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Delegation and R&D Spending: Evidence from Italy

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1 Introduction

Common wisdom suggests that firms' internal organization has profound effects on productivity, efficiency and industry structure. Stemming from the seminal contributions by Coase (1937), Williamson (1985), Klein et al. (1978), Grossman and Hart (1986) and Shleifer and Vishny (1986), many scholars have pushed forward the agenda of understanding organizational design and its effects on firms' performance. Over the past decades, a growing interest in the link between delegation and innovative activities has soared, stimulated by the pace of technological progress and the widespread move towards forms of work organization inside the firm that award more autonomy and responsibility to managers. Evidence of the significant shift towards decentralized organizational forms has, in fact, been largely documented by the recent empirical literature — for instance, Rajan and Wulf (2005), Bresnahan et al. (2002) and Caroli and Van Reenen (2004). Yet, while the existing theoretical literature on this ground has explored various aspects of the link between organization design and managerial initiative, the empirical validation of its predictions is still an open and challenging question.

The objective of this paper is to make a step forward in this direction. We use a sample of Italian manufacturing collected in surveys distributed in 1997, 2000 and 2003 by an Italian investment bank, Mediocredito Centrale, to study three specific features of the link between R&D, delegation and its determinants. More precisely, building on the belief that less hierarchical organizations stimulate managerial initiative we document a robust positive correlation between delegation of decisions within organizations and incentives for innovation. Moreover, in contrast with some predictions of the theoretical insights of the literature studying the link between corporate governance and the distribution of power along firms' control chain, we also document a negative correlation between delegation and ownership dispersion. Finally, we show that some recently empirical regularities concerning the determinants of delegation are not detected in our data. Specifically, our findings provide surprisingly little support to the view that firms' age, their distance from the technological frontier and the heterogeneity of the environment in which these operate, can explain variability in delegation measures across firms and industries. On the other hand, in the context of the Italian manufacturing sector, ownership dispersion is a very important determinant of delegation.

This evidence seems interesting for three main reasons. First, by showing that there exists a robust positive correlation between delegation and R&D, our analysis complements, and actually reinforces, the results of the previous literature emphasizing that vertical control

is negatively correlated with the diffusion of new technologies, as for instance documented by Acemoglu, Aghion, Lelarge, Van Reenan and Zilibotti (2007). Second, the negative correlation between delegation and ownership dispersion suggests that delegation in the Italian manufacturing sector, where firms are typically of small size and family owned, has somewhat different roots relative to large corporations studied in Shleifer and Vishny (1986). Finally, by not being able to verify some of the main findings of the recent literature on the determinants of delegation on a data set from a different country, the evidence collected in our paper also suggests that more work, both empirical and theoretical, must be done in the direction of cross-country comparisons.

Our results are related to the recent and growing empirical literature investigating the determinants of firms' internal organization. Using US data, Rajan and Wulf (2005) provide empirical evidence that firms tend to select flatter organizational structures in more recent years relative to the past. Bresnahan, Brynjolfsson and Hitt (2002) and Caroli and Van Reenen (2001) find that with more adoption of information technology (and human capital), firms also tend to adopt more decentralized organizational structure. On a similar note, Baker and Hubbard (2003, 2004) find that with the adoption of new technology in trucking that allows for better monitoring, incentive-improving features of this technology pushed hauls toward in-house owned trucks, while the resource-allocation-improving features pushed them toward for-hire carriage, suggesting that the organizational form is indeed closely related to technology adoption. Finally, Colombo and Delmastro (2004) test empirically some predictions of economic theory with respect to delegation of authority within a firm, concluding that the managers' informational advantage seems to be a key determinant of delegation.

All these papers mainly address questions about firms' organization structure and its determinants, but they are mute on the link between delegation and more direct measures of R&D, a question that will be central to our analysis. Moreover, while they have systematically overlooked the link between ownership concentration and delegation, our data set allows us to explicitly account for this intriguing relationship.

The contribution which is probably most closely related to our work is Acemoglu et al. (2007), who document a robust positive correlation between delegation and innovation using data from the French and British manufacturing sector. There are two main qualitative differences between our work and this paper. First, while Acemoglu et al. investigate the impact that the distance of the firm from the technology frontier has on various decentralization measures, we focus on the relationship between direct measures of firms' R&D activities and delegation. Second, our data does not seem to provide evidence for their main findings.

