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Corporate Ownership and Managers' Selection

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PRELIMINARY DRAFT

Abstract

We present a model in which the owners of the firm enjoys a private return from employment relationship with the managers. This may lead the owner to retain in office an incumbent manager even though a more productive replacement is available. The model thus predicts that corporations in which the private return of the employment relationship is high, feature a large proportion of senior managers and a low productivity. This dual prediction is tested using a panel of 8,000 Italian firms over 1984-1997. We assume that government and family controlled firms care about the private returns while foreign and financial institution controlled firms do not. We present structural estimates of the model fundamental parameters and use them to quantify the relevance of non-monetary objectives and the related productivity "losses". We find that the lack of managerial selection in family firms accounts for a decrease in the average firm productivity of about 10%. The structural estimates are fully consistent with model-based OLS regressions.

Key Words: corporate governance, private returns, total factor productivity.

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1 Introduction

A large amount of empirical work documents that Friedman's (1953) firm selection argument, according to which inefficient firms will be driven out of the market by competition, does not hold in general. In fact, a robust empirical finding across time, sectors and space is that firms of very different productivity levels coexist in a market equilibrium (Bartelsmann & Doms 2000). This evidence rises two related questions: Where do this productivity differences come from? And why are they not eliminated by market selection? The literature on corporate control has identified a clear mechanism that can answer both questions: the existence of private benefits of control (La Porta, Lopez-de Silanes, Shleifer & Vishny 2000). If private benefits are important, the controlling shareholder does not pursue the simple maximization of the firm's value, because she extracts additional returns from control.[1] Typically, the pursue of private benefits entails a loss of efficiency. But lower efficiency is sustainable in equilibrium exactly because compensated by some additional, possibly non monetary returns.

In this paper, we focus on a specific form of private benefits. We assume that some firm owners derive utility not only from profits but also from employing managers with whom they have developed a personal tie. Personal ties might be useful to determine if a manager can or is willing to deliver (possibly) non monetary payoffs, typically not verifiable in court and therefore not stipulable in an employment contract. For example, a politician (the "owner" of a government controlled firm) might want managers that serve his political interests, such as hiring workers in his constituency. The owner of a family business might enjoy a compliant entourage and/or a group of managers that pursue the prestige of the family. Finally, diverting resources at the expenses of minority shareholders requires obliging managers, as some recent corporate scandals have shown.[2]

The relational motive can distort the process of managerial selection, reducing the role of capabilities and increasing that of personal ties. We propose a model that formalizes this idea and structurally estimate its parameters to get a quantitative assessment of the importance of the relational component and of its effects in terms of managerial selection. We consider an infinite horizon economy in which managerial

[1] Consistently with this, Dyck & Zingales (2004) provide cross-country evidence that controlling blocks are sold on average at a 14% premium, up to 65% in certain countries–see below for more details.

[2] For example, in the case of the Parmalat corporate fraud, the CFO was a long term friend of the controlling shareholder. In the Madoff case, investigators claim that the scheme could only be sustained with the complicity of some managers in the investment fund.

ability is heterogeneous and observed only after a certain tenure, when the owner has to decide if to confirm the manager, who in this case turns senior, or replace him with a junior one. The main assumption is that relationship building takes time, so that only senior managers may (but not necessarily do) deliver the private returns from the personal relation. We show that the greater the value of the private returns, the higher the probability that senior low-capabilities managers are retained and the lower the productivity of the firm. As a consequence, the model predicts that a higher value of the personal relation increases the average managers' tenure and decreases the firm productivity. Moreover, in a cross section of firms, we expect that the correlation between the share of senior manager and firm productivity is more negative the more important private benefits.

We test these predictions using a sample of Italian manufacturing firms for which we have detailed information of firms characteristics as well as the complete history of their workforce, including managers. We classify the importance of non monetary returns according to the identify of the controlling shareholders. We assume that firms controlled by foreign owners or by financial institutions only care about profits; government and family owned firms instead also deliver private benefits to their owner. We first perform a series of (model-based) OLS regressions. Consistently with the model's predictions, we find that, when compared to the firms only interested in profits, government and family firms i) have a larger share of senior managers; ii) display average lower TFP; iii) are characterized by a negative relation between TFP and the share of senior managers. We then structural estimate of the model fundamental parameters and use them to quantify the relevance of non-monetary objectives and the related efficiency losses. We find that the lack of managerial selection in family firms account for a decrease in average managerial ability of around 10% (similarly for government owned firms). This is because owner of family firms select managers almost only on the basis of the private benefits: they keep all the managers with whom they developed a relation, independently from ability, and fire all the others. This mechanism completely inhibits the selection effect of managerial ability. The structural estimates are fully consistent with the reduced form ones.

The idea that private benefits play a central role in shaping firms' performance is central to the recent corporate governance literature (La Porta et al. 2000). Dyck & Zingales (2004) empirically estimate the value of private benefits of controls using the difference between the price per share of a transaction involving a controlling block and the price on the stock market before that transaction. They find large values of private benefits of control. In particular, the value for Italy is the second highest in a sample of 39 countries, and equal to 37 percent. Compared to this literature, we focus on a very specific channel through which the private benefits arise, that is the relation between the owner and her managers. Moreover, we use the model's predictions on productivity and managerial seniority distribution to estimate the value of such relation, rather than referring to stock market data.

In our model, inefficient selection derives from owners' valuing a personal relation with the management. The fact that personal ties between firms' high-ranked stakeholders (large shareholders, board members, top managers) is detrimental for firm performance finds support in recent literature. Landier, Sraer & Thesmar (2006) study the effects of independent top-ranking executives, defined as those that joined the firm before the current CEO was appointed, of firms' profitability and returns from takeovers. They assume that top-ranking executives hired after the current CEO was appointed are more likely to implement her decisions in an a-critical way. They find that, for a panel of US listed corporations, the share of independent top executive is positively related to all indicators of firms' performance. For France, Kramarz & Thesmar (2006) study the effects of social network for the composition of firms' board of directors and performance. They find that networks, defined in terms of school of graduation, influence the board composition; moreover, firms with a higher share of directors from the same network have lower performance. This evidence also supports the *private* convenience to appoint members with a personal relation and the detrimental effects on firms' performance. For Italy, Bandiera, Guiso, Prat & Sadun (2009) show that family firms tend to hire managers with a higher risk aversion and lower ability. Bandiera, Barankay & Rasul (2008) study the effects of social connections among managers and workers on workers and firm performance. Using a field experiment, they show that managers favor workers they are socially connected to, possibly at the expenses of the firm's performance. Using an international survey on management practices, Bloom & Van Reenen (2007) show that there is a wide range of variability of practices across firms. With respect to this paper, we build a story of why inefficient practices survive in equilibrium: they are balanced by the private benefits accruing from "colluded managers". ¿From a methodological point of view, the paper that is closest to ours is Taylor (2008). He builds and estimate a structural model of managerial turnover, with learning about the managerial ability and costly turnover. He finds that only very high turnover costs can rationalize the low rate of turnover observed in the data. He interpret this results in terms of CEO entrenchment and poor governance, consistently with our view. Compared to his paper, we exploit differences in the value of relation for different types of owners to identify the main model parameters.

The paper is organized as follows. The next Section presents a simple model to formalize the nature of the problem we are interested in: how the presence of private returns affects the selection of managers within a firm and its average productivity. Section 3 describes an original data set that is useful to test the theory, and presents a first test of the model predictions based on model-based (i.e. structural) regression analysis. Section 4 presents the structural estimates of the model parameters and uses these estimates to quantify the "costs", in terms of foregone productivity, that are due to the presence of the non-monetary returns.

2 A simple model

Managers are hired junior and become senior after "one period". We can think of this period as a time unit during which the manager quality is tested by the the corporate owner (the principal henceforth) who decides about his tenured appointment at the beginning of the second period. A manager quality is characterized by two independent exogenous features: his productivity x, a non-negative random variable with continuous and differentiable CDF $G(x)$ with $G(0) = 0$ and expected value $\mu = \int_0^\infty x dG(x)$, and his relationship value r, a non-negative random variable that is identically zero for a junior manager and equals zero with probability $1 - q$ or R with probability q for a senior manager.

We assume that upon hiring a (junior) manager the principal does not observe x nor r, but only knows their distribution. At the end of the first period the principal learns the value of the manager productivity, a realization of x, and the value of his relationship, the realization of r (either 0 or $R > 0$). It is assumed that both the manager relationship value and productivity are specific to a firm, so that if a manager moves to a new firm both his x and r are unknown to the new principal. One rationale for the value of relationship to mature only for senior managers is that relationships take time to be developed. After learning the realizations of x and r the principal decides whether to keep the manager in office or to fire him. Using that the random variables x and r are independent, it is convenient to define a new random variable $s \equiv x + r$, with CDF

$$F(s, R, q) = q\ G(\max(s - R, 0)) + (1 - q)\ G(s) \quad \forall s > 0 \tag{1}$$

which gives that the probability that a senior manager with $r + x \geq s$ is observed is $1 - F(s)$.

We assume that, if appointed, the (senior) manager stays one period with the firm and then dies (i.e. breaks the relationship) with an exogenous probability ρ, so that the expected office tenure as a senior manager is $1/\rho$. When a senior manager dies the principal must replace him or her with a junior one.

The period return for the risk-neutral principal is given by the realizations of $x + r$, his utility is given by the expected present values of the sum of the $x + r$ realizations, discounted at a rate β. The principal cares about the manager productivity and his/her relationship value, and decides whether or not to fire a manager after observing the realization of both variables at the end of the first period. When a junior manager is in office at the beginning of period t there is no decision to be taken for the principal, and the expected value of hiring the manager is:

$$v_y = \mu + \beta \, \mathbb{E} \; \max\{v_y \; , \; \tilde{x}^o + \tilde{r}^o + \beta v_y\} \tag{2}$$

where expectations are taken with respect to the next period realizations of the manager ability (denoted by a tilde).

When a senior manager is in office in period t, the principal learns the manager value $s_t = x_t + R_t$, and decides whether to keep him or replace him with a junior manager, so that the value of this manager is

$$v_o(s_t) = \max\{ \; v_y \; , \; s_t + \beta \, [\; \rho \; v_y + (1 - \rho) v_o(s_t) \;] \; \} \quad . \tag{3}$$

where the value function takes into account that a senior manager dies with probability ρ.

