Ownership Structure, Governance, and Innovation: Evidence from Italy

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Abstract

This paper tests the impact of firms' ownership structure on firms' innovation decisions using a rich dataset of about 20,000 Italian manufacturers. After accounting for its possible endogeneity, we find that ownership concentration negatively affects the probability of innovation, especially by reducing firms' R&D effort. The results suggest that conflicts of interest between large and minority shareholders are a determinant of the negative effect of ownership concentration on innovation. Moreover, risk aversion induced by lack of financial or industrial diversification appears to be an additional source of large shareholders' reluctance to innovate. Once we distinguish across types of shareholders, we uncover some evidence that families support innovation more than financial institutions, but that the benefits of financial institutions for technological change increase with their equity stakes. Collectively, the findings support the view that the agency problems that affect firms in continental Europe differ from those in the United States, not only in static but also in technologically dynamic environments.

JEL Codes: G32, O3

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1 Introduction

Technological innovation is a key determinant of firms' performance (OECD, 2010). Innovation affects the degree to which firms can enhance their productivity (Tellis, Prabhu and Chandy, 2007). It also influences their ability to penetrate into new markets, including foreign ones, or preserve their leadership as market incumbents (Geroski, 1995). Corporate governance can play a crucial role in firms' ability to advance their technological frontier. For example, it is sometimes claimed that the public companies that are prevalent in the United States are suitable for promoting innovation because they can diversify the risk of innovation across a large number of investors (Aghion, Van Reenen and Zingales, 2009). By contrary, in recent years some policymakers have expressed concerns that family–oriented businesses, such as those typical of countries of continental Europe and East Asia, might be less prone to technological change (Onida, 2004). For example, families could be reluctant to abandon their traditional core business and venture into risky new activities. These arguments are however far from being established and the relation between firms' ownership structure and innovation remains an open question.

The objective of this paper is to shed new light on the effects of ownership on innovation exploiting a rich survey of over 20,000 Italian manufacturing firms conducted by the banking group Capitalia. The dataset

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provides thorough information on firms' innovation effort which is based directly on firms' responses to survey questions. It also contains precise measures of firms' ownership structure, such as the capital shares and the type of the largest equity–holders. Another advantage of our dataset is the availability of instruments for firms' ownership structure. A challenge of any study on the relation between ownership and innovation is that unobservable factors can affect both the governance structure and innovation decisions. Moreover, reverse causality may also be an issue at play as technological progress itself can shape the ownership structure. Our strategy for tackling these issues is to employ information on past regulation of Italian local financial markets. It is believed that the ability of firms to obtain external finance (credit) is a key determinant of firms' needs and incentives to open participation to new shareholders, issue new equity and go public.[1] We thus employ information on the regulation of Italian local financial markets, introduced in the late 1930s, to capture exogenous restrictions on the availability of external finance and construct instruments for firms' ownership structure.

After accounting for the possible endogeneity of the ownership structure and controlling for a variety of factors that may also affect innovation, we find that ownership concentration negatively affects the probability that firms innovate: increasing the equity share held by the main shareholder reduces the likelihood of innovating by 15 percent, which corresponds to 40 percent of the mean likelihood to innovate. The negative effect weakens as ownership concentration increases, with the effect essentially tapering off for levels of ownership concentration above 70 percent of capital.[2] This result holds regardless of whether we focus on the capital share of the main equity–holder or the two largest equity–holders. Furthermore, ownership concentration appears to be essentially neutral for total investment, signalling that its negative effect on innovation does not simply reflect a broader effect on the total volume of investment. When we subdivide the innovation process into its phases, we also find that ownership concentration depresses investment in R&D more than (proxies for) technology adoption. When we split the sample by size of the firm, we find that ownership concentration has a negative effect on innovation on large firms, and not on small firms, for whom the effect is not statistically significant. The effect is negative for firms in sectors where economies of scale are not important and for firms operating in 'traditional' sectors. Ownership concentration does not seem to matter for high tech firms, for whom, presumably, innovation is a precondition for survival. Finally, it is worth mentioning that, throughout the analysis, we distinguish between product and process innovation. Most results mentioned so far refer to the former. In contrast, ownership concentration has no significant effect on process innovation, which is consistent with the hypothesis that the two respond to different objectives and may have different determinants (Cohen, 1995, and Cohen and Klepper, 1996).

The analysis then turns to disentangle the mechanisms through which ownership concentration depresses innovation. Italy represents an ideal environment to study conflicts of interest between large and minority shareholders and their possible impact on innovation. In fact, the Italian corporate sector is characterized by a strong presence of individual owners that hold sizable equity stakes in companies, while institutional ownership is less diffused than in the United States. The results suggest that conflicts of interest between large and minority shareholders indeed contribute to the negative effect of ownership concentration on innovation. In fact, the presence of external managers (who are believed to safeguard minority shareholders' interests against the opportunism of large shareholders) in the board of directors has a positive effect on the propensity

[1] For example, the access to bank loans can impact investors' ability to obtain funds to purchase equity (Caselli and Gennaioli, 2006), the need for firms to issue new equity or also the price at which new equity can be sold.

[2] These results hold for product innovation, while ownership concentration appears to be neutral for process innovation.

to innovate. We also uncover evidence that attributing control to the main shareholder fosters innovation. This suggests that aligning cash flow rights with control rights may mitigate agency problems inside firms, for example because it induces controlling shareholders to fully internalize the effect of their decisions on the firm's performance. In addition to this, we find that risk aversion induced by lack of financial or industrial diversification may be a further source of large shareholders' reluctance to innovate. The last part of the paper examines whether the nature of the main shareholder plays a role in innovation decisions. Firms led by a family appear to be more prone to innovation than firms led by a financial institution. However, the benefits of ownership by financial institutions for innovation increase with their equity stake.

There is growing empirical literature on the role of large shareholders in explaining corporate performance, but the evidence is mixed. Shleifer and Vishny (1986), McConnell and Servaes (1990) and Zingales (1995) find a strong positive relation between ownership concentration and corporate performance in the United States and some other developed economies and attribute this to large shareholders' monitoring. For Japan, Kaplan and Minton (1994) show that firms with large shareholders are more likely to replace managers in response to poor performance. Yafeh and Yosha (1996) uncover evidence that large shareholders reduce discretionary spending by Japanese managers, such as advertising and entertainment expenses. Focusing on transition economies, Claessens (1997) identifies a positive relationship between ownership concentration and both voucher prices and stock market prices. Xu and Wang (1999) obtain similar evidence for a sample of listed Chinese companies. Finally, Barberis, Boycko, Shleifer and Tsukanova (1996) detect a positive relation between firm performance and ownership concentration in Russia. In contrast with these studies, other scholars find a negative effect of concentration on performance for non–U.S. firms. For example, Claessens, Djankov, Fan and Lang (2002) demonstrate the existence of a negative effect of large controlling shareholders on the valuation of East Asian firms. Gillan and Starks (2000) survey this empirical literature and conclude that, while some short–term market reaction to increases in the control rights of large shareholders has been documented, there is little evidence of improvements in long–term operating or stock market performance.[3]

The empirical evidence on the impact of ownership structure on innovation is scant and focuses on the United States. Eng and Shackell (2001) find a positive correlation between institutional ownership and R&D expenditures. Bushee (1998) confirms this positive link between institutional ownership and innovation. In fact, his results indicate that managers are less likely to cut R&D to reverse a decline in earnings when institutional ownership is high. Aghion, Van Reenen and Zingales (2009) confirm this positive link between the innovation effort of U.S. firms and institutional ownership, especially when product market competition is intense and CEOs are less entrenched (that is, less protected from hostile takeovers). Sapra, Subramanian and Subramanian (2009) find that the innovation of U.S. firms has a U–shaped relationship with the level of takeover pressure that firms face. Collectively, our finding that ownership concentration is detrimental to innovation contrasts with what predicted by the U.S.–based literature. This corroborates the view that the agency problems that affect innovative firms in the United States differ from those affecting firms in other countries. For instance, as we further discuss below, the managerial agency problems that characterize U.S. public companies can substantially differ from the conflicts of interest that plague businesses in Europe and Asia.

The remainder of the paper is structured as follows. In Section 2, we describe the institutional environment. In Section 3, we discuss the predictions of the theoretical literature. Section 4 details the data,

[3] Similar results are documented in Klein and Zur (2009) and Li, Moshirian, Pham and Zein (2006).

the measurement of the variables and the econometric methodology. Section 5 presents the main results. In Section 6, we disentangle the mechanisms through which firms' ownership structure affects innovation. In Section 7, we carry out additional tests on the role of the shareholders' type for innovation. Section 8 concludes.

2 Institutional Background

Italy provides an ideal testing ground for isolating the link between ownership concentration and innovation in a context where concentrated corporate ownership is predominant. In Anglo–Saxon countries, the degree of ownership concentration is low. In Italy, instead, in 2000 (roughly the median year of our sample) the main shareholder of a non–public manufacturing company owned about 65% of the company on average (Bianco, 2003; Bianchi and Bianco, 2008). Even restricting attention to listed companies, one still finds very strong ownership concentration with 44% of shares detained by the top shareholder. Another salient difference between the Italian ownership structure and that of Anglo–Saxon countries regards the identity of the top shareholders. In Italy, in 2000, the State was the main shareholder in 18% of firms. For non–state owned manufacturing firms, the top shareholder was a family or an individual in 54% of cases, another company in 27% of cases, a foreign firm in 13%, and a financial holding in 5% of cases. These figures reveal the importance of family firms and the limited presence of financial institutions in the ranks of shareholders. The main reason is that for several decades legal prescriptions introduced in the 1930s prevented banks from holding shares in corporations. Despite a recent change in the legislation (d.lgs. 481/92 and 385/93), the limited role of financial institutions as corporate owners continues to be a characteristic of the Italian capitalism.

Turning to innovation, the Italian economy features a relatively low R&D intensity. For instance, business R&D statistics published yearly by the OECD indicate that in Italy business formal R&D spending relative to the GDP was 0.56% (0.9%) in 2001 (2007), compared to 1.62% (1.8%) in the EU and 1.62% (2.4%) in the OECD countries (OECD, 2003 and 2009). Formal R&D spending in the OECD countries is more relevant in high– and medium–high tech industries (representing 52.6% and 36%, respectively, of total R&D spending), and tends to be carried out more by medium–sized and large firms. Both the specialization of Italian firms in low– and medium–tech industries (Malaman, 1997) and the relatively small size of Italian firms (Nicoletti, 2002) might play a role in explaining the low R&D intensity of the Italian economy. It is however possible that statistics on formal R&D spending underestimate the innovative effort carried out at the firm level, particularly for small firms that are more likely to engage in informal or "tacit" R&D activities.

3 Theoretical Predictions

To understand the relationship between ownership structure and innovation, it is crucial to keep in mind the properties of innovation. First, new technologies are informationally opaque (Rajan and Zingales, 2001): innovations are less understood by third parties (e.g., market participants, courts) and few interim signals (e.g., cash flows) are available on their final outcome (Goodacre and Tonks, 1995). Second, innovations entail large up–front effort and start–up costs (Hall, 2005). Third, innovations require a long gestation period (Goodacre and Tonks, 1995). Fourth, innovations are risky. When a firm makes an investment to improve

its processes or products, it can incur into evaluation mistakes which may render the investment unprofitable (Carpenter and Petersen, 2002). Moreover, when a new technology is introduced entrepreneurs have a strong incentive to add risk (Gonas, Highfield and Mullineax, 2004). And innovations have little salvage value: at the R&D stage, investments consist mostly of salaries and intangible assets (e.g., intellectual property); at the adoption stage, the assets that embody innovations are specific to the firm (Carpenter and Petersen, 2002; Hall and Khan, 2003).

These four features of innovation (informational opaqueness, start–up costs, long–term horizon, riskiness) are relevant for the impact of ownership structure on the agency problems inside firms that pursue innovation. The U.S.–based literature highlights the positive role of ownership concentration in mitigating agency problems between shareholders and managers in dispersed companies, such as the U.S. public companies (see, e.g., Shleifer and Vishny, 1997, for a survey). Consider the case in which managers are "lazy"(prefer a quite life) or have career concerns. These problems are likely to be especially severe for innovations: new technologies entail large effort and start–up costs so they are naturally conducive to laziness. Moreover, as argued by Aghion, Van Reenen and Zingales (2009), innovation is risky for a CEO: if things go wrong for purely stochastic reasons, the board may think he is a bad manager and may fire him. This generates aversion to innovation. If incentive contracts cannot overcome these problems, a large investor could have the incentive to monitor managers, forcing them to choose innovation optimally, and insulate managers from the reputational consequences of a failure of the innovations (Aghion, Van Reenen and Zingales, 2009).[4] Another problem that is especially severe for innovation is "short–termism". Stein (1988) argues that shareholders cannot properly evaluate investments in long–term innovative projects and therefore tend to undervalue the stocks of innovative companies. This, in turn, would make it easier for hostile acquirers to obtain control of the company by buying its shares at low prices. To protect current shareholders from such an expropriation, managers will invest less effort and human capital in innovative projects and more in routine projects with quicker and more certain returns. If ownership concentration is high, and in particular institutional owners are important, they will reduce the pressure on managers for myopic investment behavior. Manso (2010) develops a theoretical model, and Azoulay, Manso and Zivin (2009) provide evidence, that greater pressure on innovators and lower tolerance towards mistakes can lead to lower creativity and less innovation. If one applies this reasoning, in highly concentrated firms, and particularly in family firms where the ownership structure is more stable, long–termism of investors might promote investments in new technologies (Lehmann and Weigand, 2000).