That is that firms' age, their distance from the technology frontier, and the uncertainty of the environment in which firms operate are important determinants of delegation. As we shall argue, one possible source of this discrepancy, which opens new theoretical issues linking delegation and firms' characteristics such as the nature of corporate control, is the peculiarity of the Italian manufacturing sectors, which is mainly formed by small or family owned firms. In this perspective our results also suggest that more empirical work on cross-country comparisons must be done on this ground to identify more carefully the hidden sources of these differences (a direction recently taken in Bloom, Sadun and Van Reenen, 2009).

The theoretical background upon which our empirical analysis rests is mainly composed by two strands of literature. As regards the link between delegation and managerial initiative, in a simple agency model Riordan (1990) was the first to formalize the idea that delegation has beneficial effects on cost reduction incentives. Riordan shows that although vertical control might provide more efficient output decisions, it undermines managerial incentives for cost reduction. He argued that, in those instances where ex ante and ex post efficiency are incompatible, the ownership structure matters. Essentially, when contracts are incomplete, owners can stimulate managerial initiative only by leaving higher information rents to their managers: Arms' length relationships spur R&D incentives. The subsequent agency literature has developed these insights by studying the conditions under which delegated contracting can replicate and sometimes even deliver better outcomes than centralized contracting (Baron and Besanko, 1992, and Melumad, Mookherjee and Reichelstein, 1997, Laffont and Martimort, 1998, Mookherjee and Tsumagari, 2007, Martimort and Piccolo 2007 and 2009, among others). Building on the idea that managers have superior information relative to shareholders, and that these latter can control the innovation process only to a limited extent, these papers have offered an ample range of results showing that not only arms' length relationships stimulate managerial initiative, but they can also be ex ante preferable to monitoring intensive arrangements. On a similar note, other scholars have looked at these trade-offs by emphasizing the informational advantages of delegation (Aghion and Tirole, 1997, Baker, Gibbons and Murphy, 1999, Rajan and Zingales, 2001, Dessein, 2002, and Hart and Moore, 2005). By exploiting the same kind of trade-offs underscored by Riordan, these papers show that delegation may be more effective than vertical control in providing incentives for information gathering.

We shall base our empirical investigation on these insights rather than following the approach taken in Acemoglu et al. (2007), whose theoretical model postulates an inverse relationship relative to what Riordan's agency model would deliver, that is, delegation decisions affect innovation and not the opposite. The causality relationship upon which Acemoglu

et al. build their analysis requires the hypothesis that different, but exogenous information structures rationalize alternative internal organizations: we shall take the opposite view.[1]

Concerning the link between delegation and ownership dispersion, our results contribute to the large literature on corporate control and managerial incentives. Following the seminal contribution by Shleifer and Vishny (1986), many theoretical papers have studied the link between shareholders' control and managerial initiative. Building on a simple free riding story, Shleifer and Vishny argued that in a corporation with many small owners, it may not pay any one of them to monitor the performance of the management. Instead, the presence of a large minority shareholder provides a partial solution to this free-riding problem. This suggests that a positive correlation between delegation and ownership concentration should be detected. Nevertheless, our findings seem to reject this view as long as firms are small or family owned. In these cases we find the opposite and quite robust correlation between delegation and ownership dispersion: It seems that, for small firms, the more concentrated is ownership, the more initiative is left to managers. As observed in Burkart et al. (1997), this finding seems to support the idea that the simple trade-off between ownership concentration and delegation emphasized by Shleifer and Vishny might in practice involve more complex forces. For instance, the positive correlation between ownership concentration and delegation found in our data could simply reflect the fact that tighter control by shareholders might constitute ex ante an expropriation threat that reduces managerial incentives and non-contractible investments, whereby requiring implicit forms of compensation that could be based on more managerial discretion. Otherwise, such positive correlation could simply capture the idea that, in small firms (many of which might be family owned), as most of those considered in our sample, delegation becomes an essential feature insofar as a single or few owners cannot handle all administrative, financial and innovative phases surrounding the production process. In a nutshell, the evidence found suggests that in the future theoretical work it might be worth analyzing models where the firms' size, ownership structure and corporate control policy interplay so as to determine firms' specific decentralization modes.

The rest of the paper is organized as follows. Section 2 describes our data from Italian manufacturing sector. In Section 3 we present our data analysis and discuss the results. Section 4 concludes.

[1]In the previous version of the paper we did provide an agency model with an endogenous information structure driving our empirical analysis. This analysis is available upon request.