The optimal policy will thus follow a threshold rule. The principal fires the senior manager if $s < s^*$, i.e. if the value of $s = r + x$ which is learned when the manager becomes senior is below the threshold s^*, to be determined.

Next, we use equation (3) to compute the *expected* value of a senior manager *conditional on being in office* is

$$\begin{aligned} v_o \equiv \mathbb{E}(v_o(s) | s > s^*) \;\; &= \;\; \int_{s^*}^{\infty} s \frac{dF(s)}{1 - F(s^*)} + \beta \left[\rho v_y + (1 - \rho) v_o \right] \\ &= \;\; \frac{1}{1 - \beta(1 - \rho)} \left[\int_{s^*}^{\infty} s \frac{dF(s)}{1 - F(s^*)} + \beta \rho \; v_y \right] \end{aligned} \tag{4}$$

Given s^*, the expected value of a junior manager is

$$v_y = \mu + \beta \left[\text{prob}(s < s^*) \cdot v_y + \text{prob}(s > s^*) \cdot v_o \right] \tag{5}$$

Using (5) and the expression for v_o in equation (4) gives a closed form equation for v_y as a function of s^*:

$$v_y = \frac{\mu\,(1 - \beta(1-\rho)) + \beta \int_{s^*}^{\infty} s \; dF(s)}{(1-\beta)\,[1 + \beta(\rho - F(s^*))]} \quad . \tag{6}$$

The optimal threshold s^* is the smallest value of $s = x + r$ that leaves the firm indifferent between keeping the senior manager or appointing a junior one. Hence s^* solves

$$v_o(s^*) = v_y \tag{7}$$

Using equation (3) to write the value of a senior manager of type s as

$$v_o(s^*) = \frac{1}{1 - \beta(1-\rho)} \left(s^* + \beta \rho v_y \right)$$

and replacing this expression into equation (7) gives the simple optimality condition

$$s^* = (1-\beta) v_y \tag{8}$$

Using this condition and the expression for v_y in (6) gives one equation in one unknown for s^*:

$$H(s, R) \equiv s^* \;\; [1 + \beta(\rho - F(s^*))] - \mu\,(1 - \beta(1-\rho)) - \beta \int_{s^*}^{\infty} s \; dF(s) = 0 \tag{9}$$

This leads us to:

Proposition 1. *The equilibrium threshold $s^* > 0$ exists and is unique.*
Proof. See Appendix A.

Equation (9) can be used to show that when $r \equiv 0$ (relationships bring no value to the principal) the equilibrium threshold $s^*(r \equiv 0) > \mu$. Intuitively, if $r \equiv 0$ a senior manager is retained in office only if he turns out to be better than the expected value of a junior, μ. That is because the appointment of a junior, and the possibility of future replacement, give the policy of appointing a junior a positive option value. The fact that productivity x is learned after one period induces a selection whereby senior managers who retain office are more productive, on average, than junior managers.

The next proposition characterizes how the threshold s^* varies with R and q:

Proposition 2. *The equilibrium threshold s^* is increasing in R with:*

$$0 \leq \frac{\partial s^*}{\partial R} = q\beta \frac{1 - G(s^* - R)}{1 + \beta(1 - F(s^*))} < 1 \tag{10}$$

Proof. See Appendix A.

This proposition tells us that the more valuable the non monetary returns to the principal (as measured by a higher value of the realization R), the greater the value of the threshold s^*. This has a dual effect on the productivity of the managers who get tenured: as R increases, the productivity threshold for the managers who develop a relationship (i.e. those with $r = R$) falls, since $s^* - R$ is decreasing in R. Instead, threshold for the managers who do not develop a valuable relationship (i.e. those with $r = 0$) increases, i.e. these managers must compensate their lacking "non monetary" qualities with a higher productivity, such that $x \geq s^*$. As shown in Figure 4, the ability threshold for managers with and without relationship value move apart as R increases. Intuitively, an increase in R lowers the productivity of the managers with $r = R$, and increases their share in the total population of senior managers.

We now turn to the model prediction concerning the seniority profile of a firm's managers in a steady state. The fraction of senior managers in office, ϕ, follows the law of motion

$$\phi_t = \phi_{t-1}(1 - \rho) + (1 - \phi_{t-1})(1 - F(s^*)) \quad ,$$

so that the steady state fraction of senior managers is

$$\phi(s^*) = \frac{1}{1 + \frac{\rho}{1 - F(s^*)}} \in (0, 1) \tag{11}$$

which is decreasing in ρ. Mechanically, a higher survival probability of senior managers increases the fraction of senior managers. It is also immediate that ϕ is decreasing in $F(s^*)$. To study how ϕ depends on R we need to compute the total derivative of $F(s^*, R)$, since changes in R affect the CDF directly and also affect the threshold s^*. Note that

$$\frac{dF(s^*,R)}{dR} = [q\ g(s^*-R)+(1-q)\ g(s^*)]\frac{\partial s^*}{\partial R} - q\ g(s^*-R) \tag{12}$$

Recalling that $\frac{\partial s^*}{\partial R} < q$ (see proposition 2) shows that the derivative is negative at $R = 0$, hence raising R at this point increases the share of senior managers.[3] In general the effect of R on the fraction of senior managers is ambiguous. The reason is that an increase in R has two opposing effects: on the one hand it *lowers* the threshold $s^* - R$ for that fraction (q) of senior managers who display valuable relationships $r = R$. This increases ϕ. On the other hand a higher s^* raises the acceptance threshold for the senior manager with no relationship capital $r = 0$. This reduces ϕ. In the special case in which $q = 1$ i.e. all senior managers have $r = R$ and then, intuitively, a higher R increases the proportion of senior managers. In particular, we notice that if the comparison is done at $R = 0$, i.e. in comparison to a principal who does not care about private returns, then increasing R causes the fraction of senior managers to increase.

Finally, we combine the previous result to determine how changes in R affect the firm's average productivity. Let X denote the steady state expected productivity of a firm, given by the weighted average of the expected productivity of the junior manager, $X_y \equiv \mu$, and of the senior incumbent manager:

$$X_o \equiv \mathbb{E}_{r,x}\left(x|x > s^* - r\right) = \frac{q\ \int_{s^*-R}^{\infty} x\ dG(x) + (1-q)\ \int_{s^*}^{\infty} x\ dG(x)}{1-F(s^*)}$$

or

$$X = \mathbb{E}_{r,x}(x) = [1-\phi(s^*)]\ X_y + \phi(s^*)\ X_o \tag{13}$$

Proposition 3. *The policy $s^*(R = 0)$, as from equation (9), is the one that maximizes the expected firm productivity in the steady state.*
Proof. See Appendix A.

A straightforward implication of this proposition is stated in the next Corollary.

Corollary 1. *Productivity is smaller for any policy $s^*(R)$ where $R > 0$ when compared to $s^*(R = 0)$.*

[3] A sufficient condition for this to happen over the whole $R \geq 0$ range is $q\ g(s^* - R) + (1 - q)\ g(s^*) < g(s^* - R)$ which holds for e.g. every non-increasing density function $g(\cdot)$.

Figures 1, 2 and 3 illustrate the relation between R and the share of senior managers, TFP and senior-junior productivity differentials for a typical parametrization. As discussed above, as R increases ϕ increases, TFP decreases and so does the productivity differential: the selection effect on senior managers becomes weaker and so their productivity advantage over the junior ones decreases. For this parametrization, the functions become flat for $R \simeq 5$: at that value, owners are basically already firing all managers with $R = 0$ and keeping all those with $R > 0$, so that further increases in R do not influence the selection process anymore.

2.1 The model and the data

An alternative representation of (13), that is useful in the empirical analysis, is:

$$X = \mu + \phi(s^*) \left\{ \frac{q \int_{s^*-R}^{\infty} x \; dG(x) + (1-q) \int_{s^*}^{\infty} x \; dG(x)}{1 - F(s^*)} - \mu \right\} \tag{14}$$

Notice that the cross section variation of productivity is given by the fraction of senior managers ϕ multiplied by the expected productivity differential between the senior and the junior managers (the term in the curly bracket). It is key to note that at $R = 0$, this productivity differential is decreasing in R:

$$\left.\frac{\partial \{\cdot\}}{\partial R}\right|_{R=0} = \frac{g(s^*)\left(q - \frac{\partial s^*}{\partial R}\right)\left[s^* - \frac{\int_{s^*}^{\infty} x \; dG(x)}{1-G(s^*)}\right]}{1 - G(s^*)} < 0 \tag{15}$$

This implies that if we take two groups of firms, identical in every other respect (industry features) except for R, which is zero in one and $R > 0$ in the other, we should expect the that the fraction of senior managers is higher, and the productivity differential is smaller, in the group where $R > 0$.

Imagine to have data drawn from several firms in a given industry. The industry is characterized by a certain level of $q, R, G(\cdot)$. Firms differ with respect to the quality of managers, which depends on the realizations of $x + r$ in each firm i. The econometrician observes a measure of the firm productivity X_i and the quota of senior managers $\phi_i \equiv \frac{n_{o,i}}{n}$, the ratio between the number of senior managers $(n_{o,i})$ and the (exogenous) total number of managers in the firm (n).

Denote by X_o and $X_y = \mu$ the conditional mean productivity of the incumbent senior and junior managers, respectively, as defined above. Let $\xi_{i,j}$ and $\zeta_{i,j}$ be the deviations from those means for manager j in firm i. Note that the expected value of those deviations is zero. The mean productivity of junior and senior incumbent managers in firm i can be written as:

$$X_{y,i} = \mu + \left(\frac{\Sigma_{j=1}^{n-n_{o,i}} \xi_{i,j}}{n - n_{o,i}} \right) \ , \ X_{o,i} = X_o + \left(\frac{\Sigma_{j=1}^{n_{o,i}} \zeta_{i,j}}{n_{o,i}} \right)$$

The productivity of firm i obeys the following relationship:

$$\begin{aligned} X_i &= (1-\phi_i) \left(X_y + \frac{\Sigma_{j=1}^{n-n_{o,i}} \xi_{i,j}}{n - n_{o,i}} \right) + \phi_i \left(X_o + \frac{\Sigma_{j=1}^{n_{o,i}} \zeta_{i,j}}{n_{o,i}} \right) \\ &= X_y + \phi_i \left(X_o - X_y \right) + \varepsilon_i \qquad (16) \end{aligned}$$

$$\text{where } \varepsilon_i \equiv \phi_i \left(\frac{\Sigma_{j=1}^{n_{o,i}} \zeta_{i,j}}{n_{o,i}} - \frac{\Sigma_{j=1}^{n-n_{o,i}} \xi_{i,j}}{n - n_{o,i}} \right)$$

Inspection of equation (16) leads to:

Proposition 4. *The term ε_i is uncorrelated with ϕ_i.*
Proof. See Appendix A.