In the United States, only few firms are controlled by a large investor, so the U.S.–based literature focuses on the above benefits of large shareholders in mitigating managerial agency problems while it downplays the costs of having large shareholders. However, in Italy, like in other countries of continental Europe and in East Asia, ownership is often concentrated. A broad body of literature argues that large investors can become entrenched and represent their own interests at the expense of minority shareholders and other stakeholders of the firm (Shleifer and Vishny, 1997; Morck, Shleifer and Vishny, 1988). Conflicts between large and minority shareholders are allegedly frequent in concentrated companies in Europe and South East Asia, especially when large shareholders have control over firms in excess of their cash flow rights (La Porta, Lopez-de-Silanes and Shleifer, 1999). Expropriation of minority stakeholders is likely to be easier for informationally opaque

[4] Jensen and Meckling (1976) show that large shareholders have more incentives to monitor firms' managers. According to a large body of studies, institutional owners have better incentives (they generally own a larger share of the firm) and skills (they own stock in many firms so they benefit from economies of scope in monitoring) to monitor.

new technologies and, hence, minority stakeholders will be less prone to innovation. A second problem is that large, undiversified shareholders can distort firms' investment decisions because of their risk aversion (Bolton and von Thadden, 1998; Shleifer and Vishny, 1986). This problem is probably severe for innovations because they are very risky. In this case, ownership concentration will reduce diversification, thus depressing the incentive to innovate (see, e.g., Morck and Yeung, 2003, for a model).[5]

4 Data and Empirical Strategy

4.1 The Empirical Model

In the first part of the analysis, we investigate the effect of ownership concentration on innovation. Denote by y^* the difference between the return that a firm expects to appropriate from a new technology and the expected return from an existent technology. The firm's decision to innovate can be modeled as:

$$y = \begin{cases} 1 & \text{if } y^* > 0 \\ 0 & otherwise \end{cases} \tag{1}$$

$$y^* = xa_1 + z_1 d_{11} + u_1, \tag{2}$$

where y is a measure of the innovation choice (e.g., a dummy variable that takes the value of one if the firm innovates, zero otherwise), x is a measure of the capital share held by the main shareholder(s), z_1 denotes a vector of controls, and u_1 is the residual.

In testing for the effect of ownership concentration on innovation, we must account for the possibility that ownership structure and innovation are jointly determined and that there exist unobserved factors that are correlated with both. The literature offers predictions on possible common determinants of innovation and ownership structure. These include firm characteristics and local market conditions. For example, informational transparency is a feature of a firm that may affect innovation (Cohen, 1995). The informational transparency of the firm may also affect its ownership structure because asymmetric information determines the availability of equity and debt (see, e.g., Rajan, 1992, and Rajan and Zingales, 2001). Another characteristic of a firm that may affect both innovation and ownership structure is production efficiency. On the one hand, higher efficiency implies a higher return and probability of success of new technologies. On the other hand, higher efficiency may also attract new investors to the firm, affecting its ownership structure. Local market conditions may also be a common determinant of innovation and ownership structure. For example, tax policy is a critical determinant of ownership structure (Gentry and Hubbard, 2000), but also affects firms' innovation choices (Levine, 1991). Moreover, the endogeneity of ownership structure may stem from the reverse causality between ownership and innovation.[6] A final issue relevant for our analysis is the attenuation bias that may affect our estimates and that can originate from errors in the measurement of the share of capital held by the main shareholder(s), which, in our data, is reported by the person within the firm in charge of answering the survey questionnaire.[7]

[5] Recent empirical findings on R&D spending are consistent with this hypothesis. For example, Morck, Stangeland and Yeung (2000) find that Canadian firms controlled by heirs are less active in research and development.

[6] Himmelberg, Hubbard and Palia (1999) find evidence of reverse causality between ownership and firm performance.

[7] The agency in charge of conducting the survey on behalf of Capitalia identifies by phone the person within each firm to submit the survey to. This person is generally the administrator or the entrepreneur, who is subsequently contacted and interviewed by phone.

We address these endogeneity issues using an instrumental variable approach. We denote by z_2 a vector of instrumental variables that are correlated with the ownership structure but affect the innovation decision only through the ownership channel. The effect of these instruments on x is captured by d_{22} in the ''ownership equation'':

$$x = z_1 d_{21} + z_2 d_{22} + u_2, \tag{3}$$

where z_1 refers to the control variables in (2), z_2 is the vector of instruments, and u_2 is the residual.

We estimate the model in (1)-(2) using two methods, two–stage least squares (2SLS) and Newey (1987)'s Amemya's generalized least squares (AGLS) for limited dependent variable models. The 2SLS estimation assumes that the probability of innovation is linear in x and z_1. Usually, with dicothomous dependent variables, 2SLS work well for values of the explanatory variables close to sample averages, but suffer from two limitations. The first is that predicted values can fall outside the unit interval of probabilities. The second is that the model restricts the partial effect of any explanatory variable (expressed in levels) to be constant. Despite that, 2SLS provide a consistent estimate of the (partial) effect of ownership concentration on the probability of innovating, averaged across the distribution of the other controls.[8] In addition to 2SLS, we estimate the model using the AGLS estimator for probit models, which is a minimum chi–square estimator.[9] This is less efficient than maximum likelihood probit estimation, but is computationally robust and produces consistent estimates and accurate standard errors when the dependent variable is dicothomous and the endogenous explanatory variable is continuous (Newey, 1987). Furthermore, based on Adkins' (2009) simulations, AGLS estimators perform better than maximum likelihood probit estimation when instruments are not strong. OLS and maximum likelihood probit estimation results are also reported.

4.2 Data Description

Our main data source is the sample of Italian manufacturing firms surveyed by the Italian banking group Capitalia. We use four waves of the Capitalia survey, which cover three–year periods ending respectively in 1997, 2000, 2003 and 2006. The data set includes a representative sample of all firms with 10 to 500 employees and the universe of firms with more than 500 employees (about 6 percent of firms in the sample). Overall, approximately 4,500 firms were interviewed in each survey wave. Collected data include: information on product and process innovation, R&D investment and other innovation variables; information on the largest shareholders, including their type and equity shares, as well as other details on the ownership structure; balance sheet data; company characteristics, including demographics, data on management and employment at various organizational levels, participation in groups and consortia of firms, data on the market for the firm's products, on the relationship with customers, suppliers and banks, and information regarding sources of finance. Three, four or five–digit industry (ATECO) codes are also reported. Some of these variables (e.g., balance sheet data) are available for each year covered by the survey; some (e.g., affiliation to groups) refer to the time of interview; others refer to the three–year period covered by the survey.

[8] Running least squares on a dichotomous variable results into inefficient estimates by definition, since the structure of the estimation is guaranteed to create heteroscedasticity (Aldrich and Nelson, 1984). We deal with this issue by using heteroskedasticity-robust standard errors.

[9] This estimator consists of first estimating a reduced form for the endogenous regressor (i.e., for our measure of ownership concentration) and computing the residual. Then, generalized least squares are applied to a reduced form for the probit model for innovation. The explanatory variables of the probit model include all the exogenous variables and instruments plus the residual from the first-step estimation.

Table 1 displays summary statistics of the variables used in the empirical analysis (see the Appendix for details regarding the construction of these variables). The firms' geographic distribution reveals a predominance of firms located in the North of Italy (68% of the total), while 21% of the firms are in the Center and 11% in the South. The distribution among sectors, defined according to Pavitt's taxonomy (Pavitt, 1984), shows the predominance of businesses operating in traditional manufacturing sectors (almost half of the sample). The portion of high technology firms is relatively low, less than 5% of the sample. The average size of firms, as measured by the number of employees, is small to medium (with an average of 105 employees and a median of 34). The mean level of annual sales is 242,500 euro, while the median is 55,000 euro. To better grasp these magnitudes, we compared the demographic statistics for the firms in our sample with those for the pooled 1998 and 1993 waves of the National Survey of Small Business Finances (NSSBF) conducted by the U.S. Board of Governors of the Federal Reserve System and the Small Business Administration. On average, the businesses in the pooled NSSBF waves are 15 years old (with a median of 12) and have 30 employees (with a median of 6). Thus, the businesses in our sample are slightly larger than those in the NSSBF, although they are still small or medium-sized.

For the analysis, we also use data from other sources (see the Appendix for details on the variables). We employ data made available by the Bank of Italy on the presence of banks in local markets. We use data provided by the Italian National Statistics Office (ISTAT) on civil suits and population per judicial district, as well as on the value added and population of provinces. Finally, we employ the index of financial development of Guiso, Sapienza and Zingales (2004).

4.3 Innovation

We distinguish between product and process innovation because the two tend to respond to different objectives and, more importantly, different factors can have very different impact on them (Cohen, 1995; Cohen and Klepper, 1996). To study innovation, we use measures based on firms' responses to the following survey question: "In the last three years, did the firm realize product innovations, process innovations, organizational innovations related to product innovations, organizational innovations related to process innovations?". We define two binary variables that take the value of one if the firm innovated, zero otherwise: (a) *Innoprod* refers to product or related organizational innovation; (b) *Innoproc* refers to process or related organizational innovation. Later in the analysis, we will introduce and discuss other variables capturing specific aspects of innovation.

In our sample, 39 percent of the firms report some product or product–related innovation over the three years covered by the survey and 51 percent report some process or process–related innovation.[10] The correlation between these two variables is between 0.3 and 0.4. Table 1 reports firms' characteristics for the whole sample and for sub–samples of firms: we distinguish between firms that have carried out or not some product innovation (second and third column), some process innovation (fourth and fifth column), and some R&D investment (last two columns). Innovators exhibit higher ownership concentration, are substantially less likely to be private limited companies (LTDs; *societa' a responsabilita' limitata*) and more likely to be public limited (PLCs; *societa' per azioni*) or publicly listed companies. They are also more likely to belong to a group or a consortium. Relative to firms that do not innovate, the main shareholder is less

[10] These percentages are similar to those reported by Eurostat for the universe of Italian firms (2004, p. 162). Eurostat reports that in 2000 about 40% of Italian manufacturing firms innovated, with higher values for medium-sized and large firms.

often an individual person or a family as opposed to a financial institution or a bank. Firms carrying out process innovation are relatively more likely to be owned by other manufacturing firms or holding companies. Innovators operate more often in high–tech industries than in traditional ones, maintain a relationship with more banks, are older, are about twice the size of non–innovators in terms of number of employees, assets and sales, and are somewhat more likely to be located in the North of the country.

Employing self-reported data on innovation may generate concerns that firms overstate or understate their advances. This is unlikely to be the case. First, the Italian law (675/1996) on personal data prohibits using collected data for objectives different from those originally stated in the survey, which, in the case considered, are the compilation of statistical tables. Hence, firms should have no incentive to overstate their innovations in order to establish a record as appealing borrowers. Second, the personnel employed in the survey is highly qualified; firms' responses went through multiple filters and double checks by this personnel. Third, a pure measurement error in the dependent variable would bias the results only if systematically related to the explanatory variables.

4.4 Ownership Structure

The strength of our data set lies in the highly detailed information on ownership structure and in particular on the largest shareholders, including their types and equity shares. A first key explanatory variable is the ownership concentration of the firm, which we proxy by the equity share held by the main shareholder(s). The data confirm that on average concentration is high among Italian manufacturing firms. In our data set, the largest shareholder owns 57 percent of equity on average; together, the two largest shareholders own about 80 percent on average. The remaining equity share of the firm is in the hands of minority shareholders including other individuals and families, other firms, institutional investors, such as financial institutions and equity funds. Table 1 reveals also that there is substantial variation in ownership concentration across businesses. For example, the share of the main equity holder is 25 (34) percent at the lowest decile (quartile) of firms, it equals 50 percent at the median and 85 percent at the uppest quartile. 57 percent of firms are private limited companies, 39 percent are public limited companies, 1 percent of firms are publicly listed. In 77 percent of firms the main shareholder is an individual or a family; in 10 percent it is a bank or a financial institution; in 13 percent it is another manufacturing firm or a holding company.

The survey also asks if the main shareholders have direct control over the firm (91 percent of cases) and are part of a shareholder voting agreement (48 percent of cases). Finally, the data allow us to detect if the firm made acquisitions or divestitures in the years of survey: 10% of firms made acquisitions while 3% were involved in a divestiture.

4.5 Instruments

To implement our empirical model we need an appropriate set of instruments for our measure of ownership concentration, that is, for the share of equity held by the main shareholder(s). Our strategy relies on identifying exogenous restrictions on the local financial system that affect firms' ownership concentration but not directly firms' propensity to innovate. To this end, we exploit the 1936 banking law which subjected the Italian banking system to strict regulation of entry until the end of the eighties. The rationale for using (measures of the constrictiveness of) this regulation to instrument ownership concentration is that until it was removed at the end of the eighties it plausibly affected firms' need and incentive to open participation to

new shareholders, issue new equity and go public.[11] We have in mind three possible channels through which local credit market conditions can affect ownership structure. First, when restrictions on the local supply of credit are more severe, it could be more difficult for potential acquirers to obtain the liquidity necessary to purchase shares of other firms. Caselli and Gennaioli (2006) demonstrate theoretically that less efficient credit markets prevent investors from borrowing and acquiring firms' equity. This would in turn affect the distribution of equity inside companies. Second, tighter restrictions on the local supply of credit may force a firm to resort to alternative sources of external finance by issuing equity. Myers (1984) argues that if external financing is required, firms issue the safest security first (debt). When the credit market conditions limit the possibility to apply for bank credit, firms may resort to equity. Finally, a strand of literature suggests that the credit market may offer signals to potential shareholders. For example, for the United States, Shockley and Thakor (1992) find that the existence or renewal of a loan is a positive signal to potential shareholders. For this reason, restrictions on the local supply of loans may affect a firm's ability to issue new equity.

The ownership structure is a highly persistent firm characteristic, and in Italy its persistence appears to be even stronger than usual (Bianco, 2003; Bianchi and Bianco, 2008). Thus, we expect that the 1936 banking regulation shaped firms' ownership structure during the decades in which it was in place and that this impact persisted in strongly affecting the ownership structure for several years after the lifting of the regulation at the end of the eighties. Hence, we expect the 1936 banking regulation to be correlated with the current ownership structure. On the other hand, the 1936 law is unlikely to have affected credit supply conditions for long after its complete lifting. Therefore, our instruments are unlikely to pick any direct effect on innovation of credit market conditions.

The objective of the 1936 Italian banking regulation was to enhance bank stability through severe restrictions on bank competition. In fact, in the late 1920s and early 1930s the Italian regulatory authorities formed the opinion that an excess of bank competition was at the root of the recurrent problems of bank instability. The banking law that was enacted imposed strict limits on the ability of different types of credit institutions to open new branches. Specifically, each credit institution was attributed a geographical area of competence based on its presence in 1936 and its ability to grow and lend was restricted to that area. A further directive issued in 1938 regulated differentially the ability of credit institutions to grow. National banks (*banche di interesse nazionale*) could open branches only in the main cities; cooperative and local commercial banks could open branches within the boundaries of the province where they operated in 1936; savings banks could expand within the boundaries of the region (which comprises several provinces) where they operated in 1936.[12] Guiso, Sapienza and Zingales (2003, 2004) demonstrate that these banking laws deeply impacted local credit markets (creation and location of new branches) in the decades that followed. For example, between 1936 and 1985, in Italy the total number of bank branches grew by 87 percent versus 1228 percent in the United States. By contrary, after the deregulation (1985-late 1990s), the total number of branches grew by 79 percent, versus 43 percent in the United States.