2 Data

2.1 Description

Our main data source is a sample of Italian firms in the manufacturing industry collected in surveys distributed in years 1997, 2000 and 2003 by an Italian investment bank, Mediocredito Centrale.[2] The data set includes a representative sample of all firms with 10 to 500 employees, and a census of all firms with more than 500 employees.[3] Overall, approximately $4,500$ firms were surveyed in each wave[4] and answered various questions from 3 distinct categories: (i) balance sheet data, (ii) measurable company characteristics for each year in the 1995-2003 period (for example employment at various organizational levels, investment, R&D expenditures etc.), and (iii) questionnaire data regarding firm's relationship with customers and suppliers, details on competitive environment, industry characteristics, ownership structure and other qualitative information. The summary statistics of the variables that we will be using are included in Table 1. For each firm, we observe regular data such as 5-digit industry code, the total number of employees, total revenues, profits etc. In addition, we also have data on firms' organization such as the number of managers employed by the firm at each of the two highest levels and information about whether or not a number of important financial, administrative, R&D and business decisions within the firm are delegated or made in a more centralized manner. Our data also includes the number of employees with a university degree, and we use this variable to construct an index of human capital within firms. In particular, we construct a variable *Human Capital* which is defined as the fraction of high-skilled employees (i.e., university-trained ones). We also have information about the ownership structure of the firm. In particular, we observe ownership stakes of three largest shareholders. Finally, we also define a *Capital Intensity* index as $\frac{Capital}{Employees}$, where the capital

[2]The data set is described in more detail in the appendix.

[3]As observed by Audretsch and Vivarelli (1996), restricting attention to data on firms which may appear small in size is not necessarily a drawback for analyzing R&D. Indeed, studies linking patent activity to firm size do not generally support the hypothesis that larger firms make more or better R&D. Based on a study of $2,852$ American companies which registered $4,553$ patents, Bound et al. (1984) found that small firms (with less than \$10 million in sales) accounted for 4.3 percent of sales but 5.7 percent of the patents. Such results are not limited to the United States. Schwalbach and Zimmerman (1991) found that the propensity to patent is smaller for the largest firms in West Germany than for small- and medium-sized enterprises. Moreover, in their 1988 and 1990 studies, Acs and Audretsch found that small firms (with fewer than 500 employees) contribute 2.38-times more innovations per employee than do their larger counterparts. Finally, concerning the particular case of Italy, Archibugi, Cesaratto and Sirilli (1990) observe that firms with less than 500 employees constituted 87.9% of the innovating firms in Italy during the years 1980-85 and the 45.9% of the highly innovating firms in the same period.

[4]Each wave contained separate questions for each of the three previous years.

measure we use includes machinery and equipment, but not land and buildings.

The monetary variables were reported in millions of italian liras prior to 2001 and in Euros thereafter. We convert liras into euros by dividing by $1,936.27$, which was the rate fixed during the transition to euro. We used the CPI to express all monetary variables in 2003 prices.

The average firm in our sample has 222 employees, who are supervised by 13 managers. The average annual revenue of firms in our sample is 27 million Euros and firms spend on average $818,600$ Euros on research and development annually[5] The definition of R&D expenditures used in the questionnaire is fairly broad: it includes expenditures on (i) product innovation activities including introduction of new products and quality improvements of old products; (ii) process innovation activities including introduction of new and more efficient production processes and quality improvements of old production processes; and (iii) any activity linked to a better organization and management of innovations. The distribution of R&D spending is skewed towards zero, with more than 75% of firms with positive R&D expenditures spending less than $260,000$ euros per year, 25% of firms spending less than $26,000$ euros per year and the median being $77,500$ euros. Since the distribution of R&D expenditures is highely skewed (with a long, but thin right tail) we work with logarithms in our analysis. About 90% of firms in our sample report that at least some decisions are delegated within the firm rather than made by the headquarters or the owner. On average, the workers with a university degree amount to about 8% of the total number of employees.

We complemented our sample with (cross-sectional) data from the Italian statistical office (ISTAT) providing some additional covariates such as the number of female employees per 100 employees or value added in manufacturing 1999 on the provincional level. Our goal is to use our data to investigate the relationship between delegation and R&D expenditures. Let us now look in detail at the measure of delegation that we employ.

2.2 Measure of delegation

Throughout our empirical exercises, we use a traditional measure of delegation, which is based on self-reported answers to questions related to the extent of managerial discretion over firms' main strategic decisions. Four questions in the questionnaire distributed among firms ask whether or not administrative, financial, business and R&D-related decisions within firms are made autonomously by separate divisions. For each question the firms are asked to

[5]There are 677 firm-years, for which 0 R&D expenditures were reported and we include these observations in the sample.