Intuitively, this proposition holds since an increase (or a decrease) in the quota of senior managers ϕ about its average does not contain any information on the innovation ε, i.e. the amount by which the productivity of the senior (junior) manager exceeds the selection threshold s^*. This proposition suggests that the productivity differential $X_o - X_y$ can be estimated with an OLS regression of X_i on ϕ_i, since the equation error term is uncorrelated with the regressors. This is used in the empirical analysis of the next section.

3 Data description and model-based regressions

In this section we describe the data and run a series of OLS regressions, based on the correlation among the endogenous variables described by the model. In the text we only report the most relevant information and discuss the details in appendix B.

3.1 The data

The data are drawn from the Bank of Italy's annual INVIND survey of manufacturing firms. INVIND is an open panel of around 1,200 firms per year representative of manufacturing firms with at least 50 employees. It contains detailed information on firms' characteristics (see below). The Social Security Institute (Inps) was asked to provide the complete work histories of *all* workers that ever transited in an INVIND firm for the period 1981-1997. Workers are classified as blue collar (*operai*), white collar (*impiegati*) and managers (*dirigenti*).

The INVIND survey gives an extensive list of firm characteristics, including industrial sector, nationality, year of creation, average number of employees during the year, value of shipments, value of exports and investment. It also reports sampling weights to replicate the universe of firms with at least 50 employees. The survey asks a series of questions regarding the controlling shareholder, from which we construct an indicator of the controller's type (see Appendix B for the details), divided into 5 categories: 1) individual or family; 2) government (local or central or other publicly controlled entities); 3) holding; 4) institution (financial or not); 5) foreign owner. We completed the dataset with balance-sheet data collected by the Company Accounts Data Service (CADS) since 1982, from which it was possible to reconstruct the capital series, using the perpetual inventory method.[4]

Table 1 reports summary statistics for the firm data used in the regression analysis. We distinguish firms by ownership type. For the total sample, on average firms' value added is 30 million euros (at 1995 prices), they employ 691 workers of which 7 managers, with a ratio of managers over total workforce of 1.7%. Around 41% are classified as medium-high and high-tech according to the OECD system[5] and 3 quarters are located in the north. Clear differences emerge according to the ownership type. Family firms are substantially smaller than the average (11 million euros and less than 300 employees) and specialize in more traditional activities. Importantly, they have a lower TFP level, followed by government controlled firms, while foreign firms have the highest TFP.

The data on workers include age, gender, area where the employee works, occupational status, annual gross earnings number of weeks worked and the firm identifier. We only use workers classified as managers. Seniority is computed over the entire match history, that is including also the years in which the individual was working for the firm not as a managers. In fact, the relationship between the owner and the employee develops already before the employee becomes a manager.

Table 2 reports the statistics on managers' characteristics for the total sample and by ownership type. For the total sample, average gross weekly earnings at 1995

[4]See Cingano & Schivardi (2004) for a detailed account of the procedure.

[5]See OECD (2003) for the details on how the classification system is constructed.

constant prices are 1.230 euros and the average within-firm standard deviation of earnings is 361. The share of managers that have been with the firm at least 4 years is .77, at least 7 years .66, average age is 46.5 and the share of managers older than 45 is .56. Family controlled firms have both lower levels and dispersion of wages, a higher share of senior managers while the age is similar to the total sample. Managers' characteristics of holding, institution and government controlled firms are fairly similar to the overall ones, with the exception of age for the latter, more than a year higher than the average. Finally, foreign control firms pay their managers more and also have a larger dispersion of compensation, while resembling the average in terms of the tenure and age structure.

3.2 Model-based regressions

Before turning to the structural estimation, we consider the correlations implied by the model for productivity, seniority and ownership status. Our measure of productivity is TFP. We assume that production takes place with a Cobb-Douglas production function of the form:

$$Y_{it} = \text{TFP}_{it} K_{it}^{\beta} L_{it}^{\alpha} \tag{17}$$

where Y is value added, K is capital and L labor. TFP depends on average managerial ability X and, possibly, other additional observable characteristics W_{it}, such as time, sector and firm size:

$$\text{TFP}_{it} = \left(\frac{1}{n_{it}} \sum_{j=1}^{n_{it}} X_{j \in i,t} \right) * e^{W_{it} + \epsilon_{it}} \tag{18}$$

where n_{it} is the number of managers in firm i at t, $X_{j \in i,t}$ is the ability of managers in firm i at t and ϵ_{it} is an iid shock unobserved to the firm or, more simply, measurement error in TFP. We estimate TFP using using the Olley & Pakes (1996) approach. The procedure is briefly described in Appendix B; all the details are in Cingano & Schivardi (2004).

Our identifying assumption is that institutional or foreign controllers are only interested in profits, that is are characterized by $R = 0$. A foreign controller is much less likely to be interested in private benefits such as prestige or connections, that are less "transferable" abroad than profits. Institutions, such as banks or insurance companies, are also likely to be interested in the financial performance of their portfolio of assets rather than in other types of non monetary returns. Instead, individual or family controlling shareholders will tend to also weight non monetary returns from control, such as prestige, employing family members, hiring friends and people they like to interact with. Also government controlled firms are likely to aim at nonmonetary returns, as politicians (the controlling shareholders) might use the firms to buy political consensus, for example promoting employment in their electoral district. Holdings might be interested in self-dealing, at the expense of the firm's profits.

The models has three predictions that can be readily tested with our data

1. According to Proposition (3), productivity should be lower in firms with $R > 0$ when compared to those with $R = 0$.

2. Corollary (1) states that the differential in productivity between senior and junior managers is lower in firms with $R > 0$ when compared to those with $R = 0$. Moreover, equation (16) and Proposition (4) imply that this differential can be estimated via an OLS regression of the share of senior managers on productivity.

3. Finally, as shown in equation (12), at $R = 0$ the share of senior managers increases with R.

We test the first prediction above by estimating a TFP equation of the form:

$$\log TFP_{it} = D_f + D_g + D_p + \gamma' \mathbf{W_{it}} + \epsilon_{it} \tag{19}$$

where $D_s, s = f, g, p$ are ownership status dummies equal to one for family, group and public control firms, $\mathbf{W_{it}}$ other controls. In column (1) of Table 3 we report the results of regressing log TFP on dummies for the different ownership type. Given that the dependent variable is in log and that the excluded category are firms controlled either by a foreign or an financial institution, the coefficients of the ownership types are the percentage productivity differences according to the status. Consistently with proposition 1 and the assumptions on the relevance of the non monetary benefits, publicly controlled firms' TFP is 10% lower than foreign and institution controlled ones, controlling for sector, area and year dummies. Family firms are 4.4% less productive. Both coefficient are highly statistically significant. Instead, firms controlled by a holding are not statistically different from the control group. This latter result questions the assumption that such firms place a significant weight non monetary returns. These basic results are robust to a large number of of modifications (see Appendix B for details).

To examine the relation between the share of senior managers and productivity, we estimated an augmented version of equation (19), which also includes

$$\mathbf{Z_{it}} = \lambda_0 \phi_{it} + \lambda_1 D_f * \phi_{it} + \lambda_2 D_g * \phi_{it} + \lambda_3 D_p * \phi_{it}$$

where ϕ_{it} measures the share of senior managers in firm i at t. We define "senior" managers those that have been working in the firm for at least 4 years (we have experimented with different thresholds finding similar results). The coefficient λ_0 represents the relation between share of seniore managers and productivity in firms that select managers only on the basis of ability and therefore measures the selection effect on managerial abilities (see Proposition 2). According to equation (15), λ_1, λ_2 and λ_3 represent the differences in the average productivity of senior managers with respect to the benchmark group. Note that, with respect to the previous regression, we are not comparing directly levels of productivity – accounted for by the ownership dummies – but rather measuring differences in the elasticity of productivity to managerial tenure. Column (2) of Table 3 shows that the relationship between productivity and the share of seniore managers is positive for firms whose owners only care about profits: the coefficient is .106 with a standard error of .039. To give a sense of the size of the effect, increasing the share of managers with more than 4 years of tenure by one standard deviation (.26, Table 2) would increase productivity by around 3%. Consistently with our theory, the coefficient for public and family firms is negative and highly significant, and larger for the former group (-.345 vs. -.104). These estimates imply that senior managers are on average 30% less productive in public firms than in foreign or institution controlled firms. The difference is around 10% in family firms and in firms controlled by a holding, although the latter is marginally statistically significant. These results are robust to a series of changes in the regression framework, reported in Appendix B.

To test the third prediction, relating R to the share of senior manages, in Column (3) we regress the share of senior managers on the ownership indicators; the excluded category is again foreign and institution owned firms. We find that family firms have a significant higher share, (4 percent). Public firms also have a higher share; if anything, holding controlled firms have a lower share.

These model-based regressions are in line with the predictions. Firms with an owner that is likely to seek non-monetary rewards have lower TFP, select the senior managers less on ability and have a higher share of senior managers. We now turn to the structural estimation of the model to obtain direct estimates of the model's primitives and to check if they agree with the OLS estimates.