To identify the effects of ownership concentration on the propensity to innovate, we will exploit the differences in the constrictiveness of regulation across local credit markets, as determined by the structure

[11] Bhattacharya and Ravikumar (2001) suggest that the evolution of firms' ownership structure depends on the development of primary capital markets in the economy. Aganin and Volpin (2004) show that in Italy, due to a joint negative effect of laws and politics on financial markets, the majority of firms steer clear of the stock market and are closely held by the founders' families.

[12] Provinces are local entities with the size of U.S. counties. They are 103 and are grouped in 20 regions.

of credit markets in 1936. The variation in the tightness of restrictions can be safely considered exogenous because in 1936, when the regulation was introduced, the local credit market structure was independent of local market characteristics that could affect the ability to do banking and the ability of firms to grow. As discussed by Guiso, Sapienza and Zingales (2003, 2004), in 1936 the distribution of types of banks across provinces, and hence the constrictiveness of regulation in a province, was not the result of market forces, but of a government–directed consolidation activity occurred during the 1930-1933 crisis.[13] In addition to this, and relevant for the exogeneity of our instruments, the regulation was not designed with the needs of the different provinces in mind. In fact, the differences in the restrictions imposed on the various types of banks were related to differences in the connections of the banks with the Fascist regime.[14] Finally, in that period there was a bias against large banks, due to their role during the 1930-33 banking crisis.

In practice, as instruments we use the four indicators that Guiso, Sapienza and Zingales (2003) employ to characterize the local structure of the banking system in 1936, and thus the constrictiveness of regulation. These indicators are: i. the number of bank branches in the province (per 100,000 inhabitants); ii. the share of bank branches owned by local banks over total banks in the province; iii. the number of savings banks in the province (per 100,000 inhabitants); and, iv. the number of cooperative banks in the province (per 100,000 inhabitants). Based on the discussion above, provinces with more bank branches in 1936, with a higher share of branches of local banks, with relatively more savings banks and less cooperative banks should have suffered less from the freeze. Besides these indicators, other variables that are likely to reflect the constrictiveness of the 1936 banking regulation are the (average annual) number of new bank branches created within a province (net of branches closed) in the years immediately after the lifting of the regulation. Following Herrera and Minetti (2007), we distinguish between branches created by incumbent banks and branches created by entrant banks in the province (per 100,000 inhabitants).

Our instruments could be criticized on the ground that cyclical variations in the economic activity of a province after the deregulation are correlated both with our instruments and with firms' current innovation decisions. Thus, in our regressions we control for the growth rate of the value added of the province imputed as the average over the 1991-98 period. In addition to this, to further reduce the risk that our historical instruments have an independent effect (i.e., other than through the ownership structure) on the current propensity to innovate, we include in the regressions several firm–level variables capturing current credit conditions (credit rationing, length of credit relationships, number of banks) as well as proxies for current local lending conditions (the number of bank branches in the province where the firm is headquartered, the Herfindhal–Hirschman Index on bank loans and the financial development index put forth by Guiso, Sapienza and Zingales, 2004). To conclude, a broader argument in defense of our instruments relates to the unclear importance of province–level characteristics for firms' innovation. Cohen (1995) stresses that few

[13] The Italian government bailed out the major national banks and savings banks, but let smaller commercial banks and cooperative banks fail. Furthermore, the distribution of different types of banks reflected the interaction between previous waves of bank creation and the history of Italian unification. For instance, the strong presence of savings banks in the North East and the Center stemmed from the fact that this institution originated in Austria and started to operate first in the provinces dominated by the Austrian Empire (Lombardia and the North East) and in close-by states (especially Tuscany and the Papal States). By contrary, two of the major national banks (Banca Commerciale and Credito Italiano) were the result of direct German investments in Lombardia and Liguria, the most advanced regions at the time.

[14] In particular, savings banks were one of the main financial supporters of the regime. Savings banks were non-profit organizations and they had to distribute their profits to "charitable activities". After 1931 these donations were concentrated toward political organizations created by the Fascists.

studies have controlled for the impact of local characteristics on firms' technological innovation and that the results of these studies are mixed.[15] All in all, we have reasons to believe that the correlation between our instruments and the residual in the innovation equation is negligible.

4.6 Control Variables

We finally discuss the other explanatory variables included in the regressions (more details are in the Appendix). The literature suggests that the probability of innovation is a function of the value and pledgeability of the assets of a firm. In fact, if the firm's innovation fails, its financiers will recover the liquidation value of the firm's assets (Rajan, 1992). Thus, the larger and the more easily pleadgeable the assets, the easier will be for the firm to obtain external funds for the innovation. We measure the assets of a firm by total assets and their pledgeability by two proxies for asset liquidity, the ratio of current to total assets and the ratio of inventories to total assets. The predictions of the literature about the effect of these variables are ambiguous. Some studies suggest that more liquid assets are more pledgeable, others argue that more liquid assets are easier to expropriate and, hence, less pledgeable (Myers and Rajan, 1998). Another element that could impact innovation is the verifiability of the entrepreneur's output. This, in turn, depends on the informational opaqueness of the firm and on the efficiency of courts. Young firms are more informationally opaque than older ones because they lack an established track record. Hence, we control for the natural logarithm of age and its square, where the age of the firm is measured from the firm's inception. The literature also suggests that small firms are more informationally opaque than bigger ones because they are not scrutinized by rating agencies or by the financial press (Petersen and Rajan, 1994; Berger and Udell, 1998). We measure size by total sales (results with the number of employees are similar). Regarding the efficiency of courts, we control for the number of civil suits pending in each of the 27 judicial districts of Italy per 1,000 inhabitants. A high number of pending suits could reflect an inefficient enforcement system (Bianco, Jappelli, and Pagano, 2005). This variable is imputed to the firms according to the judicial district where they are headquartered. Besides this, the propensity to innovate is likely to depend on the return advantage of innovation. The literature has pinned down several factors that may affect such an advantage (Cohen, 1995). A first factor is size: bigger firms can spread the fixed costs of innovation over a larger volume of sales, which we account for. Another factor is diversification. Diversified firms have more chances for exploiting economies of scope associated with innovation. Presumably, the higher the number of industries in which the firm is active, the more diversified the firm is. For this reason, we construct two dummy variables equal to one when the firm is classified in a four– or five–digit ATECO sector (zero otherwise). An additional factor is age. Plausibly, older firms are less flexible and face higher adjustment costs when innovating (Hall and Khan, 2003).

Other factors that can affect the likelihood of innovation are current local lending conditions and access to financial resources in general. Moreover, the information made available to a bank can affect the expected return of an innovation over and above its allocation between entrepreneur and bank: for example, when a firm engages in an R&D race for a patentable innovation, the bank can disclose information to the firm's rivals (Bhattacharya and Chiesa, 1995; Yosha, 1995). In practice, we control for current access to bank

[15] A final objection to our instruments is that firms can choose where to locate. However, since we control for current lending conditions, firms' mobility would invalidate our analysis only if firms chose their location keeping into account the distribution of bank branches in 1936 and its implications for their (future) innovation plans. While this cannot be ruled out a priori, we feel that it might happen for a handful of firms at most.

credit by including in our regressions the number of banks with which the firm maintains a relationship, the duration of the relationship with the main bank (i.e., with the bank granting the largest share of credit) and a dummy variable equal to one if the firm reports to be credit rationed, zero otherwise. Furthermore, we insert some variables to control for the structural characteristics of the banking sector at the time of the survey, such as the number of bank branches (in the province, per 100,000 inhabitants), the Herfindahl–Hirschman Index on bank loans (in the province) and the Guiso, Sapienza and Zingales (2004) financial development index.

Finally, we include provincial GDP growth and sector dummies based on a two–digit ATECO classification. As Cohen (1995) argues, industry dummies perform well in capturing the probability that a firm faces innovation opportunities because they can capture intra–industry knowledge spillovers or the competitiveness of the industry. Last, some factors, including the quality of infrastructure and the level of crime, could differ across the three macro areas of Italy (North, Center, and South). We code dummies for whether a firm is located in the Center or in the South of Italy, to account for the possible consequences of these factors on innovation opportunities and on the returns from innovation.

5 The Role of Ownership Structure

5.1 Main Results

Table 2 reports OLS and probit estimates of the likelihood of realizing some product or product–related innovation (columns 1-2) and some process or process-related innovation (columns 3-4). OLS estimates are in the upper panel of the table; probit estimates are in the lower panel. Tables 3 and 4 report instrumental variable (IV) estimates. All our results are virtually identical whether we lump product and process innovations together with related organizational innovations or not. Henceforth, we focus on the results obtained by including organizational innovations. In columns 1 and 3 of Table 2, we regress the innovation dummies on our first measure of ownership concentration, the capital share held by the main shareholder. The list of controls is described in the previous section and is also reported in the note to the table. Let us first consider the OLS estimates. We find that the larger the equity share held by the main shareholder, the greater is the probability that the firm carries out product innovation. Instead, in the regression for process innovation, the coefficient on the equity share of the main shareholder is statistically insignificant. In the probit estimation, the coefficients of our measure of ownership concentration are 0.185 for product innovation and 0.041 for process innovation; the z–statistics are 4.30 and 0.95, respectively.[16] In columns 2 and 4, instead of controlling for ownership concentration by looking only at the main shareholder, we use the equity share held by the two largest shareholders. The sign and significance of the coefficients are essentially unaffected.

The OLS and the probit estimates are likely to be biased due to reverse causality problems and to the omission of variables that could be correlated with both innovation and ownership concentration. The direction of this bias is not clear a priori. For example, our controls for firms' informational transparency and production efficiency may be imperfect. In general, a higher degree of informational transparency is likely to facilitate innovation by attracting outside investors. At the same time, it can reduce the need for

[16] The coefficients of the linear probability model are a direct estimate of the (partial) effects of the explanatory variables on the probability of innovation. Instead, with probit estimation, to gauge such effects, the common approach is to divide the coefficient estimates by 2.5 (Wooldrige, 2002, p. 466).

monitoring by shareholders and, hence, for ownership concentration, which would lead to a downward bias in the estimate of the impact of concentration on innovation. As another example, consider the inability to control thoroughly for production efficiency, which may also be a source of downward bias. In fact, higher efficiency may increase the benefits of innovation and thus promote it. At the same time it can also attract new equity–holders, reducing ownership concentration. On the other hand, one may conjecture that reverse causality can generate an upward bias in our estimates. For instance, the main shareholder of an innovative firm could have little incentive and need to attract new shareholders if she expects good profits from the introduction of a new technology. Instrumental variable estimation allows us to address these issues. In practice, we choose our instruments out of the set of variables reflecting the constrictiveness of the 1936 banking regulation in Italy, with the exact set varying somewhat depending on the specific regression (full details are reported in the notes to the tables). The exact choice of instruments is based on first–stage regressions, that is, on the ability of the instrumental variables to predict ownership concentration, conditioning on the exogenous variables included. Tables 3 and 4 report the results of IV estimation using 2SLS on the linear probability model and AGLS for the probit specification. Table 3 displays the first–stage coefficients on the excluded instruments (the coefficients on the other variables are available upon request). The equity share held by the main shareholder is increasing in the number of bank branches in the province in 1936 and in the number of branches created by new entrants over the 1991-1998 period, supporting the hypothesis that greater availability of bank credit reduces the need to sell equity. Instead, it is decreasing in the relative importance of local banks and in the diffusion of savings banks (but the latter coefficient is not statistically significant). The instruments are jointly highly significant (p–value = 0.0000); first–stage F–statistics are between 5 and 6.[17] The p–values of the overidentification tests, reported in Table 4, show that, except for the regressions for process innovation, we cannot reject the null hypothesis that the instruments are uncorrelated with the regression residual at standard levels of confidence. Finally, in Table 4 we also report the p–value for a test of exogeneity of our measure of ownership concentration in the probit.[18] Based on this test, we reject the null hypothesis that the equity share is exogenous with respect to the propensity to carry out product innovation, but we generally do not reject this hypothesis with respect to the propensity to carry out process innovation.

In Table 4, we report the results of the second–stage of the IV estimation. Henceforth, we provide comments on the AGLS probit estimates; the 2SLS estimates are qualitatively similar. Once we account for the problem of endogeneity, the impact of ownership concentration on the likelihood of innovation becomes negative. The negative impact on product innovation is significant (with z–statistic equal to –2.54 and –1.85, depending on the set of instruments used) and large (with coefficients equal to –2.852 and –1.406), especially when compared to the effect of control variables such as firm characteristics or local market conditions. Estimated coefficients imply that increasing the equity share of the main shareholder by one standard deviation would reduce the likelihood of innovation by over 15 percent, which corresponds to almost 40 percent of the mean. The impact on process innovation becomes negative too (for at least some set of instruments, columns 5a and 5b), but it remains insignificant. As discuss earlier, the estimated negative

[17] An F-statistic between 5 and 6 signals that we could have a weak instruments problem and our estimates could be biased toward their OLS counterparts. However, based on Stock and Yogo (2002)'s tabulation of the critical values for the weak instrument test, we reject the null of a relative bias greater than 20 percent.

[18] In the AGLS probit estimator, in the second stage we include the residual from the first-stage OLS as a regressor. The Wald test for the exogeneity of ownership concentration is a test of significance on the coefficient of this residual.

effect of ownership concentration on firms' innovation stands in sharp contrast with the predictions of the theoretical literature for U.S. public companies, suggesting that agency conflicts between large and minority shareholders or problems of lack of diversification could hinder the innovation activities of Italian firms. Later in the paper, we will try to disentangle the channels through which these negative effects operate. One possible interpretation for the difference in the results for product and process innovations relates to the fact that typically product innovations, such as the introduction of new varieties of goods, are more radical than process innovations. In fact, process innovations mostly consist of marginal technological advances in the production process of existing goods. Such minor technological changes may be only loosely affected by the agency conflicts discussed earlier and, hence, be more weakly related to the ownership structure.

Interestingly, our negative coefficients should be considered an upper bound to the true estimates of the effects of interest: in fact, because our instruments are not strong, our findings are somewhat biased towards OLS (Stock, Wright and Yogo, 2002). Finally, results are robust to using different sets of instruments, such as adding the squares of the variables used as instruments, the squares of balance sheet variables, and using other subsets of the variables reflecting the constrictiveness of the 1936 banking regulation. For product innovation, the sign, size and significance of estimated coefficients does not change when we consider the equity share held by the two largest shareholders (Table 5). For process innovation the coefficient of this measure of concentration is negative and insignificant.

