks, *Journal of Financial Services Research* **25**(2), 233–252.

Cerqueiro, G., Degryse, H. and Ongena, S.: 2008, Distance, bank organizational structure, and credit. Chapter 4 of this Volume.

Chick, V. and Dow, S. C.: 1988, A Post-Keynesian Perspective on the Relation Between Banking and Regional Development, *in* P. Arestis (ed.), *Post-Keynesian Monetary Economics - New Approaches to Financial Modelling*, Edward Elgar, Aldershot, pp. 219–250.

Ciocca, P.: 2001, Le nuove "forme" della finanza in Italia, *in* P. Alessandrini (ed.), *Il Sistema Finanziario Italiano tra Globalizzazione e Localismo*, Il Mulino, Bologna.

Cole, R. A., Goldberg, L. G. and White, L. J.: 2004, Cookie-cutter versus character: The micro structure of small business lending by large and small banks, *Journal of Financial and Quantitative Analysis* **39**(2), 227–251.

Dow, S. C.: 1994, European monetary integration and the distribution of credit availability, *in* S. Corbridge, R. Martin and N. Thrift (eds), *Money, Space and Power*, Blackwell Publishers, Oxford, chapter 7, pp. 149–164.

Dow, S. C.: 1999, Stages of banking development and the spatial evolution of financial systems, *in* R. Martin (ed.), *Money and the Space Economy*, Wiley, Chichester, chapter 2, pp. 31–48.

Ferri, G.: 1997, Branch manager turnover and lending efficiency: local vs. national banks, *BNL Quarterly Review* **50**, 229–247.

Ferri, G. and Rotondi, Z.: 2006, Does finance matter in the re–specialization of italy's industrial districts?, *in* G. Bracchi and D. Masciandaro (eds), *XI Report on the Italian Financial System*, Rosselli Foundation - Bancaria Editrice, Milan, pp. 397–433.

Galia, F. and Legros, D.: 2004, Complementarities between obstacles to innovation: evidence from france, *Research Policy* **33**(8), 1185–1199.

Gambini, A. and Zazzaro, A.: 2008, The effect of close bank relationships on small and large firms' growth rate. Università Politecnica delle Marche.

Garicano, L.: 2000, Hierarchies and the organization of knowledge in production, *Journal of Political Economy* **108**(5), 874–904.

Guiso, L., Sapienza, P. and Zingales, L.: 2004, Does local financial development matter?, *The Quarterly Journal of Economics* **119**(3), 929–969.

Hall, B. H.: 2005, The financing of innovation, *in* S. Shane (ed.), *Blackwell Handbook of Technology and Innovation Management*, Blackwell Publishers, Oxford.

Henderson, V. J. and Davis, J.: 2004, The agglomeration of headquarters, *Working Papers 04-02*, Center for Economic Studies, U.S. Census Bureau.

Herrera, A. M. and Minetti, R.: 2007, Informed finance and technological change: Evidence from credit relationships, *Journal of Financial Economics* **83**(1), 223–269.

Holloway, S. R. and Wheeler, J. O.: 1991, Corporate headquarters relocation and changes in metropolitan corporate dominance, 1980-1987, *Economic Geography* **67**(1), 54–74.

Ichino, A. and Maggi, G.: 2000, Work environment and individual background: Explaining regional shirking differentials in a large italian firm, *The Quarterly Journal of Economics* **115**(3), 1057–1090.

Jenness, J.: 2005, Distance matrix (dist-mat-jen.avx) extension for arcview 3.x, v. 2, Jenness Enterprises. Available at: $http://www.jennessent.com/arcview/dist_matrix.htm$.

Jimenez, G., Salas, V. and Saurina, J.: 2007, Organizational distance and use of collateral in business loans. mimeo.

Keeton, W. R.: 1995, Multi-office bank lending to small businesses: some new evidence, *Federal Reserve Bank of Kansas City Economic Review* (Q II), 45–57.

Liberti, J. M.: 2003, Initiative, incentives and soft information: How does delegation impact the role of bank relationship managers?, *London Business School, IFA Working Paper* (404).

Liberti, J. M. and Mian, A.: 2006, Estimating the effect of hierarchies on information use. mimeo.

Martin, R.: 1989, The growth and geographical anatomy of venture capitalism in the united kingdom, *Regional Studies: The Journal of the Regional Studies Association* **23**(5), 389–403.

Martin, R.: 1994, Stateless monies, global financial integration and national economic autonomy: the end of geography?, *in* S. Corbridge, R. Martin and N. Thrift (eds), *Money, Space and Power*, Blackwell Publishers, Oxford, chapter 11, pp. 253–278.

Mattesini, F. and Messori, M.: 2004, *L'evoluzione del sistema bancario meridionale: problemi aperti e possibili soluzioni*, Il Mulino, Bologna.

Meijer, M.: 1993, Growth and Decline of European Cities: Changing Positions of Cities in Europe, *Urban Studies* **30**(6), 981–990.

Messori, M. and Zazzaro, A.: 2003, Aggregazioni bancarie, riassetti proprietari e modelli di governo. come sono cambiate le banche italiane negli anni novanta, *in* M. Messori, R. Tamborini and A. Zazzaro (eds), *Il sistema bancario italiano*, Carocci, Rome.