4 Structural estimation

We assume that the distribution of ability $G(x)$ is lognormal with log mean λ_m and log standard deviation λ_σ. Our model has 6 fundamental parameters: the discount factor β, the mortality rate ρ, the probability to develop a relation q, the value of such relation R and the parameters of the lognormal $\lambda_\sigma, \lambda_m$. As for the reduced form case, we assume that $R = 0$ for firms owned by a foreign or institutional entity. If we assumed no further heterogeneity, the model would supply four conditions, one for each R. Of course, the model does not address all the potential determinants of TFP. In particular, TFP has both a sectoral and a time component, as the significance of the sectoral and time dummies in the regressions of the previous section shows. We therefore allow the mean of the ability distribution to differ by year t and sector τ. For computational feasibility, we aggregate the data into 4 sectors according to the technological level (low, medium-low, medium-high and high (OECD 2003)). The other four parameters $\beta, \rho, q, \lambda_\sigma$ are identical for all firms. We have observations on a large number of firms that vary across 14 years (index y), 4 sectors (index τ), and 4 ownership types (index c). The unconditional log mean of productivity, $\lambda_m^{y\times\tau}$, varies by year and sector and the parameter $R^c = \theta_j$ varies by ownership type. These assumptions imply that all firms in a given year(14)-ownership(4)-sector(4) combination are expected to have the same X and ϕ. There are $224 = 14 \times 4 \times 4$ combinations (or groups), indexed by s, each one with its own mean value of $\lambda_m^{y\times\tau}$. Of course, we need to impose some more structure to reduce the dimensionality of the problem, as without any further restrictions the model is underidentified. We assume that the log mean of productivity varies by year and sector according to the linear specification

$$\lambda_m(y,\tau) = \theta_5 + a_0 \cdot year_y + \mathbf{a_1} \cdot \mathbf{1}_\tau + a_2 W_{y\tau} \tag{20}$$

where θ_5 is the level of TFP in the base year (1984) for the low TFP sector ($\tau = 1$), a_0 the coefficient of a time trend and $\mathbf{a_1}$ a vector of coefficients that capture TFP differences for firms in sectors $\tau = 2, 3, 4$. We also allow for other potential determinants of TFP, $W_{y\tau}$. In particular, the descriptive stats clearly indicate that foreign controlled firms are on average larger than the others. We want therefore to control for potential effects of firm size on TFP. We estimate the coefficients $[a_0, \ \mathbf{a_1}, a_2]$, by an OLS regression of log TFP on a constant, time-trend, 3 sector dummies and the average firm size in group (y, τ).

To reduce the computational burden of the estimation routine, we compute some parameters directly from the data. We fix β to an annual value of .96, as standard in the literature. A manager becomes senior after four years with the firm. To determine the mortality rate of senior managers, we use the individual data and compute the mortality rate of senior managers using the Kaplan & Meier (1958) estimator. Wi find that $\rho = .099$, which implies that the expected tenure of senior managers is approximately 10 years. The model has a low power in estimating the variance of the talent distribution, λ_σ, assumed to be the same for all firms in all years. We therefore use the managers' compensation data to estimate a value for $\lambda_\sigma = .097$. The method, based on an application of matched employer-employees estimation techniques (Abowd, Kramarz & Margolis 1999), is explained in the appendix.

Our parsimonious structural estimate concerns 5 parameters, $\theta_k \in \Theta_{5,1}, k = 1, 2, ..5$. We assume that the probability to develop a relation $q = \frac{\theta_1}{1+\theta_1}$ is common to all firms in the sample; the value of the relation R^c is zero for the firms with foreign corporate ownership, and is $R^c = \theta_k$, $k = 2, 3, 4$ for the firms with, respectively, Family (θ_2), Group (θ_3) and Public (θ_4) ownership. Finally, $\theta_5 = \lambda_m$ is the mean ability of the G distribution for the year 1984 and the low-technology group. Equation 20 determines the corresponding values for all other groups. Given these assumptions, we estimate $\Theta_{5,1}$ by maximum likelihood.

Each group $s \in S$ is populated by n_s firms. For each firm i in s there are 2 observables $z_{i,s}^j$, $j = 1, 2$. We assume that the variable $z_{i,s}^j$ is measured with error ε_i^j that is normal with mean zero and variance σ_j^2, common across groups. Inspection of the raw data suggests that measurement error is multiplicative in levels for TFP,[6] X, and additive for the share of senior managers, ϕ. Hence the ML estimates use the following observables $z_{i,s}^1 = \log X_{i,s}$ and $z_{i,s}^2 = \phi_{i,s}$.

Let $f^j(\theta_s)$ be the prediction of the model for the j variable under the parameter settings $\theta_s \in \Theta$. We then have that

$$z_{i,s}^j = f^j(\theta_s) + \varepsilon_i^j.$$

[6] This follows from the fact that the estimation of TFP is carried out on a log production function which delivers a log TFP value.

It is assumed that measurement errors are independent across variables, groups and observations. Let n_s be the number of firms i in group s. Define the objective function F as

$$F(\Theta; z) \equiv \sum_{s=1}^{S} \sum_{j=1}^{2} \left(\frac{n_s}{\sigma_j^2}\right) \left(\frac{\sum_{i=1}^{n_s} z_{i,s}^j}{n_s} - f^j(\theta_s)\right)^2 \tag{21}$$

The maximum likelihood estimation is based on the following proposition.

Proposition 5. *The likelihood function is related to the objective function by:*

$$\begin{aligned}\ln L(\Theta; z) &= -\frac{1}{2} \sum_{s=1}^{S} \sum_{j=1}^{2} n_s \log\left(2\pi\sigma_j^2\right) - \frac{1}{2} \sum_{s=1}^{S} \sum_{j=1}^{2} n_s - \frac{1}{2} F(\Theta; z) \\ &= -\frac{1}{2} \sum_{s=1}^{S} \sum_{j=1}^{2} n_s \log\left(2\pi\sigma_j^2\right) - \sum_{s=1}^{S} n_s - \frac{1}{2} F(\Theta; z)\end{aligned}$$

Proof. See Appendix A.

We estimate the model by minimizing the objective function (21). At each iteration, the algorithm solves the model for each of the 224 cells and compute the objective function. For each cell and current parameter estimate, the algorithm solves equation (9) for $s*$ and compute the corresponding values of of $f^j(\theta_s)$, $j = 1, 2$. The relative weights σ_j^2, $j = 1, 2$ are computed as the variance of the residuals of an OLS regression of $\log X$ and ϕ on year and sector dummies respectively; the values are 0.1798 and 0.0818. In the appendix we derive the formulates for the score and the information matrix, used for the inference.

The structural estimates of the model parameters are reported in Table 4. Approximately 3/4 of the managers develop a relation. The estimated value of R is 5 for family firms. Given that the average level of TFP is around 7, this means that owners of family firms value relation almost as much as efficiency. The standard error, estimated through the BHHH method, indicate that the value is highly significant. We also get significant values for R in case of Holdings (1.28) and government controlled firms (2.14), both highly significant. The mean of the log ability distribution is 1.93. The estimation gives a MSE of fit for $\hat{\sigma}_{\log X}^2 = 0.13$ and $\hat{\sigma}_{\phi}^2 = 0.10$

To better evaluate these results, in Table 5 we report some key statistics from the model, given the parameter estimates. By assumption, $R = 0$ for foreign-controlled firms. In these firms, the average log managerial ability is 1.99, higher than the unconditional average (1.93), because senior managers are in fact selected.

According to our estimates, senior managers are confirmed if their ability is above 7.22 (the the unconditional value is 6.9). In Figure 4 we report the distribution of ability and the threshold level for these firms (red vertical bar). $E(\log X_o) = 2.04$ meaning that senior managers' ability on average is 11% higher than that of the junior ones. Finally, 69% of the junior managers are fired when turning senior.

Things are very different for family firms, for which $R = 4.99$. In this case, $s^* = 9.76$ and $S^* - R = 5.63$, which is the cutoff ability of managers that have developed a relation with the owner. With these values, there is basically no selection among senior managers: in practice, all those with $R = 0$ are fired and those with $R >=$ are confirmed. This can be seen in Figure 4, where the two pink bars represent the cutoff levels for the two types of managers. One important thing to notice is that the young-old differential in ability is basically zero, which implies that senior managers' average ability in family firms is 11% lower than in foreign controlled firms. And this is exactly the OLS estimate of Table 3. For holding and government controlled firms, the situation is intermediate between these two extremes.

Finally, in Table 6 we repeat the estimation exercise for two alternative values of the standard deviation of the ability distribution λ_σ, equal respectively to .5 and 1.5 of the basic estimates. We only report the results for the foreign and family firms and, in the firs two columns, reproduce those of the basic estimates. Increasing the dispersion level enhances the effects of selection, while the opposite occurs by decreasing it: in fact, if managers' ability are very similar, then selection is not very important, while of they differ substantially, then one can greatly enhance efficiency via selection. Note that, in all cases, family firms do not select managers at all. Note also that the share of senior managers changes only marginally for the different values of λ_σ.

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Figure 1: Fraction of senior managers vs R