The results for the firm–specific control variables are generally consistent with the findings of the empirical literature on the determinants of innovation. As for firm characteristics, we find that the coefficient on the book value of assets is positive and statistically significant. The ratio of current to total assets has a large negative and significant effect, whereas the ratio of inventories to total assets has a positive impact. The coefficient of the size of the firm, as measured by its sales, is positive but not significant for product innovation, while it is negative and significant (at the 5% level) for process innovation. The polynomial in age is statistically significant and suggests a convex relationship. As for the ATECO dummies that capture the degree of diversification, we find that the coefficients of ATECO 5-digit are negative and statistically significant. This result is in line with the predictions of the theoretical literature suggesting that less diversified firms are less prone to innovation.

Regarding the variables controlling for the characteristics of the environment in which firms operate, we find that bank branch density in the province has a positive effect on the probability of innovating. The coefficients on the Herfindhal index on bank loans and on the Guiso, Sapienza, and Zingales (2004) index of financial development are generally not significant. The growth rate of the value added of the province has a positive impact on the probability of introducing innovations, but its coefficient is not significant. The dummies for Center and South are not statistically significant, either. Finally, let us briefly look at the variables proxying for external finance. The likelihood of innovations is significantly decreasing in the duration of the credit relationship with the main bank. This result could match the theoretical view that informed financiers reduce firms' innovation in order to preserve their informational rents on traditional technologies (see Minetti, 2011). As a robustness check, we use the number of banking relationships as a control (columns 3a and 3b) and obtain that the likelihood of innovations is increasing in the number of relationships, which is consistent with the view that multiple banks reduce the incidence of lenders' moral hazard (hold–up) (Rajan, 1992; Petersen and Rajan, 1994). As for credit rationing, perhaps surprisingly, the results suggest it has a positive impact on innovation (columns 4a and 4b).

5.2 Non–linear Effects

The literature argues that the effect of ownership concentration on the value of a firm may be non–linear (Stultz, 1988; Morck, Shleifer and Vishny, 1988). In the regressions displayed in columns 1 and 2 of Table 6, we allow for non–linearities in the effect of ownership concentration on innovation. For example, the presence of fixed monitoring costs could imply that large shareholders monitor only if their equity holdings exceed some threshold. Therefore, firms' innovation might decrease with more concentrated ownership, but, beyond some level of concentration, the positive effects associated with large shareholders' incentives to monitor could overcome the negative ones associated with entrenchment and expropriation. Furthermore, large shareholders could face diseconomies of scale in the expropriation of resources: a large shareholder who already diverts substantial resources from the firm might find difficult to expropriate further revenues. Both these effects would imply that the negative effect of ownership concentration on innovation decreases as concentration rises. We thus experiment by adding a quadratic term in the equity share held by the main owner and we also instrument this term.[19] Overall, the instruments are jointly highly statistically significant and we do not reject the overidentifying restrictions for either product or process innovation. In the 2SLS regressions, the likelihood of product and process innovation appears to be convex in ownership concentration, with turning point at around 70 percent of total capital, which corresponds to the 70th percentile of the distribution of ownership concentration. When allowing for a quadratic relationship, ownership concentration becomes significant also in the regression for process innovation. The evidence based on AGLS probit estimation is similar in size and sign.

In columns 3 through 9 of Table 6, we report the results from running the regressions for product innovation on sub–samples of observations. First, we distinguish between small and large firms, based on the number of employees (columns 3 and 4). The impact of ownership concentration turns out to be negative and significant only for firms with at least 34 employees, which is the median number of employees in our sample. The coefficient equals –2.887 and is significant at the 10% level. In smaller firms the effect is negative, but lower and insignificant. These results remain virtually unchanged if we split the sample at the median value of sales. One interpretation is that in very small firms minority shareholders are probably very close to the main ones (perhaps part of the extended family or network) and, hence, problems of expropriation that can depress innovation are less important. When distinguishing across sectors of activity (columns 5 and 6), we find that concentration has a negative, large (coefficient equal to –6.021) and significant (z = –2.12) impact for firms operating in traditional sectors (such as textiles, food and tobacco). By contrary, the impact is not significant for firms in high–tech sectors. This could be due to the fact that, for high tech firms, innovating is a condition for survival. Thus, the ownership structure can be expected to have a relatively limited impact on the propensity to innovate. In addition to this, it is worth mentioning that for high-tech firms ownership concentration is typically very high with the main shareholder holding 100 percent of equity in 25 percent of cases, versus less than 10 percent of cases among traditional firms. These results carry through if we partition the sample according to the classification of high–tech sectors put forth by Benfratello, Schiantarelli and Sembenelli (2008). Concentration has also a negative and significant impact (z = –2.36), with a coefficient equal to –3.874, in sectors where economies of scale are not important,

[19] As reported in the note to the table, following Wooldridge (2002), to the set of instruments used so far, we add the square of the balance sheet variables included as right-hand-side controls in the regressions for innovation. First-stage regressions are available upon request.

which include many traditional firms, whereas its coefficient is insignificant, albeit negative, in sectors where economies of scale are important (columns 7 and 8). We do not report the results of running sample splits for process innovation (available upon request). For process innovation, we obtain patterns that are in all respects very similar to those obtained for product innovation, but the coefficient estimates are insignificant. Finally, in column 9, we display the results for firms that are part of a consortium. Ownership concentration has no significant impact ($z = –0.58$) for firms affiliated to a consortium.

5.3 Changes of Ownership Structure

It is possible that not only the current ownership structure affects a firm's decision to innovate, but also that changes in the ownership structure have a role in innovation choices. Two questions in the survey may help us capture these "dynamic"effects. First, the survey asks whether the firm has issued new equity over the three years ending in the year of the survey. In addition to this, it asks about the nature of the outside investors that underwrote the new shares (financial institutions or other subscribers). The percentage of firms with new subscribers is 2.1% and 1% have financial institutions as new subscribers. In Table 7 (columns 1-4), we report regressions in which we add a dummy equal to one if a financial institution subscribed shares, zero otherwise. We treat this dummy as endogenous and instrument it using the same set of variables that we use for ownership concentration.[20] In the linear probability model, we address the endogeneity issue using two–stage least squares and instrument the dummy by its fitted probability.[21] In the non–linear probability (probit) model for innovation, we address the issue of endogeneity of the dummy by a two–step method based on a least square approximation as proposed by Arendt and Holm (2006). This procedure consists of estimating first a linear probability model for the endogenous dummy, computing the residual and then performing a probit estimation for innovation adding the fitted residual as a covariate.[22] In the tables, we label the columns reporting the estimates based on this procedure as "augmented model". The dummy for financial institution subscribing shares has a significant and positive coefficient in the model for product innovation, whether we control or not for ownership concentration.[23] The effect of this dummy on process innovation is similar.

The second relevant survey question regards the intention of the firm to go public in the following year. Less than 2% of the firms declare such an intention. In the last four columns of Table 7, we report the regressions with a dummy equal to one if the firm plans to go public, zero otherwise. Like before, we treat the dummy as endogenous and either instrument it with its fitted probability in the linear probability model or estimate a "residual augmented" non–linear probability (probit) model, as detailed above.[24] The

[20] *Our choice is justified by the fact that where the local credit market is more developed, banks may have more funds and information about firms for subscribing new equity shares.*

[21] Angrist and Pischke (2009) consider the issue of estimation when a dichotomous regressor is endogenous and suggest to instrument it with the fitted probability from a first stage probit reduced form model for the endogenous dummy. However, this procedure presents difficulties when there is more than one endogenous variable and the endogenous variables share the same instruments, which is our case when we add to the regression the main shareholder' equity share.

[22] This procedure is a simple alternative to maximum likelihood estimation. It is computationally less demanding and always converges. Arendt and Holm (2006) conduct Monte Carlo exercises to evaluate the bias of this approximation in different settings and find that this procedure works well and overall performs as well as full maximum likelihood estimation in small samples when the endogeneity is not too severe.

[23] When we control for ownership concentration in the non-linear probability model, we estimate the coefficients of interest by running AGLS on the "residual augmented" model.

[24] As instruments for the dummy for "intention to go public", we use the variables used for ownership concentration (see the

coefficient of the dummy for the intention to go public is positive and significant for both product and process innovation. These findings are consistent with our priors. In fact, issuing new equity and going public mean diluting the cash flow rights of the main shareholder and thus tends to reduce ownership concentration. Finally, in untabulated regressions, we verified whether acquisitions and divestitures have any effect on innovation. The results suggest that such events do not play a role.

5.4 Ownership and the Phases of the Innovation Process

We now break the innovation process into phases to understand at what stage of innovation corporate governance is most relevant. Broadly speaking, the innovation process comprises two phases: the research phase and the phase of introduction or adoption of new technologies. We proceed in two steps to disentangle the effects of corporate governance on research and on technology adoption. First, we investigate whether ownership concentration affects R&D decisions; then, we explore whether it affects patenting activity, expenditures for technological innovation not directly destined to R&D, and investment in information technology. Investment in information technology also appears to be a good proxy for the adoption of innovations because it is an area in which most manufacturing firms do not invent new hardware, software, or communication equipment but acquire them from ICT firms, research centers, and universities (Confindustria, 2007; Onida, 2004).

To appraise the effect of ownership concentration on R&D, we use the following survey question: "In the last three years, did the firm carry out any R&D expenditures?". Through this question, we construct a dummy variable that takes the value of one if the firm carried out some R&D, zero otherwise. In our sample, 43 percent of the firms report some R&D expenditure. The correlation between the indicator for R&D expenditure and the indicator variables for product and process innovation is between 0.3 and 0.4. We regress the dummy variable of R&D on our measure of ownership concentration. Results are in column 1 of Table 8. The effect of the capital share held by the main shareholder on the R&D decision of the firm is negative and significant at the 5% level. The effect of ownership concentration on R&D is economically sizable, especially when compared to the impact of control variables such as firm characteristics or local economic conditions.

To verify whether ownership concentration matters for the adoption of new technologies, we use the following survey question: "In the last three years did the firm carry out investment for the introduction of hardware, software, telecommunication networks?". We define a binary variable that takes the value of one if the firm carried out this type of investment (76% of firms did), zero otherwise, and regress it on our measure of ownership concentration. The results are reported in column 2. The coefficients of the equity share are negative, but small and not significant. In addition to these regressions, we carry out two additional tests on the adoption of innovations. The first test (column 3) regards patenting activity. The survey reports whether a firm acquired or sold a patent abroad. We consider the acquisition of patents: about 2% of the firms acquired patents abroad in the years of the survey. The estimated effect of ownership concentration on patent acquisition is positive, large (coefficient equal to 5.791) and significant ($z = 2.13$). The second test (column 4) considers the natural logarithm of expenditures for technological innovation that are not directly destined to R&D (e.g., acquisitions of plants, know how, training and marketing of innovative

note to the table for the exact list). The rationale for using these instruments is that tighter restrictions in the local credit market may force firms to search alternative sources of financing and induce them to go public.

products).[25] On average, the firms spend 56% of their total budget for innovation on these items. The effect of concentration is negative, but not significant. In sum, the results that we obtain breaking the innovation process in separate phases suggest that ownership concentration discourages internal research more than the adoption of innovations.

Finally, in columns 9 and 10, we investigate whether ownership concentration affects firms' investment in human capital, which is an important input for inventing and adopting new technologies. In column 9, we consider as dependent variable the number of workers with a college degree hired by the firm in the last year of the survey. In column 10, we consider instead the percentage of workers of the firm who are employed in R&D activities. The estimated effects of ownership concentration on these two variables are both negative and significant (at the 10% level). This finding confirms that ownership concentration depresses the internal effort for innovation and the acquisition of innovative skills.

5.5 Innovative and Traditional Investments

The reader may wonder whether the negative effect of ownership concentration on innovation simply reflects a broader negative effect on total investment (traditional or innovative). In Table 8, we present two regressions that test whether ownership concentration has a role in explaining the likelihood and the amount of firms' total investment. To this end we use the following survey question: "In the last three years did the firm carry out investment for purchasing plants or equipment, and, if so, for what amount in each year?". Thus, we define a binary variable that takes the value of one if the firm invested, zero otherwise; and a variable equal to the average investment expenditures over the three years. In our sample 85 percent of firms reported some investment. There is a positive correlation between the decision to carry out some investment and innovation activity: for product (process) or related organizational innovation the pairwise correlation coefficient is 10.2% (25.7%).

For comparison purposes, in column 5 and 6, we carry over the baseline estimates from Table 4. In column 7, we report the estimates for the propensity to invest; in the regression in column 8, the left hand side variable is the average investment expenditure. The estimates suggest that, in contrast to innovation decisions, ownership concentration does not matter for firms' investment decisions. These results would suggest that the effects of the ownership structure are specific to innovation.

6 Disentangling the Link Ownership–Innovation

In the analysis so far, we have not tried to disentangle the mechanisms through which firms' ownership structure affects innovation decisions. As discussed in Section 3, there are two main reasons why concentrated shareholding can hinder technical change. The first is the incentives of large shareholders to expropriate minority shareholders: according to scholars and policymakers, agency conflicts between large and minority shareholders remain widespread in Italian businesses (see, e.g., Onida, 2004, chs. 5 and 7). The second reason is large shareholders' lack of diversification and consequent risk aversion. In Tables 9 and 10, we try to assess the contribution of these two mechanisms.

[25] This information is available only in the last two waves of the Capitalia survey. Thus, we restrict this regression to the last waves.

6.1 Agency Problems

In Table 9, we explore how the risk of expropriation of minority stakeholders by large ones may influence innovation. We develop three tests. First, we examine whether the presence of external managers in the firm's board of directors affects the likelihood of innovation. As suggested by Anderson and Reeb (2003) for family–led firms, one can expect that whenever a firm resorts to managers outside the controlling family, the conflicts of interest between large and minority shareholders are milder. In fact, independent directors may represent an important line of defense of minority shareholders against the opportunism of large shareholders. Consistent with this, Onida (2004, ch. 5) reports anecdotal evidence from interviews with Italian firms about the disciplining role of external managers vis–à–vis large shareholders. The last two waves of the Capitalia survey ask each firm the percentage of external managers in the board of the firm. In columns 1-6 of Table 9, we restrict the analysis to these two waves and control for the impact that the share of outside managers has on innovation.[26] We treat this variable as endogenous and instrument it using the variables reflecting the constrictiveness of the 1936 banking regulation in Italy, on the ground that governance practices are persistent over time.[27] We find that the likelihood of product and process innovation increase with the share of external managers: the coefficients of the percentage of external managers are respectively equal to 1.784 and 2.177 and significant at the 1% level (the results are robust to inserting the equity share held by the main owner). This corroborates the idea that having outside managers increases the likelihood of innovation, mitigating conflicts of interest among shareholders.