Mian, A.: 2006, Distance constraints: The limits of foreign lending in poor economies, *The Journal of Finance* **LXI**(3), 1465–1505.

Milbourn, T. T., Shockley, R. L. and Thakor, A. V.: 2001, Managerial career concerns and investments in information, *RAND Journal of Economics* **32**(2), 334–51.

Mistrulli, P. E. and Casolaro, L.: 2008, Distance, lending technologies and interest rates. Bank of Italy.

Mohnen, P., Palm, F., Schim van der Loeff, S. and Tiwari, A.: 2008, Financial constraints and other obstacles: Are they a threat to innovation activity?, *Technical Report 006*, United Nations University.

Mohnen, P. and Roller, L.-H.: 2005, Complementarities in innovation policy, *European Economic Review* **49**(6), 1431–1450.

Novaes, W. and Zingales, L.: 2004, Bureaucracy as a mechanism to generate information, *RAND Journal of Economics* **35**(2), 245–259.

Pike, A.: 2006, 'shareholder value' versus the regions: the closure of the vaux brewery in sunderland, *Journal of Economic Geography* **6**(2), 201–222.

Putnam, R. D.: 1995, Bowling alone: America's declining social capital, *Journal of Democracy* **6**(1), 65–78.

Rivers, D. and Vuong, Q. H.: 1988, Limited information estimators and exogeneity tests for simultaneous probit models, *Journal of Econometrics* **39**(3), 347–366.

Savignac, F.: 2006, The impact of financial constraints on innovation : evidence from french manufacturing firms, *Cahiers de la Maison des Sciences Economiques 06042*, Université Panthéon-Sorbonne (Paris 1).

Stein, J. C.: 2002, Information production and capital allocation: Decentralized versus hierarchical firms, *Journal of Finance* **57**(5), 1891–1921.

Strauss-Kahn, V. and Vives, X.: 2005, Why and where do headquarters move?, *CEPR Discussion Papers 5070*, C.E.P.R. Discussion Papers.

Takáts, E.: 2004, Banking consolidation and small business lending, *Working Paper Series 407*, European Central Bank.

Udell, G. F.: 1989, Loan quality, commercial loan review and loan officer contracting, *Journal of Banking & Finance* **13**(3), 367–382.

Udell, G. F.: 2008, Innovation, organizations and small business lending. Chapter 2 of this Volume.

Wooldridge, J. M.: 2002, *Econometrics Analysis of Cross Section and Panel Data*, MIT Press, Cambridge, MA.

Zazzaro, A.: 2006, La scomparsa dei centri decisionali dal sistema bancario meridional, *Rivista di Politica Economica* **3-4**, 31–60.

A List of variables

INNOVATION, by firm, is a dichotomous variable which is equal to one if the firm introduced a process and/or product innovation in the three–year period covered by each survey. Source: Unicredit's Surveys.

PROCESS, by firm, is a dichotomous variable which is equal to one if the firm introduced a process innovation in the three-.year period covered by each survey. Source: Unicredit's Surveys.

PRODUCT, by firm, is a dichotomous variable which is equal to one if the firm introduced a product innovation in the three–year period covered by each survey. Source: Unicredit's Surveys.

F–DISTANCE_KM, by province, is a measure of functional distance, computed as the ratio of branches weighted by the logarithm of 1 plus the kilometric distance between the province of the branch and that where the parent bank is headquartered, over total branches in province j (see Section 4 for details). Source: authors' calculations on Bank of Italy data.

F–DISTANCE_SC, by province, is a measure of functional distance, computed as the ratio of branches weighted by the logarithm of 1 plus the difference in social capital (computed as the average voter turnout at the 21 referenda held in Italy in 1993, 1995 and 2001 as published by the Home Department) between the province of the branch and that where the parent bank is headquartered, over total branches in province j (see Section 4 and equation 1 for details). Source: authors' calculations on Bank of Italy data.

BRANCHES, by province, is an indicator of branch density, computed as the number of bank branches in province j per 10,000 inhabitants (see Section 4 for details). Source: authors' calculations on Bank of Italy and ISTAT data.

RELATIONSHIP, by firm, is the natural logarithm of one plus the length in years of the credit relationship between the firm and its main bank. (see Section 4 and equation 2 for details). Source: Unicredit's Surveys.

VALUE ADDED, by province, is the logarithm of the real value–added. Source: ISTAT.

EMPLOYEES, by firm, is the number of workers, divided into six categories: 11–20, 21–50, 51–100, 101–250, 251-500, and more than 500, where the first class is taken as reference category. Source: Unicredit's Surveys.

AGE, by firm, is the age, in years since the foundation of the firm. Source: Unicredit's Surveys.

CORPORATION, by firm, is a dummy equal to one if the firm is a corporation. Source: Unicredit's Surveys.

R&D, by firm, is the ratio between the expenditures in research and development per–employee, deflated by the ISTAT's price index by industrial sectors. Source: authors' calculations on ISTAT data and Unicredit's Surveys.

EXPORT, by firm, is a dummy equal to one if the firm exports a share of its sales. Source: Unicredit's Surveys.

*ISO*9000, by firm, is a dummy equal to one if the firm is ISO9000 certified. Source: Unicredit's Surveys.

$CONSORTIUM$, by firm, is a dummy equal to one if the firm if the firm belongs to one or more credit, export and/or research consortium. Source: Unicredit's Surveys.