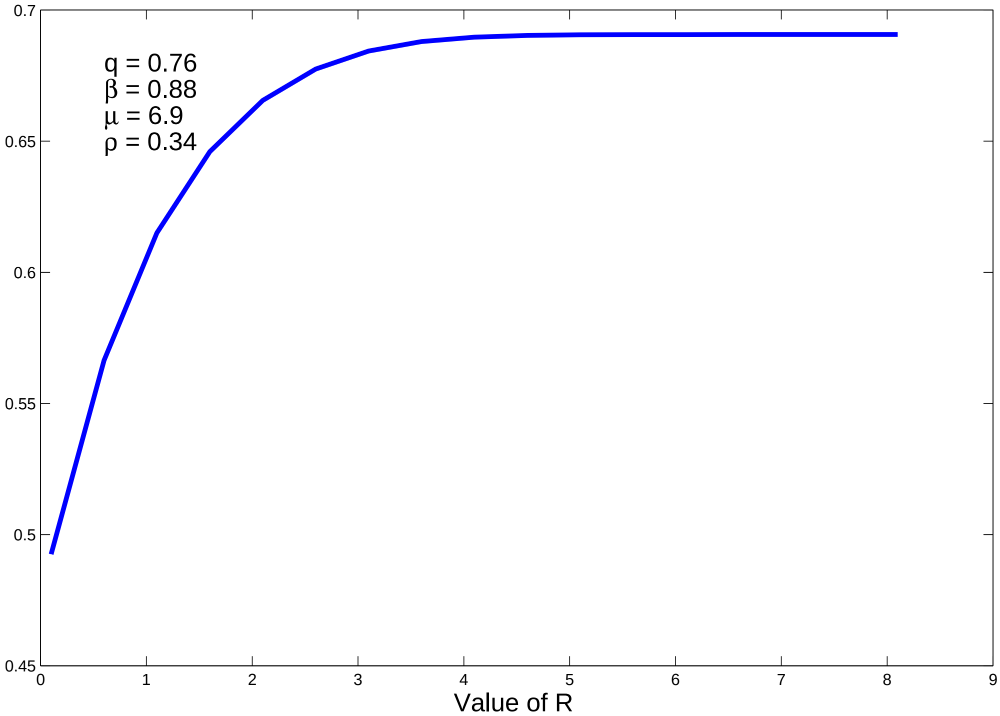

Figure 2: Avg. Firm log(TFP) vs R

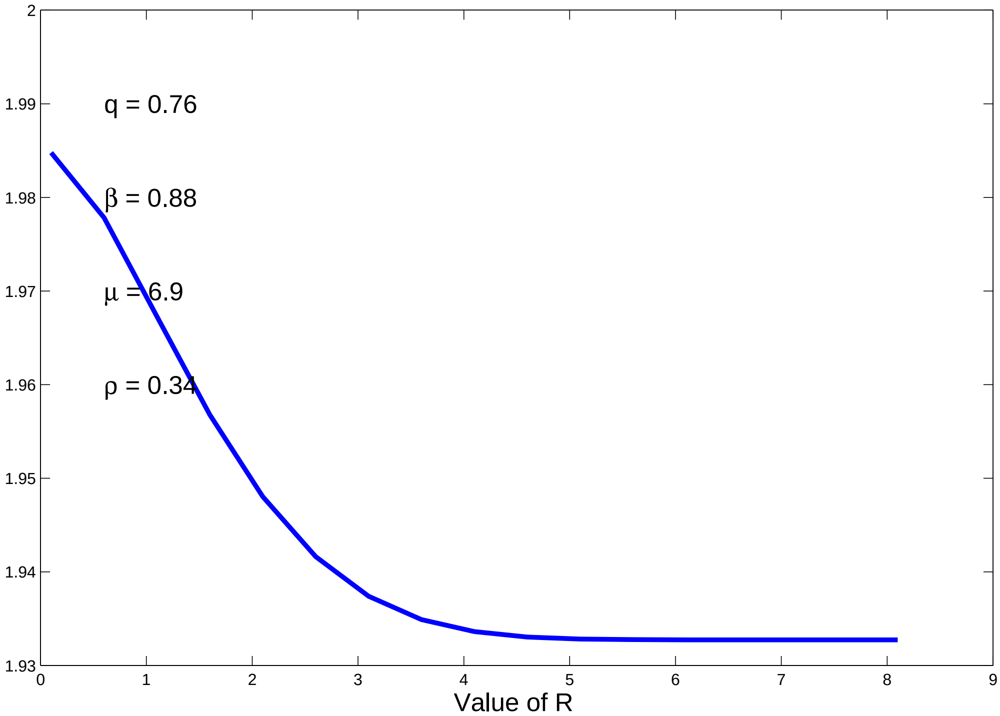

Figure 3: Young - Old productivity differential (in %) vs R

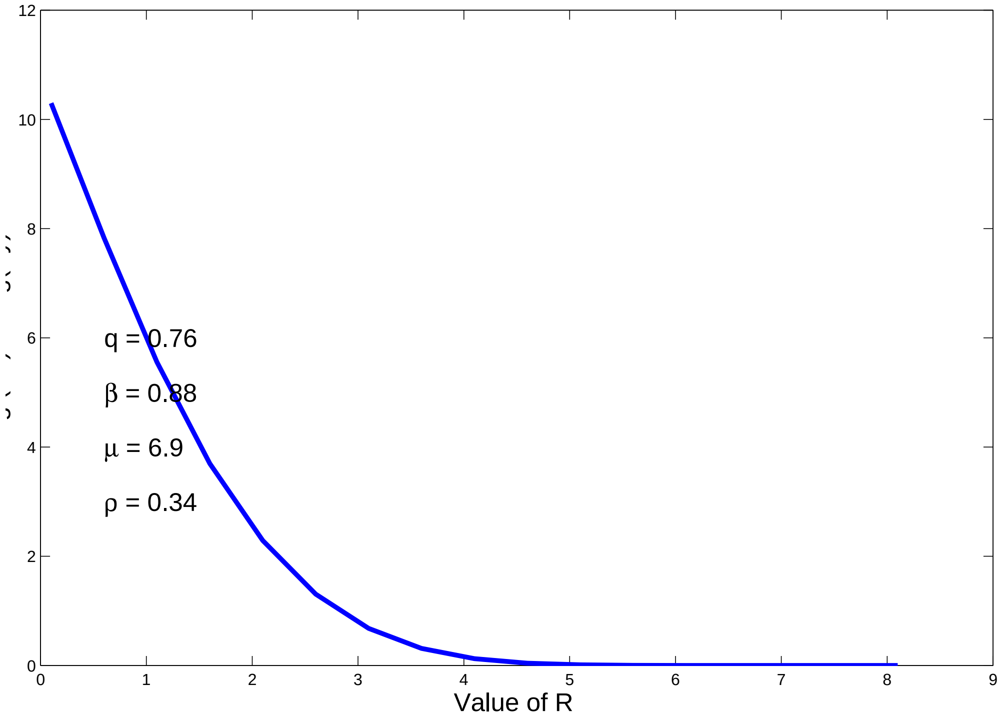

Figure 4: Selection thresholds, $R0 =$ and $R = 5$

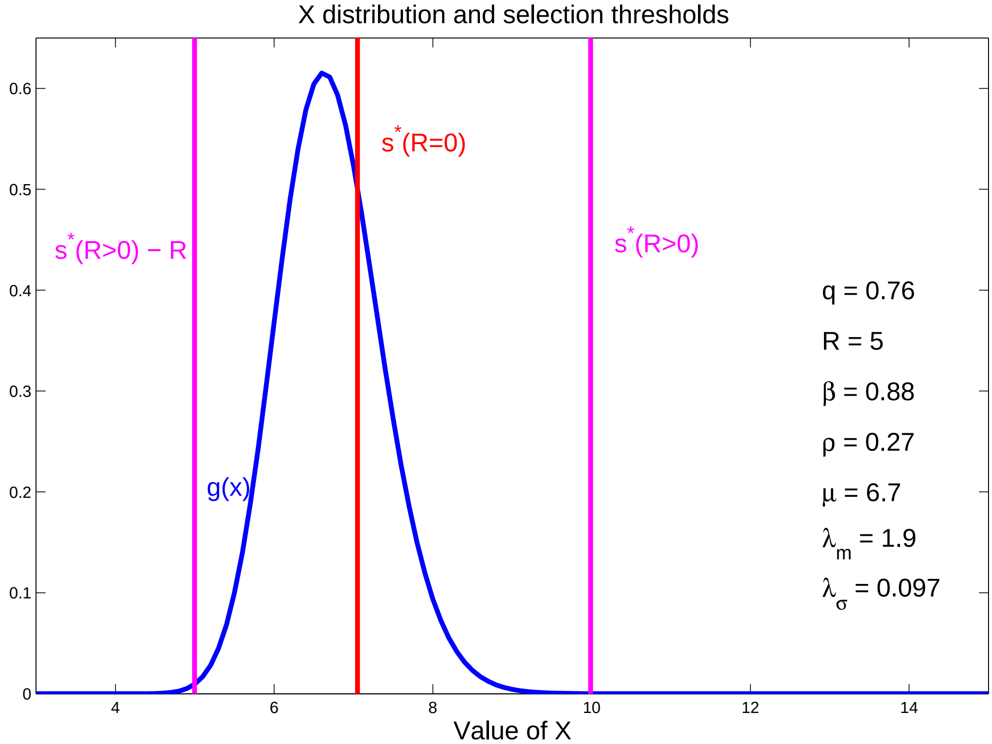

Table 1: Descriptive stats: firms' characteristics, by ownership type

	V.A.	Empl.	# Man.	Sh. Man.	TFP	High Tech	North	N. obs.
				All firms				
Mean	30.00	691.80	7.04	0.017	2.41	0.41	0.74	7773
S.D.	127.35	3299.32	16.25	0.014	0.51	0.49	0.44	
				Family				
Mean	11.23	281.35	3.67	0.019	2.33	0.33	0.73	2906
S.D.	17.95	419.73	3.79	0.013	0.46	0.47	0.44	
				Holding				
Mean	44.55	1024.07	7.44	0.015	2.44	0.40	0.82	2390
S.D.	214.21	5637.32	13.86	0.013	0.54	0.49	0.39	
				Government				
Mean	40.57	1012.93	12.58	0.013	2.38	0.47	0.51	687
S.D.	87.41	2076.30	38.36	0.018	0.61	0.50	0.50	
				Institution and foreign				
Mean	37.00	791.25	9.95	0.017	2.53	0.52	0.75	1790
S.D.	69.11	1562.97	16.51	0.014	0.48	0.50	0.44	

NOTE.— V. A. is value added (in millions of 1995 euros), # Man. is the number of managers, Sh. managers is the share of managers over the total number of employees, TFP is total factor productivity, High Tech is the share of firms classified as medium-high and high tech according to the OECD classification system (OECD 2003), North is the share of firms located in the North, N. obs. is the number of firm-year observations.

Table 2: Descriptive stats: managers' characteristics, by ownership type

	Wage	W. dispersion	ϕ	Age
		All firms		
Mean	1236.32	361.04	0.77	46.53
S.D.	345.39	330.01	0.26	4.62
		Family		
Mean	1130.01	267.98	0.80	45.98
S.D.	347.09	287.83	0.27	5.25
		Holding		
Mean	1293.60	402.35	0.74	46.57
S.D.	347.34	321.08	0.26	4.03
		Government		
Mean	1298.11	395.80	0.78	47.66
S.D.	307.81	348.71	0.24	4.63
		Institution and foreign		
Mean	1308.69	429.68	0.77	46.93
S.D.	309.43	360.99	0.26	4.12

NOTE.— Wage is in 1995 euros, W. dispersion is the dispersion of managers' wages within the firm, ϕ the share of managers that have been with the firm at least 4 years,Age is average managerial age.