In our second test, we account for whether the main shareholder reports to have control over the firm. Bebchuk, Kraakman and Triantis (2000) suggest that separating control rights from cash–flow rights increases agency costs and, in particular, it can distort the incentives of corporate controllers to make efficient decisions with respect to project selection. Grossman and Hart (1988) show that separating ownership and control can lower shareholders' value. Claessens, Djankov, Fan and Lang (2002) argue that the agency problems of entrenchment and value extraction are more important when there is a large divergence between control rights and cash–flow rights, because the incentive to extract value is less restrained by the controlling shareholder's cash–flow stake. In columns 7-8, we include a dummy for whether the main shareholder has control over the firm and find that having a main shareholder with control promotes innovation (2SLS coefficient equal to 1.217). This suggests that aligning control rights and cash flow rights fosters innovation, although the coefficient on the dummy variable tends to lose significance when we control for ownership concentration (columns 9-10).[28]

Finally, in columns 5-6 and 11-12 of the table, we display the results after sub–sampling firms according to whether they are part of a group or not. Firms that are part of a group might be more exposed to agency problems. In fact, due to the chain shareholding inside the group, controlling shareholders could effectively

[26] The rate of response to this question is around 40 percent of the sample.

[27] The (efficiency of the) credit market can affect both the demand and the supply of managers. On the demand side, limited credit availability can hinder the ability of firms to pay the (possibly high) salaries of outside managers and induce firms to rely mostly on competencies inside the family. On the supply side, it is widely agreed that the credit market impacts individuals' ability to invest in human capital and, hence, can influence the formation of managerial capital.

[28] In the estimation, we treat the dummy for "main shareholder with control" as endogenous and address the endogeneity issue as we did with the dummies proxying for shocks to the ownership structure. See Section 5.3 for details about the procedure and the note to the table for the list of instruments used, which are drawn from the same set of variables that we use for ownership concentration. It is plausible that the conditions in the local financial market affect both the shares of a firm held by equity-holders and their level of involvement in the firm (that is, whether they have an incentive to control the firm).

have little cash flow rights inside the firms. We obtain that having external managers has a stronger positive effect on product innovation for firms affiliated to a group, suggesting that the agency problems that external managers can help solve are more severe inside groups. Moreover, attributing control to the main shareholder has a positive effect on product innovation for firms that are not part of a group, while it has no effect for firms affiliated to a group. This may be consistent with the argument that main shareholders effectively hold little cash flows right inside group–affiliated firms, so that attributing control to them could have little benefit in aligning cash flow rights with control rights.

6.2 Risk and Diversification

In Table 10, we explore the role of risk and diversification in the innovation process. In columns 1-2, we interact our measure of ownership concentration with an (inverse) measure of a firm's financial diversification. If the financial portfolio of a firm is not diversified, large investors could be reluctant to undertake risky innovations (Bolton and von Thadden, 1998). Our measure of diversification is based on a question asking firms about the allocation of their financial investments among equity participation in Italian companies, equity participation in foreign companies, short–term Italian bonds, medium– and long–term Italian bonds, foreign bonds, other financial instruments. The rate of response to this question is about 35%. We measure the concentration of firms' financial portfolio with the Herfindahl–Hirschman index of the various asset shares.[29] The coefficient of the interaction between this index and our measure of ownership concentration is negative and significant both in the regression for product innovation and in that for process innovation. Hence, the negative effect of ownership concentration on innovation depends on the degree of financial diversification of the firm: the less diversified the firm is, the lower its propensity to innovate if its ownership is relatively more concentrated.[30] In columns 3 and 4, we use a different measure of firms' diversification (following Anderson and Reeb, 2003). Plausibly, the higher the number of industries in which a firm is active, the more diversified its production. We thus code dummy variables for whether the firm is classified in a three–, four–, or five–digit ATECO sector and interact the equity share of the main shareholder with the five–digit ATECO dummy, which indicates a case of low industrial diversification. The results confirm the role of diversification. For product innovation, the coefficient on the interaction variable is negative (coefficient equal to –0.148) and statistically significant (z = –2.085). Overall, diversification (whether financial or industrial) appears to mitigate the negative effect of ownership concentration on innovation.

Finally, in columns 5-6, we allow for differences in legal types by inserting a dummy that takes the value of one if the firm is a corporation, that is, a private limited company (LTD; about 57 percent of the firms in the sample) or a public limited company (PLC; 39 percent of the firms). The information on the legal type is not reported in the early waves of the survey. When not available, we obtained it from firms' web–sites and then hand–matched it with the surveys using the VAT identification number. Shareholders of corporations

[29] Firms' financial portfolio composition is in principle endogenous to innovation decisions. Hence, we instrument the Herfindahl-Hirschman index and use the same variables that we use for ownership concentration. The conditions of the local credit market can affect firms' financial portfolio diversification in two ways: through the information that local banks are able to provide to the firms and through the incentives for firms to hold deposits in banks.

[30] A possible concern is that we observe the degree of diversification of the financial portfolio of the firm, but not of the portfolio of the main shareholders. However, as suggested by Onida (2004), for example, for small and medium-sized Italian firms the distinction between the two portfolios is very often blurred. To further assuage such a concern, we checked whether the results carry through for smaller firms, that is for firms in which the distinction is probably tenuous. Indeed, the findings are confirmed when we restrict attention to firms with less than 50 employees.

are protected by limited liability, so they might be less averse to risky ventures such as innovations. We treat the "legal type" dummy as endogenous and instrument it using the same variables used for ownership concentration. Estimation results confirm our hypothesis: the coefficient on the "corporation" dummy is positive and significant (at the 10% level). The reader could however suspect that this positive effect on innovation is picking up the effect of dispersed ownership (in fact, corporations tend to have a more dispersed ownership structure). To assuage this concern, we add to the regression the share of the main owner (columns 7-8). The results suggest that the incorporation of the firm has an effect on innovation on top of the effect of ownership concentration. In particular, although the evidence regarding the "corporation" dummy is mixed for product innovation, the coefficient is always positive and significant for process innovation.

7 Family Firms and Innovation

In the regressions in Table 11, we allow for differences in the type of the main owner by adding, in separate regressions, a dummy for "family business", when the main shareholder is an individual or family (77 percent of firms in the sample), and a dummy for bank or financial institution (10 percent of the sample). The remaining 13 percent of firms have another firm or a holding company as the main shareholder. The owner type dummy is treated as endogenous and instrumented using the same variables used for ownership concentration.[31] With the "family business" dummy, we have also experimented by adding to the set of instruments an index of financial awareness similar to that in Guiso and Jappelli (2005). This index is based on the Bank of Italy Surveys of Household Income and Wealth (SHIW) and is computed (at the regional level) as the fraction of Italian households that are aware of the existence of basic financial instruments such as stocks and mutual funds. The rationale for using this instrument is that where there is better awareness of the functioning of financial markets, individual competence and skills to run a business might be more far–reaching and individuals might be more prone to run their firm and retain a larger stake in it. By contrary, financial awareness should not impact firms' innovation decisions directly, also in view of the fact that our index is an average at the regional level and is based on household survey data dating back to 1995. Results, available upon request, do not change when we use this additional instrument.

The evidence for family firms is reported in columns 1-4 for product innovation and 8-10 for process innovation. Based on our analysis, family firms are somewhat more likely to carry out product innovations than firms whose main shareholder is a financial institution, another firm or a holding company. When no other controls for ownership are included, the coefficient of the owner type dummy is positive and statistically significant. When we control for ownership concentration and interact the owner type dummy with the capital share, the coefficient on the dummy for family firm becomes negative, but the coefficient on the interaction term is positive. This suggests that family firms are relatively less likely to innovate, but the negative effect of concentration on product innovation is marginally smaller for family firms. As for process innovation, family firms are significantly more likely to innovate, but the negative effect of concentration is substantially larger for these firms than for firms held by financial or industrial entities.

[31] As instruments (listed in the note to the table), we use the variables that capture the constrictiveness of the credit market regulation in 1936. Their use can be justified on the basis of the same arguments used for shareholders' equity share. Indeed, firms' owner type is likely to reflect the same needs and incentives to open participation to new shareholders and go public as the degree of ownership concentration. As for the econometric procedure, we use 2SLS when considering the linear probability model and estimate a residual-augmented model when considering the probit specification, as detailed in Section 5.3.

The mildly positive effect of family ownership on innovation might appear puzzling if read in relation to our results regarding the positive effect of diversification (Table 10). In fact, family owners are likely to be less diversified than, for example, institutional owners. A possible interpretation of this positive effect is long–termism (Lehmann and Weigand, 2000). A more stable ownership structure, typical of family firms, may mitigate managerial myopia. In fact, since the company will be passed to future generations of family members, current owners will be long–term value maximizers and have longer investment horizons (Anderson and Reeb, 2003). As discussed earlier, both these aspects are particularly beneficial for investments in R&D and new technologies, because such investments entail long gestation periods. Besides putting forth these considerations, we also control directly for lack of diversification and interact the family owner dummy with the same proxies for diversification used in Table 10. Our previous results are confirmed as family firms are somewhat more likely to innovate, but the effect is smaller if diversification is low (columns 4 and 11 of Table 11). Indeed, we control directly for the impact of family owner dummy on the phases of the innovation process (as for ownership concentration in Section 5.4). The findings show that family ownership does not affect either R&D decisions or technology adoption. In particular, the effect of family owner dummy on investments in R&D appears to be negative, but not significant. Instead, the impact of family owners on investments in information technology is positive and not significant. Finally, like ownership concentration (section 5.5), the family ownership does not matter for firms' traditional investment decisions.

Regarding ownership by financial institutions (columns 5-7 for product innovation, 12-14 for process innovation), the estimated coefficient is negative but insignificant for product innovation. The findings are similar when we control for concentration, while when we interact concentration with the financial institution dummy, we obtain that the likelihood of engaging in product innovation increases with concentration. In particular, the effect of institutional ownership becomes positive when the equity share of the main owner exceeds 70%, that is, when the influence of the institution is large enough. This is in line with the results of Aghion, Van Reenen and Zingales (2009) who find evidence of a positive association between innovation and institutional ownership concentration in the United States. As discussed in Section 3, a possible explanation for this result is that larger equity stakes in the hands of financial institutions are associated with more intense monitoring. This, in turn, can mitigate the agency problems that hinder innovation.

8 Conclusion

This paper has built on the hypothesis that the ownership structure of a firm impacts its innovation effort. We have found that, after accounting for its possible endogeneity, ownership concentration has a large, negative effect on product innovation. This result is robust to using alternative instrument sets, and to controlling for a variety of firm attributes and local conditions that may also influence innovation. Furthermore, the negative effect of ownership concentration appears to depress especially firms' R&D effort, to be stronger for medium–sized and large firms and for firms operating in traditional sectors. We have tried to disentangle the channels whereby ownership concentration may be an obstacle to innovation. The analysis reveals that conflicts of interest between large and minority shareholders may hinder technological change when ownership is concentrated. In fact, attributing control to the main shareholder appears to have a positive effect on product innovation, which is in line with the idea that aligning cash flow rights with control rights mitigates agency problems inside firms. Furthermore, the results suggest that risk aversion induced by lack of financial

and industrial diversification contributes to rendering large shareholders reluctant to innovate. Finally, in the last part of the paper, we have carried out additional tests to examine whether the nature of the main shareholder plays a role in innovation decisions. We have found that firms led by a family are more likely to innovate than firms led by financial institutions, but, importantly, the benefits of financial institutions for innovation increase with their equity stake in the company.

We believe that the analysis represents a first step in a potentially fruitful line of research. Technological change is one of the major mechanisms through which firms grow, expand abroad, and acquire market shares. Our analysis suggests that, by influencing firms' innovation decisions, corporate governance can be a driving force of these processes. An interesting research topic could be to relate the dynamics of industrial sectors to the link between corporate governance and technological change. For example, one could investigate how industry specific shocks, such as changes in the profitability or riskiness of whole industrial sectors, impact firms' innovation depending on the ownership structure prevailing in the sectors. We leave this and other issues for future research.

Appendix

Four main data sources are used in the empirical analysis: four waves of the Capitalia Survey of Italian Manufacturing Firms (SIMF), which cover three–year periods ending respectively in 1997, 2000, 2003 and 2006; the province–level database of the Italian National Statistics Office (ISTAT); the Statistical Bulletin of the Bank of Italy (SBBI); and the book "Struttura funzionale e territoriale del sistema bancario italiano 1936-1974"(SFT) by the Bank of Italy. The variables used in the empirical analysis are:

Product innovation and process innovation: The survey asks each firm: "In the last three years, did the firm realize: 1) product innovations, 2) process innovations, 3) organizational innovations related to product innovations, 4) organizational innovations related to process innovations?". The dummy for product innovation takes the value of one if the firm reports to have realized product innovations or organizational innovations related to product innovations over the three years covered by the survey (zero otherwise). The dummy for process innovation takes the value of one if the firm reports to have realized process innovations or organizational innovations related to process innovations (zero otherwise). (SIMF)

Investment in R&D: The survey asks each firm: "In the last three years, did the firm carry out R&D expenditures?". The dummy for R&D investment takes the value of one if the firm answers "yes", zero otherwise. (SIMF)

Information technology: The survey asks each firm: "In the last three years, did the firm carry out investment for the introduction of hardware, software, telecommunication networks?". The dummy for information technology takes the value of one if the firm answers "yes", zero otherwise. (SIMF)

Business type: The survey asks each firm whether it is publicly listed. The information on whether the firm is a private limited company (LTD) or a public limited company (PLCs) is available only for the 2003 and 2006 surveys. For the other years, the information, which is publicly available on firms' web–sites, has been imputed by hand based on the VAT identification number. (SIMF)

Owner information: The survey asks each firm to report the characteristics of the main shareholders owning and/or controlling the firm. The information in the survey can be tabulated as follows:

Subject	Type*	Capital share (%)	Has direct control over the firm?	Is part of shareholder voting agreement?
A			Y/N	Y/N
B			Y/N	Y/N

* Reports: 1. if residing abroad; 2. Italian person; 3. Italian private manufacturing company or firm; 4. Italian public manufacturing company or firm; 5. Italian private "holding" company or firm; 6. Italian public "holding" company or firm; 7. bank or financial institution.