Table 1: Summary Statistics

Variable	**Mean**	**Median**	**SD**	**N**
R&D Expenditures (in 1000s euro)	818.6	77.5	8,284.3	13,333
Del. Q1: Administrative	0.86	1.00	0.35	11,260
Del. Q2: Financial	0.81	1.00	0.39	11,248
Del. Q3: Commercial	0.85	1.00	0.36	11,230
Del. Q4: R&D	0.80	1.00	0.40	11,070
Delegation max(Q1-Q4)	0.90	1.00	0.30	9,666
Delegation max(Q1-Q3)	0.91	1.00	0.29	11,263
Workers	221.66	79.00	540.64	14,367
Revenues (in mil. euro)	27.2	5.4	142	39,484
Value Added per Empl/Year	59,847	51,670	42,682	12,117
Ownership Concentration	0.51	0.50	0.30	37,722
Human Capital	0.08	0.05	0.11	12,139
Capital per Empl	97,732	56,155	158,547	12,117

[a] All monetary variables are in euros deflated by CPI to 2003 prices.
[b] Variables *Delegation Qx* are a self-reported dummy variables if some important decisions are delegated within a firm.
[c] Variable *Ownership Concentration* is defined as the sum of squares of the (per cent) stakes of three largest shareholders divided by 10,000.
[e] Variable *Human Capital* is the share of workers with university degree: $\frac{UnivDegree}{Total\ Empl}$.
[f] Varying number of observations (firm-year) across variables is due to varying number of firms that responded to a given question for some year.

pick one of the options: "no delegation", "intermediate level" and "high level" of delegation. Using these answers we define several alternative measures. The first is defined as a dummy variable which is equal to one if at least one of these questions is answered positively - either medium or high level of delegation.[6,7] This delegation measure is similar to the one used in Bloom, Sadun and Van Reenen (2007).

Since we believe that out of the four questions about delegation available to us the decision about R&D spending is probably closest related to the extent of discretion about financial decisions, we also run all of our exercises with a dummy variable if a firm reported to have

[6]We prefer not to use the average of the four answers as we are not certain if two positive answers necessarily imply an ordinal ranking, i.e., "more delegation", than one positive answer. A firm in which "only" all financial decisions are delegated may be in fact more decentralized than a firm in which a part of financial and a part of administrative decisions are delegated.

[7]We opt not to use solely the answer to the question about R&D related decisions because it could potentially generate a "mechanical" dependence between the left-hand side and right-hand side variables.

at least intermediate level of delegation of financial decisions.[8] Finally, to check robustness and for comparison, we also report our results (Table 8) when all answers are used by using a set of dummy variables for each question: one for intermediate level of delegation and one for intermediate or high level of delegation.

3 Results

We split our empirical results into three parts. First, we present evidence of robust correlations between R&D expenditures and delegation. We then move on to analyze the relationship between the ownership concentration and delegation to document that firms that have highly concentrated ownership (such as family firms) which are larger (in terms of employment size) are also more likely to be decentralized. On the other hand, firms with more dispersed ownership that are larger are less likely to be decentralized. The final part of our results addresses the issue of determinants of delegation within firms. Our results suggest that our measure of delegation is very likely quite different than the one used in Acemoglu et al (2007) since the determinants of delegation that that paper identifies are not good predictors of our measure of delegation for firms in our sample. Ownership concentration, on the other hand, seems to play an imporant role in the decisions of firms to become more decentralized.

3.1 R&D Expenditures and Delegation

Since we are mainly interested in documenting the positive relationship between the R&D spending and the level of delegation (or decentralization) in firms, it is crucial that we control for the crucial determinants of R&D, especially those that could potentially be correlated with the decision to delegate. The controls that we employ include the following. The level of human capital is an important determinant of R&D as firms indending to do a lot of R&D have also to hire many high-skilled workers. Similarly, firms are likely to delegate more decisions if employees (or managers) are more skilled. Second important control is the size of the firm. While small firms account for a large fraction of R&D activity, the level of R&D spending of course depends on the financial budget of each firm. Third important control variable is the amount capital that is available per employee. Firms that have more

[8] We believe that the question about delegation of R&D is more about the discretion with respect to how to spend a given budget within R&D, whereas the financial delegation is about how to allocate funds across different budgets.

high-level machinery, computers and expensive lab equipment are also more likely to engage more in R&D.