Table 3: Reduced-form regressions

	Dependent variable		
	Log TFP		ϕ
	[1]	[2]	[3]
Public	-0.103***	.143*	.021*
	(0.019)	(.078)	(.013)
Family	-0.044***	.047	.040***
	(0.011)	(.037)	(.009)
Holding	0.012	.085**	-.021**
	(0.011)	(.04)	(.009)
ϕ		.106***	
		(039)	
ϕ*Public		-.345***	
		(.093)	
ϕ*Family		-.104**	
		(045)	
ϕ*Holding		-.096*	
		(.053)	
Observations	9,622	6,737	6,295
R-squared	0.51	0.49	0.03

Note: ϕ is the share of senior managers (that have been with the firm at least4 years) in the firm. Public is a dummy equal to one if the controlling shareholder is the government, Family if a family or individual, Holding for a holding. The excluded category is the foreign on insinuation controlled firms. All regressions include year, 2-digit sector and 4 macro-region dummies.

Table 4: Structural estimates of model parameters

	q	R_{fam}	R_{hold}	R_{gov}	λ_μ
point estimate	0.74	4.99	1.33	2.23	1.93
t-stat	3.75	4.077	7.808	5.734	367.1

MSE of fit

$\log X$	ϕ
0.13	0.10

Note: The estimation assumes $R = 0$ in firms with foreign ownership. It is also assumed that $\sigma^2_{\log X} = 0.18$ and $\sigma^2_\phi = 0.08$. The other structural parameters are fixed form auxiliary estimation or drawing from previous literature: $\beta = .96, \rho = .099, \lambda_\sigma = .097$.

Table 5: Estimation results: key statistics

	Ownership type			
	Foreign	Family	Holdings	Public
R	0	4.13	1.28	2.14
s^*	7.22	9.76	7.77	8.25
x^*	7.22	5.63	6.49	6.11
$\log X$	1.99	1.93	1.96	1.95
$\log X_o$	2.04	1.93	1.98	1.95
$\log X_o \mid R = 0$		2.3	2.1	2.15
$\log X_o \mid R > 0$		1.93	1.98	1.95
ϕ	0.47	0.69	0.63	0.67
Fired	.69	0.24	0.42	0.32
Fired$\mid R = 0$		1	0.89	0.97
Fired$\mid R > 0$		0.001	0.28	0.11

The table reports the key statistics from solving the model under the parametrization deriving from the estimates of Table 4. $\log X$ is the average managerial ability, X_o is the average managerial ability of the senior managers (that of the junior is 1.93), $\log X_o|R = 0$ is the average ability of the senior that did not develop a relation, $\log X_o|R > 0$ for those that did develop a relation, Fired is the probability that a junior manager is replaced when turning senior.

Table 6: Estimation results: comparative statics on λ_σ

	Foreign	Family	Foreign	Family	Foreign	Family
	$\lambda_\sigma = .097$		$\lambda_\sigma = .14$		$\lambda_\sigma = .049$	
R	0	4.99	0	7.06	0	2.25
s^*	7.22	9.89	7.26	11	7.16	8.35
x^*	7.22	4.9	7.26	3.97	7.16	6.1
$\log X$	1.99	1.93	2	1.92	1.97	1.95
$\log X_o$	2.04	1.93	2.08	1.92	2	1.95
$\log X_o \vert R = 0$	2.04	2.32	2.08	2.44	2	2.13
$\log X_o \vert R > 0$	2.04	1.93	2.08	1.92	2	1.95
ϕ	0.481	0.691	0.475	0.691	0.488	0.69
Fired	0.683	0.237	0.691	0.237	0.674	0.238
Fired$\vert R = 0$	0.683	0.00024	0.691	0.000135	0.674	0.0023
Fired$\vert R > 0$	0.683	1	0.691	1	0.674	1

The table reports the key statistics from solving the model under 3 values of λ_σ. To save on space, we report only the results for foreign and family owned firms. The parametrization is the same as in Table 4. $\log X$ is the average managerial ability, X_o is the average managerial ability of the senior managers (that of the junior is 1.93), $\log X_o|R = 0$ is the average ability of the senior that did not develop a relation, $\log X_o|R > 0$ for those that did develop a relation, Fired is the probability that a junior manager is replaced when turning senior.

A Proofs

Proof of Proposition 1. Simple algebra shows that $H(s,R)$: is continuous in s, that $H(0,R) < 0$, and that the first order derivative w.r.t. s^* is positive, $H_{s^*}(s^*,R) = 1 + \beta(\rho - F(s^*)) > 0$, and in the limit $\lim_{s^* \to \infty} H_{s^*}(s^*,R) > 0$. Hence there exist one and only one $s^* > 0$ that solves equation (9). □

Proof of Proposition 2. Applying the implicit function theorem to equation (9) gives

$$\frac{\partial s^*}{\partial R} = \frac{(1-\beta)\frac{\partial v_y}{\partial R}}{1-(1-\beta)\frac{\partial v_y}{\partial s^*}} \tag{22}$$

Let us use expression (6) to compute:

$$\begin{aligned}\frac{\partial v_y}{\partial s^*} &= \frac{-\beta s^*\ f(s^*)\left[(1-\beta)(1+\beta(\rho - F(s^*))\right] + \beta(1-\beta)f(s^*)\left[\mu(1-\beta(1-\rho)) + \beta\int_{s^*}^{\infty} s dF(s)\right]}{\left[(1-\beta)(1+\beta(\rho - F(s^*)))\right]^2} \\ &= \beta f(s^*)\ \frac{-s^* + (1-\beta)\frac{\mu(1-\beta(1-\rho))+\beta\int_{s^*}^{\infty} sdF(s)}{(1-\beta)(1+\beta(1-F(s^*)))}}{(1-\beta)(1+\beta(1-F(s^*)))} = \beta f(s^*)\ \frac{-s^* + (1-\beta)v_y}{(1-\beta)(1+\beta(1-F(s^*)))}\ .\end{aligned}$$

Using that at the optimum $(1-\beta)v_y = s^*$ gives $\frac{\partial v_y}{\partial s^*} = 0$. Hence $\frac{\partial s^*}{\partial R} = (1-\beta)\frac{\partial v_y}{\partial R}$. Next, we show that $0 < (1-\beta)\frac{\partial v_y}{\partial R} < 1$. Rewrite the integral term in the numerator of (6) as

$$\begin{aligned}\int_{s^*}^{\infty} s\ dF(s) &= q\int_{s^*-R}^{\infty}(x+R)\ dG(x) + (1-q)\int_{s^*}^{\infty} x\ dG(x) \\ &= q\left(R(1-G(s^*-R)) + \int_{s^*-R}^{\infty} x\ dG(x)\right) + (1-q)\int_{s^*}^{\infty} x\ dG(x)\end{aligned}$$

Using this expression in (6) and taking the derivative w.r.t. R yields:

$$\begin{aligned}(1-\beta)\frac{\partial v_y}{\partial R} &= \beta\frac{\frac{\partial\int_{s^*}^{\infty} s\ dF(s)}{\partial R} + (1-\beta)\ v_y\ \frac{\partial F(s^*)}{\partial R}}{1+\beta(1-F(s^*))} \\ &= \beta q\frac{\left[1-G(s^*-R) + Rg(s^*-R) + (s^*-R)g(s^*-R)\right] - s^*g(s^*-R)}{1+\beta(1-F(s^*))} \\ &= \beta q\frac{1-G(s^*-R)}{1+\beta(1-F(s^*))} \quad \in (0,1)\end{aligned}$$

where the second equality uses $s^* = (1-\beta)v_y$. □

Proof of Proposition 3. The derivative of (13) with respect to R gives

$$\frac{\partial X}{\partial R} = \frac{-\left[q\ (s^*-R)\ g(s^*-R)\ \frac{\partial(s^*-R)}{\partial R} + (1-q)\ s^*\ g(s^*)\frac{\partial s^*}{\partial R}\right]\cdot(2-q\ G(s^*-R)-(1-q)\ G(s^*))}{(2-F(s^*))^2}$$
$$+\frac{\left[q\ g(s^*-R)\ \frac{\partial(s^*-R)}{\partial R} + (1-q)\ g(s^*)\frac{\partial s^*}{\partial R}\right]\cdot\left(\mu+q\ \int_{s^*-R}^{\infty} x\ dG(x)+(1-q)\ \int_{s^*}^{\infty} x\ dG(x)\right)}{(2-F(s^*))^2}$$

Evaluating this derivative at $R = 0$, using that $F(s) = G(s)$, gives (after some algebraic simplification)

$$\left.\frac{\partial X}{\partial R}\right|_{R=0} = \frac{s^*\ g(s^*)\left(q-\frac{\partial s^*}{\partial R}\right)(2-G(s^*))\ +\ g(s^*)\left(\frac{\partial s^*}{\partial R}-q\ \right)\left(\mu+\int_{s^*}^{\infty} x\ dG(x)\right)}{[2-G(s^*)]^2}$$
$$= \frac{g(s^*)\left(q-\frac{\partial s^*}{\partial R}\right)\left[s^*-\frac{\mu+\int_{s^*}^{\infty} x\ dG(x)}{2-G(s^*)}\right]}{2-G(s^*)} \qquad (23)$$

Note that the term in the square parenthesis is the optimality condition produced by (9) for $\beta \to 1$, i.e. the optimal policy for the steady state problem. This implies that $\frac{\partial X}{\partial R}|_{R=0} = 0$. □

Proof of Proposition 4. We show that $cov\,(\phi_i, \varepsilon_i) = 0$, so that the OLS regression assumptions are satisfied. Let n be the number of managers in each firm.

$$cov\,(\phi_i,\varepsilon_i) = \mathbb{E}\left[\phi_i^2\left(\frac{\Sigma_{j=1}^{n_{o,i}}\zeta_{i,j}}{n_{o,i}}-\frac{\Sigma_{j=1}^{n-n_{o,i}}\xi_{i,j}}{n-n_{o,i}}\right)\right]-\mathbb{E}\,(\phi_i)\,\mathbb{E}\left[\phi_i\left(\frac{\Sigma_{j=1}^{n_{o,i}}\zeta_{i,j}}{n_{o,i}}-\frac{\Sigma_{j=1}^{n-n_{o,i}}\xi_{i,j}}{n-n_{o,i}}\right)\right]$$

For notational convenience let $y_i \equiv \frac{\Sigma_{j=1}^{n_{o,i}}\zeta_{i,j}}{n_{o,i}}$ and $u_i \equiv \frac{\Sigma_{j=1}^{n-n_{o,i}}\xi_{i,j}}{n-n_{o,i}}$. The key of the proof is to note that the conditional expectation $\mathbb{E}\,(y_i|n_{o,i} = k) = 0$, for all $k = 0, 1, ...n$. To see this note that, for a given k:

$$\mathbb{E}\left[\frac{\Sigma_{j=1}^{k}\zeta_{i,j}}{k}\ |\ n_{o,i}=k\right] = \left[\frac{1}{k}\Sigma_{j=1}^{k}\mathbb{E}\,(\zeta_{i,j}|(x_{i,j}+r_{i,j})>\underline{s})\right]=0$$

This holds since $\mathbb{E}\,(\zeta_{i,j}|(x_{i,j}+r_{i,j}) > \underline{s}) = 0$: intuitively, knowing that a senior manager has been confirmed in office (the conditioning part in the expectations) does not help predict the value of his productivity beyond the expected value X_o.