Bank branches in 1936: Number of bank branches in the year 1936 in the province, per 1,000 inhabitants. (SFT)

Local/National banks in 1936: Ratio of local to national bank branches in the year 1936 in the province. (SFT)

Cooperatives banks in 1936: Number of cooperative banks in the year 1936 in the province, per 1,000 inhabitants. (SFT)

Saving banks in 1936: Number of savings banks in the year 1936 in the province, per 1,000 inhabitants. (SFT)

New branches entrant: For each province and year we calculate the number of branches created by entrant banks per 1000 inhabitants. Then we computed the average over the years 1991-1998. (SBBI)

New branches incumbent: For each province and year we calculated the number of branches created minus those closed by incumbent banks per 1,000 inhabitants. Then we computed the average over the years 1991-1998. (SBBI)

Financial awareness: We use the weighted indicator of financial awareness of Italian families proposed by Guiso and Jappelli (2005). This indicator is based on the 1995 Bank of Italy Survey of Household Income and Wealth (SHIW). The survey collects detailed information on wealth and socioeconomic variables. Before asking if household members own any particular asset, and how much, the survey elicits data on financial awareness. Each household head reports whether he or she is aware of the existence of financial assets. This indicator is the number of assets that each individual knows about divided by the number of potential assets known (14 in all). To obtain our measure we weight less popular assets (such as checking accounts) than assets that are less widely known (such as corporate bonds and mutual funds). In practice, we weight the index by the inverse of the proportion of people aware of the asset, and scale it by the sum of the weights.

Group, Consortium: The survey asks each firm to report whether it belongs to a group of firms and whether it belongs to a consortium. The dummies for participation in a group and consortium take the value of one if the firm answers "yes"to the questions, zero otherwise. (SIMF)

Sector of activity: The survey reports the sector of activity of firms (ATECO code). Based on this information, firms are classified as *traditional*, *high tech* and *scale intensive* using Pavitt's taxonomy. *Traditional sectors* include, among others, apparel and textiles, food and beverages, tobacco and leather. *High tech firms* include producers of electric and electronic equipment, medical and orthopedic supplies, pharmaceuticals and agricultural chemicals, among others. *Scale intensive* firms include producers of paper and allied products, petroleum and coal, stone, clay, glass and concrete products, among others. (SIMF)

Ateco *n* digit: Dummy that takes the value of 1 if firm reports its ATECO classification as an n–digit number; 0 otherwise. (SIMF)

Number of banks, Duration relationship with main bank: The survey asks each firm to report the number of banks with which it maintains a stable credit relationship and the duration (in years) of the relationship with the main lender, at the time of interview. (SIMF)

Credit rationing: Our measures of credit rationing are based on firms' response to the following question in the survey: "In 2000, would the firm have liked to obtain more credit at the market interest rate?". The dummy for credit rationing takes the value of one if the firm answers "yes", zero otherwise. (SIMF)

Age: Number of years since inception. (SIMF)

Total assets, **sales** and **inventories** are balance sheet data. They are available for each year covered by the survey. We use the three–year average. (SIMF)

Center: Dummy that takes the value of one if firm is located in a central province; zero otherwise. (SIMF)

South: Dummy that takes the value of one if firm is located in a southern province; zero otherwise. (SIMF)

Provincial GDP growth: Average growth rate of the value added of the province where the firm is located over the years 1985-1994. (SBBI)

Number of branches: For each province and year we calculated the number of branches per 1,000 inhabitants; then we computed the average over the years 1991-1998. (SBBI)

Herfindahl: Average Herfindahl–Hirschman Index (HHI) on bank loans in the province during the 1985-1995 period. (SBBI)

Local financial development: We use the measure proposed by Guiso, Sapienza and Zingales (2004). This is based on the estimates of the fixed effects for geographical region from a probit for the probability that, ceteris paribus, a household is shut off from the credit market in Italy.

Efficiency of the court system: We follow the methodology of Bianco, Jappelli and Pagano (2005). We considered the number of civil suits pending in each of the 27 district courts of Italy, scaled by the population of the district. We imputed this variable to the firms according to the districts where they are headquartered. (ISTAT)

R&D workers: The percentage of firm's employees employed in R&D activities. (SIMF)

High skilled worker assumptions: Number of assumptions of graduate workers in the last year of the survey. (SIMF)

Financial Institution Subscriber: Dummy that takes the value of one a if financial institution underwrote new shares of the firm; zero otherwise. (SIMF)

Intention to go public: Dummy that takes the value of one if firm plans to go public; zero otherwise. (SIMF)

External Managers: The percentage of external managers in the board of the firm. (SIMF)

Main Shareholder has control: Dummy that takes the value of one if the main shareholder reports to have control over the firm; zero otherwise. (SIMF)

Financial concentration: The concentration of firms' financial portfolio, measured as the Herfindahl–Hirschman index of the various asset shares. The survey asks each firm to report the allocation of their financial investments among equity participation in Italian companies, equity participation in foreign companies, short–term Italian bonds, medium– and long–term Italian bonds, foreign bonds, other financial instruments. (SIMF)

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Table 1. Sample summary statistics

	Full sample	Product innov.	No prod. innov.	Process innov.	No proc. Innov.	R&D invest.	No R&D. invest.
Dependent Variables							
Product innovation*	0.388	1.000	0.000	0.511	0.257	0.607	0.225
Process innovation*	0.512	0.679	0.411	1.000	0.000	0.660	0.406
R&D investment*	0.426	0.668	0.274	0.547	0.299	1.000	0.000
Information technology*	0.764	0.817	0.725	0.804	0.713	0.835	0.703
Endogenous Variables							
Main shareholder quota	0.572	0.598	0.554	0.579	0.565	0.596	0.552
	(0.281)	(0.286)	(0.276)	(0.282)	(0.279)	(0.285)	(0.275)
Main s.holder has control	0.699	0.671	0.721	0.673	0.726	0.657	0.734
	(0.458)	(0.469)	(0.448)	(0.469)	(0.446)	(0.474)	(0.441)
Two main s.holder quota	0.809	0.826	0.797	0.810	0.807	0.820	0.800
	(0.232)	(0.222)	(0.238)	(0.231)	(0.233)	(0.224)	(0.238)
Private limited company*	0.568	0.502	0.613	0.522	0.616	0.486	0.632
Public limited company*	0.366	0.443	0.313	0.410	0.319	0.466	0.287
Listed firm*	0.012	0.017	0.008	0.015	0.009	0.019	0.006
Main s.hold. is a family/single person*	0.749	0.715	0.774	0.723	0.775	0.696	0.793
Main s.hold. is a financial institution*	0.094	0.126	0.075	0.113	0.075	0.131	0.068
Main s.hold. is a firm or holding*	0.118	0.119	0.116	0.131	0.104	0.134	0.105
Control Variables							
Member of a group*	0.240	0.288	0.203	0.277	0.201	0.310	0.181
Member of a consortium*	0.087	0.096	0.082	0.097	0.078	0.097	0.080
'Traditional' sector*	0.486	0.434	0.522	0.455	0.519	0.423	0.536
High tech*	0.047	0.059	0.039	0.054	0.039	0.067	0.032
No. banks	5.594	6.222	5.204	6.115	5.049	6.446	4.974
	(5.023)	(4.756)	(5.147)	(5.883)	(3.855)	(4.870)	(5.055)
Length relation main bank	16.766	16.783	16.771	16.742	16.798	17.095	16.531
	(12.223)	(12.084)	(12.314)	(12.392)	(12.039)	(12.547)	(11.986)
Credit Rationing*	0.134	0.131	0.135	0.130	0.137	0.125	0.140
Age	24.304	25.567	23.510	24.803	23.788	25.958	23.074
	(17.670)	(17.576)	(17.663)	(18.079)	(17.226)	(18.320)	(17.018)
No. Employees	105.449	141.952	73.859	131.223	77.735	152.063	62.030
	(354.115)	(434.551)	(250.186)	(401.598)	(292.107)	(427.347)	(242.254)
Total assets (100.000 €)	262.902	344.090	169.516	329.743	194.184	364.944	140.180
	(132.684)	(155.152)	(85.368)	(153.656)	(106.902)	(152.625)	(81.422)
Sales (100.000 €)	242.500	308.773	174.109	283.463	198.377	342.057	141.034
	(121.169)	(128.338)	(105.024)	(121.634)	(120.666)	(144.653)	(85.623)
Located in the North*	0.683	0.720	0.660	0.694	0.673	0.724	0.653
Located in the Center*	0.208	0.195	0.216	0.204	0.212	0.204	0.212
Located in the South*	0.108	0.085	0.124	0.102	0.115	0.072	0.136
No. branches,	0.462	0.470	0.457	0.465	0.460	0.472	0.456
	(0.112)	(0.108)	(0.114)	(0.111)	(0.112)	(0.106)	(0.116)
Provincial GDP growth,	0.085	0.085	0.084	0.085	0.084	0.085	0.084
	(0.047)	(0.048)	(0.047)	(0.048)	(0.047)	(0.047)	(0.048)
Provincial Herfindahl,	0.066	0.065	0.067	0.066	0.066	0.064	0.067
	(0.028)	(0.026)	(0.029)	(0.027)	(0.028)	(0.025)	(0.029)
Local financial development	0.349	0.358	0.345	0.352	0.348	0.360	0.342
	(0.113)	(0.105)	(0.117)	(0.111)	(0.115)	(0.104)	(0.119)
Pending trials,	0.004	0.003	(0.004	0.004	0.004	0.003	0.004
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.007)
Instrumental Variables							
Bank branches in 1936	20.938	21.253	20.750	21.132	20.743	21.388	20.626
	(8.537)	(8.477)	(8.580)	(8.671)	(8.392)	(8.468)	(8.592)
Local/National banks in 1936	0.809	0.821	0.802	0.812	0.806	0.820	0.802
	(0.172)	(0.167)	(0.175)	(0.171)	(0.173)	(0.166)	(0.176)
Cooperatives banks in 1936	0.698	0.696	0.700	0.688	0.709	0.693	0.702
	(0.498)	(0.489)	(0.505)	(0.493)	(0.505)	(0.492)	(0.503)
Savings banks in 1936	0.251	0.257	0.247	0.251	0.251	0.262	0.243
	(0.344)	(0.353)	(0.338)	(0.349)	(0.3407)	(0.351)	(0.338)
New branches (by entrants), 91-98	2.422	2.458	2.390	2.433	2.409	2.444	2.397
	(2.269)	(2.293)	(2.244)	(2.275)	(2.260)	(2.276)	(2.254)
New branches (by incumb.), 91-98	23.830	24.417	23.341	24.052	23.582	24.386	23.299
	(25.013)	(25.365)	(24.667)	(25.086)	(24.912)	(25.309)	(24.663)
Guiso and Jappelli index of	0.699	0.716	0.688	0.704	0.694	0.715	0.686
financial awareness of households	(0.284)	(0.282)	(0.286)	(0.285)	(0.284)	(0.278)	(0.288)
Observations	18603	7035	11117	9350	8927	7740	10411

Note: See the appendix for exact definitions. Means and (in parenthesis) standard deviations. * denotes a dummy variable.

Table 2. Ownership concentration and innovation. OLS and Probit regressions

	Panel A: OLS			
	(1)	(2)	(3)	(4)
	I.PROD	I.PROD	I.PROC	I.PROC
Main s.holder	0.071***		0.021	
Quota	(0.016)		(0.016)	
Two main		0.072***		0.012
s.holder quota		(0.018)		(0.019)
Time dummies	Y	Y	Y	Y
Area dummies	Y	Y	Y	Y
+ controls	Y	Y	Y	Y
Obs.	12113	12064	12130	12081
R-squared	0.08	0.08	0.06	0.06
	Panel B: Probit			
	(1)	(2)	(3)	(4)
	I.PROD	I.PROD	I.PROC	I.PROC
Main s.holder	0.185***		0.041	
Quota	(0.043)		(0.043)	
Two main		0.198***		0.027
s.holder quota		(0.053)		(0.051)
T. dummies	Y	Y	Y	Y
A. dummies	Y	Y	Y	Y
+ controls	Y	Y	Y	Y
Obs.	12113	12064	12130	12081
R-squared	0.06	0.06	0.05	0.05

Note: The table reports regression coefficients and associated standard errors (in parentheses). The dependent variables are reported at the top of each column. Main shareholder quota refers to the capital share held by the main shareholder. Two and three main shareholder quota refers to the capital share held by the two and three main shareholders. Time dummies denote the year of the survey. Area dummies refer to the area in the country where the firm is headquartered (Center or South). The controls included are: a) firm characteristics, such as total assets, current assets, inventories, sales, a second-order polynomial in the age of the firm since founding, ATECO four- and five-digit code dummies, dummies for the sector of activity and duration of the credit relationship with the main bank; b) structural characteristics of the banking sector, such as the number of bank branches (per 100,000 inhabitants) and the Herfindahl-Hirschman Index on bank loans, in the province; c) variables controlling for the characteristics of the environment where the firms operates, such as Guiso, Sapienza and Zingales (2004) financial development index, provincial GDP growth and a measure of the efficiency of the court system; d) 24 sector dummies. For more information, exact definitions and details see the Appendix. * significant at 10%; ** significant at 5%; *** significant at 1%. The table reports the R^2 (OLS) and Pseudo R^2 (Probit).

Table 3. The main shareholder quota and innovation. First stage of IV regressions

	(1) Product	(2) Prod – N.ban.	(3) Prod – Cr. rat.	(4) Process
	Main Shareholder quota			
Branches in 1936	0.001**	0.001**	0.001**	0.001**
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Local banks /Nat. Banks	-0.056**	-0.053**	-0.054***	-0.057**
	(0.022)	(0.021)	(0.021)	(0.022)
Savings banks	-0.008	-0.005	-0.004	-0.007
	(0.011)	(0.010)	(0.010)	(0.011)
New branches	0.005***	0.005***	0.005***	0.005***
(by entrants)	(0.002)	(0.002)	(0.002)	(0.002)
Time dummies	Y	Y	Y	Y
Area dummies	Y	Y	Y	Y
+ controls	Y	Y	Y	Y
F statistics (Instr.)	5.78	5.98	5.58	5.83
Observations	12113	13257	12893	12130

Note: The table reports regression coefficients and associated standard errors (in parentheses). The dependent variables of the second stage are reported at the top of each column. The set of instruments includes: number of bank branches in the province in 1936 (per 100,000 inhab.), the ratio of local to national bank branches, number of savings banks in the province in 1936 (per 100,000 inhab.), branches opened by new entrants in the province over the 1991-1998 period (net of closures). Main shareholder quota refers to the capital share held by the main shareholder. Time dummies denote the year of the survey. Area dummies refer to the area in the country where the firm is headquartered (Center or South). "+ controls" denotes the RHS variables of the regressions in Table 2. In col. (2) instead of the duration of the credit relationship with the main bank, we use, as a control, the number of banking relationship. In column (3) instead of the duration of the credit relationship with the main bank, we use, as a control, a dummy variable equal to one if the firm is credit rationed. * significant at 10%; ** significant at 5%; *** significant at 1%. The table reports the value of the *F*-statistics to test the weakness of the instruments.

Table 4. The main shareholder quota and innovation. Second stage of IV regressions

	(1a) 2SLS I.PROD	(1b) AGLS I.PROD	(2a) 2SLS I.PROD	(2b) AGLS I.PROD	(3a) 2SLS I.PROD	(3b) AGLS I.PROD	(4a) 2SLS I.PROC	(4b) AGLS I.PROC
Endogenous variable								
Main s.holder quota	-1.076**	-2.852**	-0.992**	-2.643**	-1.132***	-3.029***	-0.158	-0.328
	(0.422)	(1.148)	(0.404)	(1.102)	(0.437)	(1.186)	(0.362)	(0.946)
Firms' characteristics								
Center	-0.029	-0.075	-0.033	-0.084	-0.032	-0.084	0.009	0.027
	(0.022)	(0.060)	(0.022)	(0.059)	(0.023)	(0.062)	(0.019)	(0.049)
South	-0.041	-0.114	-0.043	-0.115	-0.039	-0.107	-0.015	-0.042
	(0.035)	(0.097)	(0.034)	(0.094)	(0.035)	(0.098)	(0.030)	(0.080)
Tot. assets	0.038*	0.073*	0.028*	0.060*	0.046***	0.100***	0.036***	0.146***
	(0.019)	(0.040)	(0.016)	(0.034)	(0.021)	(0.038)	(0.011)	(0.046)
Current assets	-1.608***	-4.635***	-1.335***	-3.810***	-1.545***	-4.455***	-1.930***	-4.983***
/Tot. Assets	(0.441)	(1.217)	(0.417)	(1.147)	(0.458)	(1.248)	(0.386)	(1.005)
Inventories	-0.031	0.542***	-0.034	0.321**	-0.044**	0.487***	-0.027	0.345**
	(0.030)	(0.157)	(0.025)	(0.144)	(0.032)	(0.152)	(0.017)	(0.161)
Sales	0.020	0.013	0.020**	0.025	0.026	0.024	0.004	-0.052**
	(0.015)	(0.029)	(0.013)	(0.028)	(0.018)	(0.032)	(0.010)	(0.025)
Age	0.003***	0.009***	0.001	0.003	0.001	0.004	0.002***	0.004**
	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)	(0.002)
Age squared	-0.000***	-0.000***	-0.000	-0.000	-0.000	-0.000*	-0.000*	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ATECO 5 digits	-0.034**	-0.094*	0.025	-0.070	-0.038**	-0.103**	-0.019	-0.047
	(0.017)	(0.048)	(0.016)	(0.045)	(0.017)	(0.048)	(0.015)	(0.040)
ATECO 4 digits	-0.005	-0.011	0.006	0.017	-0.002	-0.003	-0.009	-0.019
	(0.014)	(0.040)	(0.013)	(0.037)	(0.014)	(0.039)	(0.013)	(0.033)
External fin. variables								
Length rel. main	-0.063***	-0.173***					-0.018	-0.044
bank	(0.015)	(0.041)					(0.013)	(0.033)
No. banks			0.015***	0.038***				
			(0.001)	(0.004)				
Credit rationing					0.064***	0.175***		
					(0.015)	(0.043)		
Local market conditions								
No. branch/100,000	0.142*	0.378*	0.100	0.278	0.154**	0.415**	0.138**	0.337**
inhab. (91-98)	(0.072)	(0.196)	(0.067)	(0.181)	(0.072)	(0.194)	(0.062)	(0.162)
Prov. GDP	-0.001	0.006	0.059	0.183	0.078	0.210	0.143	0.378
growth (85-94)	(0.112)	(0.307)	(0.103)	(0.287)	(0.109)	(0.301)	(0.097)	(0.254)
Prov. HHI	-0.324	-0.875	-0.290	-0.789	-0.428	-1.179	0.102	0.300
(85-95)	(0.276)	(0.768)	(0.265)	(0.743)	(0.279)	(0.783)	(0.241)	(0.626)
Financ. develop.	-0.031	-0.085	-0.064	-0.175	-0.022	-0.059	-0.103	-0.266
	(0.085)	(0.234)	(0.082)	(0.228)	(0.086)	(0.239)	(0.073)	(0.193)
Pend. trials/100,000	-1.541	-4.924	-1.663	5.158	-1.429	-4.426	-0.356	-0.958
inhab (98-00)	(1.108)	(3.350)	(1.051)	(3.172)	(1.109)	(3.336)	(0.998)	(2.701)
Time dummies	Y	Y	Y	Y	Y	Y	Y	Y
Area dummies	Y	Y	Y	Y	Y	Y	Y	Y
Overid. test (p-value)	0.9774		0.9730		0.9983		0.0023	
Wald test (p-value)		0.0017		0.0026		0.0009		0.6965
Observations	12113	12113	13257	13257	12893	12893	12130	12130

Note: The table reports regression coefficients and associated standard errors (in parentheses). The dependent variables and the estimation method are reported at the top of each column. The set of instruments includes: number of bank branches in the province in 1936 (per 100,000 inhab), the ratio of local to national bank branches, number of savings banks in the province in 1936 (per 100,000 inahb), branches opened by new entrants in the province over the 1991-1998 period (net of closures). Main shareholder quota refers to the capital share held by the main shareholder. Time dummies denote the year of the survey. Area dummies refer to the area in the country where the firm is headquartered (Center or South). "+ controls" denotes the RHS variables of the regression in Table 2. In col. (2a) and (2b), instead of the duration of the credit relationship with the main bank, we use, as a control, the number of banking relationship. In col. (3a) and (3b), instead of the duration of the credit relationship with the main bank, we use, as a control, a dummy variable equal to one if the firm is credit rationed. * significant at 10%; ** significant at 5%; *** significant at 1%. The table reports the p-values of a Sargan test of overidentifying restrictions and of a Wald test of exogeneity of the variable that has been instrumented.

Table 5. The effect of the two largest shareholders on innovation. IV regressions

	Panel A: First stage		Panel B: 2SLS		Panel C: AGLS	
	(1)	(2)	(3)	(4)	(5)	(6)
	Product	Process				
	Two main s.holder quota	Two main s.holder quota	I.PROD	I.PROC	I.PROD	I.PROC
Branches	0.001*	0.001*				
in 1936	(0.000)	(0.000)				
Local banks	-0.028	-0.029				
/Nat. banks	(0.019)	(0.019)				
Savings banks	-0.023**	-0.022**				
	(0.009)	(0.009)				
New branches	0.002*	0.002*				
(by entrants)	(0.001)	(0.001)				
Two main			-1.102**	-0.438	-2.829**	-0.969
s.holder quota			(0.532)	(0.490)	(1.438)	(1.267)
Time dummies	Y	Y	Y	Y	Y	Y
Area dummies	Y	Y	Y	Y	Y	Y
+ controls	Y	Y	Y	Y	Y	Y
F statistics of instr.	4.78	4.73				
Overid. test			0.4786	0.0049		
(p-value)						
Wald test exog.					0.0171	0.4249
(p-value)						
Observations	12064	12081	12064	12081	12064	12081

Note: The table reports regression coefficients and associated standard errors (in parentheses). The dependent variables are reported at the top of each column. First-stage regressions are in Panel A; two-stage least squares (2SLS) regressions are in Panel B; and Amemya's generalized least square probit regressions are in Panel C. The set of instruments includes: number of bank branches in the province in 1936 (per 100,000 inhab.), the ratio of local to national bank branches, number of savings banks in the province in 1936 (per 100,000 inhab.), branches opened by new entrants in the province over the 1991-1998 period (net of closures). Two and three main shareholder quota refers to the capital share held by the two and three main shareholders. Time dummies denote the year of the survey. Area dummies refer to the area in the country where the firm is headquartered (Center or South). "+ controls" denotes the RHS variables of the regressions in Table 2. * significant at 10%; ** significant at 5%; *** significant at 1%. The value of the F-test on the instruments are reported. The table also reports the p-values of a Sargan test of overidentifying restrictions and of a Wald test of exogeneity for the variables that have been instrumented.

Table 6. Allowing for non-linear effects of ownership concentration on innovation

	Panel A: 2SLS								
	(1) I.PROD	(2) I.PROC	(3) I.PROD L<34	(4) I.PROD L≥34	(5) I.PROD Traditional	(6) I.PROD High Tech	(7) I.PROD Scale	(8) I.PROD No scale	(9) I.PROD Consortium
Main s.holder quota	-9.208*	-13.110**	-0.566	-1.152*	-2.065**	-0.119	-1.054	-1.446**	-1.487
	(4.755)	(6.076)	(0.533)	(0.622)	(0.987)	(0.614)	(0.694)	(0.601)	(2.534)
(Main s.holder quota)^2	7.110**	10.100**							
	(3.435)	(4.392)							
Time dummies	Y	Y	Y	Y	Y	Y	Y	Y	Y
Area dummies	Y	Y	Y	Y	Y	Y	Y	Y	Y
+ controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Overid. test (p-value)	0.0046	0.0756	0.9400	0.6462	0.9273	0.8589	0.3910	0.5647	0.7202
Observations	12113	12130	5943	6170	5998	520	2468	9645	1124
	Panel B: AGLS								
	(1) I.PROD	(2) I.PROC	(3) I.PROD L<34	(4) I.PROD L≥34	(5) I.PROD Traditional	(6) I.PROD High Tech	(7) I.PROD Scale	(8) I.PROD No scale	(9) I.PROD Consortium
Main s.holder quota	-24.426**	-36.358**	-1.636	-2.887*	-6.021**	-0.893	-2.709	-3.874**	-4.103
	(11.679)	(15.342)	(1.594)	(1.646)	(2.834)	(1.898)	(1.838)	(1.644)	(7.020)
(Main s.holder quota)^2	11.829**	28.185**							
	(8.459)	(11.114)							
T. dummies	Y	Y	Y	Y	Y	Y	Y	Y	Y
A. dummies	Y	Y	Y	Y	Y	Y	Y	Y	Y
+ controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Wald test exog. (p-value)	0.0004	0.0000	0.2308	0.0303	0.0004	0.5898	0.0855	0.0011	0.3568
Observations	12113	12130	5943	6169	5995	520	2466	9643	1122

Note: The table reports regression coefficients and associated standard errors (in parentheses). The dependent variables are reported at the top of each column. The regressions in Panel A are estimated by two-stage least squares (2SLS) and the regressions in Panel B are estimated by two-stage conditional maximum likelihood (AGLS, Newey's minimum chi-squared estimator). We instrument both the main shareholder quota and its square. The set of excluded instruments includes: the ratio of local bank branches to national bank branches, savings banks (per 100,000 inahb), in the province in 1936, and branches opened by new entrants in the province over the 1991-1998 period (net of closures). For the regressions in col. (1) and (2) we have also used total assets, the ratio of current assets to total assets, inventories and sales all squared, and the number of bank branches (per 100,000 inhab). For the regressions in col. (3) - (8) we have also used the number of cooperative banks (per 100,000 inhabitants) in the province in 1936. Finally, for the regressions in col. (9) we have used the number of bank branches (per 100,000 inhab) instead of the number of savings banks in the province in 1936. Time dummies denote the year of the survey. Area dummies refer to the area in the country where the firm is headquartered (Center or South). "+ controls" denotes the RHS variables of the regressions in Table 2. * significant at 10%; ** significant at 5%; *** significant at 1%. The table also reports the p-values of a Sargan test, as a test of overidentifying restrictions, and of a Wald test, as a test of exogeneity of the variables that have been instrumented.

Table 7. Changes to ownership structure and innovation

	Panel A: Product Innovation							
	(1) 2SLS	(2) "Augmented" Model	(3) 2SLS	(4) "Augmented" Model	(5) 2SLS	(6) "Augmented" Model	(7) 2SLS	(8) "Augmented" Model
Main s.holder quota			0.115 (0.330)	0.001 (0.394)			0.307 (0.243)	0.499 (0.614)
Fin. institution Subscriber	3.302*** (1.161)	9.585*** (3.230)	3.053* (1.740)	11.232*** (2.290)				
Intention to go public					2.593*** (0.662)	7.535* (4.098)	1.558 (0.985)	6.014* (3.325)
Time dummies	Y	Y	Y	Y	Y	Y	Y	Y
Area dummies	Y	Y	Y	Y	Y	Y	Y	Y
+ controls	Y	Y	Y	Y	Y	Y	Y	Y
Overid. test (p-value)	0.1237		0.0891		0.1370		0.0148	
Observations	12662	12662	12045	12045	12314	12314	11723	11723
	Panel B: Process Innovation							
	(1) 2SLS	(2) "Augmented" Model	(3) 2SLS	(4) "Augmented" Model	(5) 2SLS	(6) "Augmented" Model	(7) 2SLS	(8) "Augmented" Model
Main s.holder quota			0. 512* (0.265)	1.189 (1.008)			0.562** (0.252)	1.960*** (0.614)
Fin. institution Subscriber	3.425*** (1.329)	13.703*** (3.759)	2.039 (1.288)	10.970*** (4.154)				
Intention to go public					3.570*** (0.779)	10.856* (6.554)	1.977* (1.044)	5.557 (6.612)
Time dummies	Y	Y	Y	Y	Y	Y	Y	Y
Area dummies	Y	Y	Y	Y	Y	Y	Y	Y
+ controls	Y	Y	Y	Y	Y	Y	Y	Y
Overid. test (p-value)	0.0593		0.0134		0.3136		0.0503	
Observations	12586	12679	12062	12062	12330	12330	11739	11739

Note: The table reports regression coefficients and associated standard errors (in parentheses). The dependent variable of the regressions in Panel A is the dummy for Product Innovation and the dependent variable of the regressions in Panel B is the dummy for Process Innovation. The estimation method is reported at the top of each column. We instrument both the main shareholder quota and the variables proxying for changes in the ownership structure. The set of instruments includes: number of bank branches in the province in 1936 (per 100,000 inhab), the ratio of local bank branches to national bank branches, savings banks (per 100,000 inahb), in the province in 1936, branches opened by new incumbents in the province over the 1991-1998 period. In columns (1)-(4), we have also used total assets, the ratio of current assets to total assets, inventories and sales all squared. Time dummies denote the year of the survey. Area dummies refer to the area in the country where the firm is headquartered (Center or South). "+ controls" denotes the RHS variables of the regressions of Table 2. * significant at 10%; ** significant at 5%; *** significant at 1%. The table also reports the p-values of a Sargan test, as a test of overidentifying restrictions, and of a Wald test, as a test of exogeneity of the variables that have been instrumented.