Recall that ϕ_i takes the values $(0, \frac{1}{n}, ..., \frac{k}{n}, ..., 1)$. As productivity realization are independent across managers, the probability of each $\phi_i = \frac{k}{n}$ outcome is $prob\left(\frac{k}{n}\right) \equiv$

$p(k,n)$ from a binomial distribution. Then (for $a = 1, 2$)

$$\begin{aligned}\mathbb{E}_{\phi,y}\left(\phi_i^a y_i\right) &= \mathbb{E}_{\phi}\left[\mathbb{E}_y\left(\phi^a y_i\right)|\phi_i = \phi\right] = \sum_{k=0}^{n} p\left(k,n\right)\mathbb{E}_y\left[\left(\frac{k}{n}\right)^a \cdot y_i | n_{o,i} = k\right] \\ &= \sum_{k=0}^{n} p\left(k,n\right)\left(\frac{k}{n}\right)^a \mathbb{E}_y\left[y_i|n_{o,i} = k\right] = \sum_{k=0}^{n} p\left(k,n\right)\left(\frac{k}{n}\right)^a \cdot 0 = 0\end{aligned}$$

The same logic shows that $\mathbb{E}_{\phi,u}\left(u_i\ \phi_i^a\right) = 0$ for $a = 1, 2$. This is obvious as the productivity of the junior is not observed by the principal, hence it cannot be correlated with his decisions about the tenure of the senior managers. □

B Data and OLS regressions details

The INVIND survey is comprised by a fixed and some monographic sections, that change from year to year and are used to investigate in depth some specific aspects of firms activity. In 1992 a large section was devoted to corporate control. The determination of the nature of the controlling shareholders begins with that year. Among other things, the questionnaire asked the main shareholder and its nature, distinguishing between 10 different categories. Since 1992, the question on the control structure has been inserted every year. Starting in 1996, the categories have been reduced to 5: 1) individual or family; 2) government (local or central or other publicly controlled entities); 3) holding; 4) institution (financial or not); 5) foreign owner. We map the previous classification into these 5 categories. Before 1992 the nature of the controlling shareholder was not investigated. However, in 1992 the firm was asked the year of the most recent change in control. We extend the control variable of 1992 back to the year of the most recent control change. Moreover, if a firm has a certain controller type in year t and the same in year t', and some missing values in the year in between, we assume that the control has remained of the same type for all the period $t - t'$.[7]

The CADS data are used to construct the capital stock. Investment is at book value, adjusted using the appropriate two-digit deflators, derived from National Accounts published by the National Institute for Statistics. For consistency with the capital data, in the estimation of the production function we take value added and labor from the CADS database. Both the INVIND and the CADS samples are unbalanced, so that not all firms are present in all years.

Data on workers are extensively described in Iranzo, Schivardi & Tosetti (2008). As it is often the case with social security data, there is no information on education.

[7]Note that there might be some cases of misclassification, in particular among firms that are classified as non controlled by an individual. For example, a foreign entity controlling a resident firm might in turn be controlled by a resident that uses the offshore firm for tax elusion purposes. The same hold for firms that report an institution as the controlling shareholder. As will become clear later, this would bias our results downward, implying that our findings are a lower bound of the size of the effects.

We cleaned the data by eliminating the records with missing entries on either the firm or the worker identifier, those corresponding to workers younger than 25 (just 171 observations, .08% of the total) and those who had worked less than 4 weeks in a year. We also avoided duplication of workers within the same year; when a worker changed employer, we considered only the job at which he had worked the longest.[8]

The main econometric problem in estimating equation (19) is that inputs are a choice variable and thus are likely to be correlated with unobservables, particularly the productivity shock ω_{it}. This is the classical problem of endogeneity in the estimation of production functions. To deal with it we follow the procedure proposed by Olley & Pakes (1996). Using a standard dynamic programming approach, Olley and Pakes show that the unobservable productivity shock can be approximated by a non-parametric function of the investment and the capital stock, $\omega_{it} = h(i_{it}, k_{it})$. To allow for sectoral heterogeneity in the production function, we estimate it separately for 10 manufacturing subsectors. The estimation procedure, the coefficients and all the results are described in details in Cingano & Schivardi (2004).

To make sure that our results are not dependent on the TFP measure, we also perform some direct production function estimation exercises. To control for endogeneity we again follow Olley and Pakes and include in the regression a third degree polynomial series in i and k and their interactions, which approximate the unobserved productivity shock ω_{ft}.[9] All the regressions include year dummies as well as sectoral and area dummies. In Table A.7, we report a series of exercises analogous to column (1) in Table 3. The dependent variable is log value added, the regressors are capital and labor in addition to the ownership dummies. In column (1) we do simple OLS; the Olley and Pakes controls are introduced in Column (2); in Column (3) we use the sampling weights, that take into account that the sampling design does not replicate the population exactly. Results are fairly similar across specifications, although the coefficients for public and family firms are smaller in absolute value for the weighted regression, and very much in line with those of Table Table 3.

In Table A.8 we repeat an analogous exercise for the estimates of Column (2) of Table 3, relating TFP to the share of senior managers. The OLS and Olley and Pakes estimates in Columns (1) and (2) indeed confirm the results in the main text. In column (3) we run a fixed effects estimation, in addition to the OP procedure. This allows to control for unobserved firm heterogeneity. Note that the parameters are now identified only by within firm variations in the share of senior managers, so

[8]Our preferred measure of entrenchment is the fact that a manager has worked for the firm for at least n years. This is in line with the model, where ϕ represents exactly a share. An alterative would be to use average managerial seniority. In addition to being less model coherent, this variable has the disadvantage that it requires tenure to be imputed for managers already working in a firm the first year in which the firm is in the sample. Using the threshold, instead, we simply drop the first n years in which the firm appears in the sample and do not need to impute seniority.

[9]Note that when the nonparametric term in capital and investment is included, the capital coefficient can no longer be interpreted as the parameter of the production function in the first stage of the procedure. However, given that the coefficient on capital is of no particular interest to us, this is inconsequential for our purposes.

that we can exclude that the results are driven by unobserved heterogeneity possibly correlated with both productivity and fixed firm characteristics. Even with these arguably strong controls, the general patters are confirmed, although somehow reduced in size and significance. In column (4) we weight observations using sampling weights; the coefficient increase in absolute value and in significance. To make sure that these conclusions do not depend on the choice of the threshold to become senior, in column (5) we use 7 years as the "trial" period. Although the number of observations is reduced, the estimates are basically the same as in column (2). Finally, in unreported regressions we also included firm's age, as it might be correlated with mangers' age and firm productivity, although the literature on production function seldom finds an independent effect for firm age (Olley & Pakes 1996). In fact, also in our regressions firm age is never statistically significant and the other coefficients remain basically unchanged.

Finally, we have also repeated the regression of Column (3) of Table 3, relating the share of senior managers to ownership status dummies, with sampling weights (unreported for brevity). In this case, the differences become more marked: the coefficient on the Public dummies goes to .12 (from .021 in Table 3) and that on the Family dummy to .09 (from .04), both highly significant.

C Computing the parameters of the G distribution

In this subsection we illustrate how we recover the standard deviation of the ability distribution using the TFP measure and the data on managers' wages. We do not have direct information on managerial ability. However, we do observe wages. Our assumption is that owners with $R = 0$ pay managers according to their managerial ability. In the model, ability is only revealed when a manager turns senior. Of course, in reality the process of learning about managerial skills is more gradual. As long as the average wage over the job spell reflects managerial ability, we can use data on wages to infer the underlying individual ability. Once we have such measure of ability, we select junior managers (on which selection has not yet occurred) and compute the dispersion of the ability distribution on them. This implies that ability itself can be inferred from the wage. We therefore estimate a wage equation of the form:

$$\ln w_{it} = \theta_i + \lambda Z^1_{it} + \eta_{it} \tag{24}$$

where θ_i is a fixed person effect, Z^1_{it} a vector of additional controls of other determinants of the wage beyond individual ability and η_{it} an error term. For consistency with the rest of the procedure, Z^1_{it} includes 4 technology level dummies, year dummies and firm size. We also include a quadratic in age, as in Italy wages have a component linked uniquely to seniority (results are unchanged when we drop it). Following the matched employer-employee literature (Abowd et al. 1999), we interpret the fixed person effect as the measure of individual ability, modeled as a latent variable in the wage equation. Individual ability can be recovered as the coefficient of a manager-specific dummy variable. This variable captures the fixed component of wage, net of the effects of the additional controls. Recovering ability as a manager's fixed effect is model consistent: in fact, we assume that ability is time invariant.

Of course, the scale of TFP and of the individual ability measure are different. In fact, the first is computed as the residual in a value added equation, while the latter as a fixed effect in a wage equation. Moreover, we want to allow for a potential nonlinear relation between ability measured in terms of TFP and of wages. To express ability in TFP units, we estimate the equation

$$\ln \text{TFP}_{jt} = \gamma \bar{\theta}_{jt} + \delta Z_{jt}^2 + \epsilon_{jt} \tag{25}$$

where $\bar{\theta}_{jt} = \frac{1}{n_j} \sum_{i \in (jt)} \theta_i$ and where we include the same set of controls as in equation 24, with the exclusion of age. Given the estimate of γ, individual ability measured in TFP units can then we recovered as $x_i = \hat{\gamma}\theta_i$. The relevant distribution of ability for firm j at time t is then $G_{jt}(\mu, \sigma) = N(\mu_x + \hat{\delta} Z_{jt}, \sigma_x^2)$.