Table 8. The effects of ownership, R&D, technology adoption and total investment

	Panel A: 2SLS									
	(1) R&D	(2) INFO TECH	(3) PATENTS	(4) INNO Invest. Expenditure	(5) I. PROD	(6) I. PROC	(7) Total Investments	(8) Tot. Invest. Expenditure	(9) Skilled workers hiring	(10) R&D workers
Main s.holder quota	-1.022** (0.417)	-0.801 (0.514)	0.222** (0.103)	-1.214 (2.383)	-1.076** (0.422)	-0.158 (1.186)	-0.189 (0.250)	0.519 (0.503)	-9.462* (5.852)	-0.155* (0.086)
Time dummies	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Area dummies	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
+ controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Over. test (p-value)	0.8425	0.6175	0.9306	0.6017	0.9774	0.0023	0.0453	0.5977	0.7271	0.4783
Observations	12112	10584	12094	2895	12113	12130	12130	9090	8029	9856
	Panel B: AGLS									
	(1) R&D	(2) INFO TECH	(3) PATENTS		(5) I. PROD	(6) I. PROC	(7) Total Investments		(9) Skilled workers hiring	(10) R&D workers
Main s.holder quota	-2.784** (1.130)	-2.671 (1.688)	5.791** (2.711)		-2.852** (1.148)	-0.328 (0.946)	-0.957 (1.249)		-65.907* (40.903)	-0.347** (0.174)
Time dummies	Y	Y	Y		Y	Y	Y		Y	Y
Area dummies	Y	Y	Y		Y	Y	Y		Y	Y
+ controls	Y	Y	Y		Y	Y	Y		Y	Y
Wald test (p-value)	0.0015	0.0670	0.0207		0.0017	0.6965	0.4676		0.0223	0.0195
Observations	12109	10582	12055		12113	12130	12130		8029	9856

Note: The table reports regression coefficients and associated standard errors (in parentheses). The dependent variables is reported at the top of each column. The regressions in Panel A are estimated by two-stage least squares (2SLS) and the regressions in Panel B are estimated by two-stage conditional maximum likelihood (AGLS, Newey's minimum chi-squared estimator), col. (9) and (10) are estimated with AGLS tobit estimator. We instrument Main s.holder quota. The basic set of instruments includes: number of bank branches in the province in 1936 (per 100,000 inhab), the ratio of local to national bank branches, number of savings banks in the province in 1936 (per 100,000 inahb), branches opened by new entrants in the province over the 1991-1998 period (net of closures). In col. (7) we use also the number of branches opened by incumbents in the province over the 1991-1998 period (net of closures). In col. (9) we have also used the number of cooperative banks (per 100,000 inhabitants) in the province in 1936. For convenience in col. (5) and (6) we report the basic regression results of Table 4 (from col. 1a, 1b, 4a and 4b). Time dummies denote the year of the survey. Area dummies refer to the area in the country where the firm is headquartered (Center or South). "+ controls" denotes the RHS variables of the regressions in table 2. * significant at 10%; ** significant at 5%; *** significant at 1%. The table also reports the p-values of a Sargan test, as a test of overidentifying restrictions, and of a Wald test, as a test of exogeneity.

Table 9. Disentangling the link ownership-innovation. The role of agency problems

	Panel A: Product Innovation											
	External Manager						Main Shareholder has control					
	(1) 2SLS	(2) AGLS	(3) 2SLS	(4) AGLS	(5) 2SLS	(6) 2SLS	(7) 2SLS	(8) "Augmented" Model	(9) 2SLS	(10) "Augmented" Model	(11) 2SLS	(12) 2SLS
Main s.holder quota			-1.500*	-4.225*					-1.080**	0.715		
			(0.770)	(2.466)					(0.428)	(0.776)		
External Manager	0.629***	1.784***	1.679***	4.810**	0.922*	0.631***						
	(0.179)	(0.567)	(0.599)	(2.039)	(0.494)	(0.196)						
Main s.holder has control							1.217*	3.565**	0.493	4.401***	0.482	1.211*
							(0.693)	(1.420)	(0.894)	(1.456)	(0.826)	(0.627)
Time and Area dum.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
+ controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sample	All	All	All	All	Group	No Group	All	All	All	All	Group	No Group
Overid. test (p-value)	0.1623		0.9487		0.4422	0.6174	0.0000		0.9928		0.1618	0.8037
Wald test (p- value)		0.0010		0.0000								
Observations	2611	2611	2483	2476	942	1660	12742	12742	12113	12113	3097	9618
	Panel B: Process Innovation											
	External Manager						Main Shareholder has control					
	(1) 2SLS	(2) AGLS	(3) 2SLS	(4) AGLS	(5) 2SLS	(6) 2SLS	(7) 2SLS	(8) "Augmented" Model	(9) 2SLS	(10) "Augmented" Model	(11) 2SLS	(12) 2SLS
Main s.holder quota			-0.353	-1.030					-0.222	2.977***		
			(0.540)	(1.586)					(0.407)	(1.144)		
External Manager	0.771***	2.177***	1.002**	2.857**	0.655	0.939***						
	(0.170)	(0.584)	(0.418)	(1.309)	(0.461)	(0.224)						
Main s.holder has control							-0.585	-1.360	-0.862	1.321	-1.016	-0.265
							(0.585)	(1.447)	(0.854)	(2.065)	(0.957)	(0.511)
Time and Area dum.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
+ controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sample	All	All	All	All	Group	No Group	All	All	All	All	Group	No Group
Overid. test (p-value)	0.0567		0.1082		0.0040	0.5402	0.0184		0.0125		0.4557	0.0074
Wald test (p-value)		0.0019		0.0130								
Observations	2617	2617	2489	2489	944	1664	12759	12759	12130	12130	3110	9632

Note: The table reports regression coefficients and associated standard errors (in parentheses). The estimation method is reported at the top of each column. The dependent variable in the regressions in Panel A is Product Innovation. The dependent variable in the regressions in Panel B is Process Innovation. We instrument all the variables whose coefficients are reported in the table. The basic set of instruments includes: number of bank branches in the province in 1936 (per 100,000 inhab), the ratio of local to national bank branches, number of cooperative banks (per 100,000 inhab.), number of savings banks in the province in 1936 (per 100,000 inhab.), branches opened by new entrants and by incumbents in the province over the 1991-1998 period (net of closures). For the regressions in col. (1)-(6) we add also as instruments: total assets, inventories and sales all squared. For the regressions in col. (1)-(4) we add also as instruments: the ratio of current assets to total assets squared. Finally, for the regressions in col. (9) - (10) we have not used the number of cooperative banks (per 100,000 inhab.), the number of savings banks in the province in 1936 (per 100,000 inhab.) and the branches opened by incumbents in the province over the 1991-1998 period (net of closures). Time dummies denote the year of the survey. Area dummies refer to the area in the country where the firm is headquartered. "+ controls" denotes the RHS variables of the regressions in table 2. * significant at 10%; ** significant at 5%; *** significant at 1%. The table also reports the p-values of a Sargan test, as a test of overidentifying restrictions, and of a Wald test, as a test of exogeneity.

Table 10. Disentangling the link ownership-innovation. Risk and diversification

	Panel A: 2SLS							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	I.PROD	I.PROC	I.PROD	I.PROC	I.PROD	I.PROC	I.PROD	I.PROC
Main s.holder quota	-0.442	-0.169	-1.126***	-0.253			-1.031**	0.014
	(0.466)	(0.429)	(0.396)	(0.338)			(0.431)	(0.447)
Main s.holder quota *	-0.438***	-0.220***						
Financ. Concentration	(0.083)	(0.074)						
Main s.holder quota *			-0.053**	-0.027				
Ateco 5 digit			(0.026)	(0.022)				
Corporation					1.087*	0.979	0.493	1.530*
					(0.628)	(0.644)	(0.879)	(0.927)
Time and Area dum.	Y	Y	Y	Y	Y	Y	Y	Y
+ controls	Y	Y	Y	Y	Y	Y	Y	Y
Over. test (p-value)	0.1072	0.4663	0.9737	0.0109	0.1971	0.0322	0.9913	0.0353
Observations	4332	4337	12113	12130	12742	12759	12113	12130
	Panel B: AGLS or Augmented Model							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	AGLS	AGLS	AGLS	AGLS	"Augmented" Model	"Augmented" Model	"Augmented" Model	"Augmented" Model
	I.PROD	I.PROC	I.PROD	I.PROC	I.PROD	I.PROC	I.PROD	I.PROC
Main s.holder quota	-1.119	-0.346	-3.007***	-0.611			-0.114	2.591**
	(1.231)	(1.126)	(1.085)	(0.881)			(0.686)	(1.017)
Main s.holder quota *	-1.152***	-0.554***						
Financ. Concentration	(0.227)	(0.210)						
Main s.holder quota *			-0.148**	-0.071				
Ateco 5 digit			(0.071)	(0.058)				
Corporation					3.205**	2.668*	4.691***	5.781***
					(1.392)	(1.635)	(1.179)	(1.634)
Time and Area dum.	Y	Y	Y	Y	Y	Y	Y	Y
+ controls	Y	Y	Y	Y	Y	Y	Y	Y
Wald test (p-value)	0.0057	0.4447	0.0013	0.4336				
Observations	4332	4337	12113	12130	12742	12759	12113	12130

Note: The table reports regression coefficients and associated standard errors (in parentheses). The dependent variables are reported at the top of each column. The regressions in Panel A are estimated by two-stage least squares (2SLS) and the regressions in Panel B are estimated by two-stage conditional maximum likelihood (AGLS, Newey's minimum chi-squared estimator) or "Augmented" Model. We instrument all the variables whose coefficients are reported in the table. The basic set of instruments includes: number of bank branches in the province in 1936 (per 100,000 inhab.), the ratio of local to national bank branches, number of cooperative banks (per 100,000 inhab.) in the province in 1936, branches opened by new entrants in the province over the 1991-1998 period (net of closures). For the regressions in col. (1) - (4) we also use the interaction of the basic instruments with the index that we use for diversification. For the regressions in col. (5) - (8) we use also the number of savings banks in the province in 1936 (per 100,000 inahb) and the number of branches opened by incumbent banks in the province over the 1991-1998 period (net of closures). Time dummies denote the year of the survey. Area dummies refer to the area in the country where the firm is headquartered (Center of South). "+ controls" denotes the RHS variables of the regressions in Table 2. * significant at 10%; ** significant at 5%; *** significant at 1%. The table also reports the p-values of a Sargan test, as a test of overidentifying restrictions, and of a Wald test, as a test of exogeneity.

Table 11. The owner type and innovation

Panel A: 2SLS

	(1) I.PROD	(2) I.PROD	(3) I.PROD	(4) I.PROD	(5) I.PROD	(6) I.PROD	(7) I.PROD	(8) I.PROC	(9) I.PROC	(10) I.PROC	(11) I.PROC	(12) I.PROC	(13) I.PROC	(14) I.PROC
Main s.holder quota		-0.708**	-1.700	-0.688*		-0.700**	-1.880**		0.074	-3.383**	-0.031		-0.226	-1.306
		(0.319)	(1.454)	(0.416)		(0.334)	(0.860)		(0.272)	(1.728)	(0.358)		(0.335)	(0.942)
Family	0.708***	0.439*	-0.463	0.660				-0.082	-0.018	-3.169**	0.169			
	(0.245)	(0.253)	(1.322)	(0.533)				(0.216)	(0.220)	(1.571)	(0.419)			
Fam.*Main			1.252							4.367**				
s.holder quota			(1.794)							(2.120)				
Family* Financial				-0.373***							-0.170***			
Concentration				(0.079)							(0.064)			
Financial institution					-0.532	-0.211	-6.043*					0.945*	0.767	-5.499
					(0.495)	(0.547)	(3.408)					(0.541)	(0.548)	(3.730)
Fin. institution *							8.261*							8.932*
Main s.holder quota							(4.678)							(5.136)
Time and area dum.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
+ controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Over. test (p-value)	0.5278	0.8396	0.8260	0.1674	0.0159	0.1190	0.9683	0.0008	0.0002	0.2267	0.5139	0.0052	0.0004	0.4020
Observations	12505	11876	11876	4194	12742	12113	12113	12522	11893	11893	4199	12759	12130	12130

Panel B: 'Augmented' Model

	(1) I.PROD	(2) I.PROD	(3) I.PROD	(4) I.PROD	(5) I.PROD	(6) I.PROD	(7) I.PROD	(8) I.PROC	(9) I.PROC	(10) I.PROC	(11) I.PROC	(12) I.PROC	(13) I.PROC	(14) I.PROC
Main s.holder quota		-1.320	-6.032*	-1.648		-1.813**	-4.756***		0.403	-9.532*	0.062		0.082	-3.067**
		(0.898)	(3.689)	(1.296)		(0.853)	(1.535)		(0.853)	(5.493)	(1.093)		(0.853)	(1.355)
Family	2.064***	-0.662*	5.915	-0.643				-0.144	-1.662***	-10.480**	-0.412**			
	(0.501)	(0.411)	(4.158)	(0.903)				(0.456)	(0.526)	(4.767)	(0.177)			
Fam.*Main			-4.828*							12.483*				
s.holder quota			(3.003)							(6.627)				
Family* Financial				-0.891***							-1.897***			
Concentration				(0.193)							(0.653)			
Financial institution					-1.664	2.635***	-11.995**					2.276**	3.827***	-11.761**
					(1.230)	(0.662)	(5.847)					(1.071)	(0.777)	(5.880)
Fin. institution *							21.170***							22.578***
Main s.holder quota							(7.286)							(7.551)
Time and area dum.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
+ controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	12505	11876	11876	4194	12742	12113	12113	12522	11893	11893	4199	12759	12130	12130

Note: The table reports regression coefficients and associated standard errors (in parentheses). The dependent variables are reported at the top of each column. The regressions in Panel A are estimated by two-stage least squares (2SLS) and regressions in Panel B are estimated by the "Augmented" model. We instrument all the variables whose coefficients are reported in the table. The set of instruments includes: the number of bank branches in the province in 1936 (per 100,000 inhab.), the ratio of local bank branches to national bank branches, cooperative banks (per 100,000 inhab.), savings banks (per 100,000 inahb), in the province in 1936, branches opened by new entrants and branches opened by incumbent banks in the province over the 1991-1998 period (net of closures). Moreover, we also use the square of these variables. In columns (4) and (11), we have not used the square variables, but the interaction of the basic instruments with the index that we use for diversification Time dummies denote the year of the survey. Area dummies refer to the area in the country where the firm is headquartered (Center or South). "+ controls" denotes the RHS variables of the regressions in Table 2. * significant at 10%; ** significant at 5%; *** significant at 1%. The table also reports the p-values of a Sargan test, as a test of overidentifying restrictions.