To recap, we compute σ_x^2 following these steps:

1. Keep only observations of workers working in $R = 0$ firms;

2. Estimate the wage equation with age, age^2, year and sector dummies and log employment, in addition to individual dummies. Use the coefficients on individual dummies as the measure of skills. The estimation is carried out on 8,233 managers for 35,465 individual-year observations.[10]

3. Compute $\bar{\theta}_{jt}$ as the average effects for each firm-year combination.

4. Run regression (25), including sector and year dummies and log employment. The coefficient on $\bar{\theta}_{jt}$ is $\hat{\gamma} = .29$, highly significant (s.e.=.05).

5. Compute $x_i = \hat{\gamma}\theta_i$.

6. Keep only junior managers and compute the standard deviation of x_i, equal to .097.

[10] Compared to (Abowd et al. 1999), we do not include firm fixed effects. In fact, we do not have a theory of firms' effects. Moreover, connected sets are a problem: given that we only focus on managers, we have a few observations per firm, so that for many of them the firm effect would not be separately identifiable from the workers effects.

D ML estimation

The likelihood for a sample of observations z, under the parametrization Θ is

$$\begin{aligned} L(\Theta; z) &= \prod_{s=1}^{S}\prod_{j=1}^{2}\prod_{i=1}^{n_s}\frac{1}{\left(2\pi\sigma_j^2\right)^{1/2}}\exp\left(-\frac{1}{2}\left[\frac{z_{i,s}^j - f^j(\theta_s)}{\sigma_j}\right]^2\right) \\ &= \prod_{s=1}^{S}\prod_{j=1}^{2}\left(2\pi\sigma_j^2\right)^{-n_s/2}\prod_{i=1}^{n_s}\exp\left(-\frac{1}{2}\left[\frac{z_{i,s}^j - f^j(\theta_s)}{\sigma_j}\right]^2\right) \end{aligned}$$

or

$$\ln L(\Theta; z) = -\frac{1}{2}\sum_{s=1}^{S}\sum_{j=1}^{2} n_s \ \log\left(2\pi\sigma_j^2\right) - \frac{1}{2}\sum_{s=1}^{S}\sum_{j=1}^{2}\sum_{i=1}^{n_s}\left[\frac{z_{i,s}^j - f^j(\theta_s)}{\sigma_j}\right]^2$$

Let the measurement error for variable j (common for all s) be

$$\sigma_j^2 \equiv var\left(z^j\right) = \sum_{i=1}^{n_s}\frac{1}{n_s}\left[z_{i,s}^j - \left(\frac{\sum_{i=1}^{n_s} z_{i,s}^j}{n_s}\right)\right]^2$$

Since for all j, s (hence omitting j, s notation)

$$\begin{aligned} \sum_{i=1}^{n_s}\left[\frac{z_i - f}{\sigma}\right]^2 &= \frac{n_s}{\sigma^2}\left[\frac{\sum_{i=1}^{n_s} z_i^2}{n_s} + f^2 - 2\frac{\sum_{i=1}^{n_s} z_i}{n_s} f\right] \\ &= \frac{n_s}{\sigma^2}\left[\sigma^2 + \left(\frac{\sum_{i=1}^{n_s} z_i}{n_s}\right)^2 + f^2 - 2\frac{\sum_{i=1}^{n_s} z_i}{n_s} f\right] \\ &= n_s + \frac{n_s}{\sigma^2}\left(\frac{\sum_{i=1}^{n_s} z_i}{n_s} - f\right)^2 \end{aligned}$$

Score and Information matrix: Let M be the dimensionality of θ. The $n-th$ element of the score is given by

$$\begin{aligned} s_n(\theta; z) &\equiv \frac{\partial \log L(\theta; z)}{\partial \theta_n} = -\frac{1}{2}\frac{\partial F(\theta; z)}{\partial \theta_n} \\ &= \sum_{s=1}^{S}\sum_{j=1}^{2}\left(\frac{n_s}{\sigma_j^2}\right)\left(\frac{\sum_{i=1}^{n_s} z_{i,s}^j}{n_s} - f^j(\theta)\right)\frac{\partial f^j(\theta)}{\partial \theta_n} \end{aligned}$$

Let M be the dimensionality of θ. The n, m element of the $M \times M$ information matrix $I(\theta)$ is defined as:

$$I_{n,m}(\theta) = \mathbb{E}\left[\frac{\partial \log L(\theta; z)}{\partial \theta_n}\frac{\partial \log L(\theta; z)}{\partial \theta_m}\right] = \mathbb{E}\left[s_n(\theta, z)\, s_m(\theta, z)\right]$$

which in our case becomes

$$
\begin{aligned}
&= \mathbb{E}\left\{\left[\sum_{s=1}^{S}\sum_{j=1}^{J}\left(\frac{n_s}{\sigma_j^2}\right)\left(\frac{\sum_{i=1}^{n_s} z_{i,s}^{j}}{n_s} - f^{j}\left(\theta\right)\right)\frac{\partial f^{j}\left(\theta\right)}{\partial\theta_n}\right]\left[\sum_{s'=1}^{S}\sum_{j'=1}^{J}\left(\frac{n_s}{\sigma_{j'}^2}\right)\left(\frac{\sum_{i=1}^{n_{s'}} z_{i,s'}^{j'}}{n_{s'}} - f^{j'}\left(\theta\right)\right)\frac{\partial f^{j'}}{\partial\theta}\right.\right. \\
&= \sum_{s=1}^{S}\sum_{j=1}^{J}\left(\frac{n_s}{\sigma_j^2}\right)\sum_{s'=1}^{S}\sum_{j'=1}^{J}\left(\frac{n_{s'}}{\sigma_{j'}^2}\right)\mathbb{E}\left\{\left(\frac{\sum_{i=1}^{n_s} z_{i,s}^{j}}{n_s} - f^{j}\left(\theta\right)\right)\left(\frac{\sum_{i=1}^{n_{s'}} z_{i,s'}^{j'}}{n_{s'}} - f^{j'}\left(\theta\right)\right)\right\}\frac{\partial f^{j'}\left(\theta\right)}{\partial\theta_m}\frac{\partial f^{j}\left(\theta\right)}{\partial\theta_n} \\
&= \sum_{s=1}^{S}\sum_{j=1}^{J}\left(\frac{n_s}{\sigma_j^2}\right)\sum_{s'=1}^{S}\sum_{j'=1}^{J}\left(\frac{n_{s'}}{\sigma_{j'}^2}\right)\mathbb{E}\left\{\left(\frac{1}{n_s}\sum_{i=1}^{n_s}\varepsilon_i^{j}\right)\left(\frac{1}{n_{s'}}\sum_{i=1}^{n_{s'}}\varepsilon_i^{j'}\right)\right\}\frac{\partial f^{j'}\left(\theta\right)}{\partial\theta_m}\frac{\partial f^{j}\left(\theta\right)}{\partial\theta_n} \\
&= \sum_{s=1}^{S}\sum_{j=1}^{J}\left(\frac{n_s}{\sigma_j^2}\right)\left(\frac{n_s}{\sigma_j^2}\right)\left\{\frac{\sigma_j^2}{n_s}\right\}\frac{\partial f^{j}\left(\theta\right)}{\partial\theta_m}\frac{\partial f^{j}\left(\theta\right)}{\partial\theta_n} \\
&= \sum_{s=1}^{S}\sum_{j=1}^{J}\left(\frac{n_s}{\sigma_j^2}\right)\left[\frac{\partial f^{j}\left(\theta\right)}{\partial\theta_m}\frac{\partial f^{j}\left(\theta\right)}{\partial\theta_n}\right]
\end{aligned}
$$

Table A.7: Productivity, by ownership type

	(1)	(2)	(3)
Public	-0.118***	-0.106***	-0.058**
	(0.018)	(0.018)	(0.025)
Family	-0.040***	-0.044***	-0.027*
	(0.011)	(0.011)	(0.015)
Holding	0.027**	0.024**	0.069***
	(0.011)	(0.011)	(0.017)
log labor	0.752***	0.721***	0.684***
	(0.006)	(0.007)	(0.010)
log capital	0.257***		
	(0.005)		
Observations	9622	9076	9047
R^2	0.92	0.92	0.86
Estim. method	OLS	OP	OP
Weights	NO	NO	Sampl.

NOTE.— Dependent variable: log value added. Public is a dummy equal to one if the controlling shareholder is the government, Family if a family or individual, Holding for a holding. The excluded category is the foreign on insinuation controlled firms. OP is the Olley & Pakes (1996) estimation method. In the third column observations are weighted according to the sampling weights. All regressions include year, 2-digit sector and 4 macro-region dummies. The number of obs. is larger than in the other tables because here we do not use information on managers.

Table A.8: Productivity-share of senior managers relation, by firm ownership type

	(1)	(2)	(3)	(4)	(5)
ϕ	0.098***	0.116***	0.047	0.169***	0.114***
	(0.037)	(0.037)	(0.034)	(0.052)	(0.035)
ϕ *Public	-0.283***	-0.296***	-0.175*	-0.434***	-0.260***
	(0.092)	(0.094)	(0.091)	(0.101)	(0.087)
ϕ *Family	-0.128***	-0.118***	-0.081**	-0.166***	-0.111***
	(0.043)	(0.043)	(0.040)	(0.058)	(0.040)
ϕ *Holding	-0.075	-0.084	-0.031	-0.070	-0.055
	(0.052)	(0.051)	(0.041)	(0.070)	(0.051)
Log labor	0.756***	0.728***	0.715***	0.691***	0.733***
	(0.008)	(0.008)	(0.022)	(0.012)	(0.010)
Log capital	0.248***				
	(0.007)				
Observations	6737	6603	6603	6585	5246
R^2	0.92	0.92	0.97	0.87	0.92
Estim. method	OLS	OP	OP+FE	OP	OP
Weights	NO	NO	NO	Sampl.	NO

Note: dependent variable: log value added in cols. (1)-(5), log TFP in col. (6). ϕ is the share of managers that have been with the firm at least 4 years in all columns but (5), where the threshold is 7 years. Public is a dummy equal to one if the controlling shareholder is the government, Family if a family or individual, Holding for a holding. The excluded category is the foreign on insinuation controlled firms. OP is the Olley & Pakes (1996) estimation method, OP+FE is OP plus firm fixed effects. In column (4) observations are weighted according to number of managers by firm, in column (5) according to the sampling weights. All regressions include year, 2-digit sector and 4 macro-region dummies.