Our first exercise is a regression of the log of R&D expenditures on our measures of delegation and above described firm controls: size of the firm, the level of human capital, capital per worker and, depending on specification, on industry (2-digits), region and time fixed effects. To account for possible heteroscedasticity and auto-correlation in error terms (as our observation is a firm-year), we report Newey-West standard errors.[9,10] We have 2,498 observations, i.e., years in which a firm reported R&D expenditures, revenues, the number of workers, the number of employees with university degree, the level of capital, ownership structure and answered at least some of the questions about delegation.

The results of these least squares regressions are reported in Table 4 and most are as expected. Size of the firm (measured either by the number of employees or by revenues) and the proportion of workers with university degree are positively correlated with R&D expenditures. Ownership concentration does not appear to be significantly related to R&D in our sample, which suggests that whether or not a firm has a sole owner or its ownership is widely dispersed is not related to the decision about how much to spend on R&D. Perhaps counterintuitively, however, capital per worker is negatively correlated with R&D. This may be caused by the fact that the firms in our sample are from manufacturing industry where a lot of the capital owned by firms may not be related to R&D. The results are very stable across specifications and robust to controlling for sectoral and/or provincial fixed effects or provincial controls.

In Table 5 we add additional two controls: (logarithm of) value added per employee and three dummy variables for the age of the firm. The results are in line with the previous table and the amount of variation explained by the regression model increases only marginally. Value added per employee is insignificant. As we might expect and in line with previous findings, younger firms tend to invest more heavily in R&D.

To further verify robustness, we run the same regressions with the dependent variable defined as (the log of) R&D intensity: R&D expenditures as a fraction of revenues. The results are reported in Table 7. As in the previous analysis, delegation covaries positively with R&D expenditures. Younger firms and firms with higher fraction of university trained employees also spend more on R&D. After controlling for sectoral and provincial variation,

[9]We allow for autocorrelation with a lag of 3 periods.

[10]We also estimated a model with standard errors corrected for arbitrary variance-covariance matrix at the firm level (ignoring the time-series dimension, but allowing for arbitraty covariance structure among errors for observations of each firm) and standard errors were very close to the reported ones.

value added is still not related in a significant way to R&D. As found in the previous studies, the size of the firm (measured by the number of employess) is insignificant.[11] Surprisingly, the ownership concentration is negatively related to R&D expenditures per euro of revenues.

To provide a more nuanced look at delegation of which decisions is perhaps more important for R&D expenditures, in Table 8 we report the results of the regressions where separate dummy variables are included for each question in the questionnaire. Delegation of financial decisions exhibits the most significant relationship with R&D spending. The important step seems to be between "no delegation" and intermediate delegation, where the additional degree of delegation (i.e., high level) does not contribute in a significant way. Delegation of administrative decisions exhibits an interesting non-monotonicity. While an intermediate level of delegation is negatively related to R&D, as the firms delegate even more administrative decisions the relationship becomes positive.

Since the results that we have discussed above and presented in the tables are very robust, we believe that the extent of R&D spending in firms is related to the extent of delegation of decision power within firms. Delegation of financial decisions seems to be especially important. There are several alternative channels through which this positive relationship may appear. Acemoglu, Aghion, Lelarge, Van Reenan and Zilibotti (2007) provide one possible model which generates this correlation by arguing that firms that do more R&D in order to be at the frontier of the industry also need more skilled managers and thus delegation is more likely as managers are assumed to be more knowledgeable than the owners. In the previous version of this paper we provided an alternative agency model, based on moral hazard and adverse selection, in which delegation increases R&D investment since affording more decision power to the manager improves his (private) marginal return to investment in R&D and thus spurs innovation incentives. Without a good instrument, however, it seems impossible to distinguish these two causal relationships directly and thus to isolate the potential positive effects of either channel on the correlation.

3.2 Delegation and Ownership Concentration

The relationship between delegation and ownership concentration has been previously studied in Shleifer and Vishny (1986). They looked at large, publicly traded, corporations and the problem of takeovers and argued that firms with many small owners might suffer from an increased free rider problem and thus monitoring of managers by the board might be

[11] This result is regarded as a stylized fact in the R&D literature - see, for example, Klette and Kortum (2004).

Table 2: Correlations between delegation of decisions and ownership concentration

Variable	Ownership	max(Q1-Q4)	Q1	Q2	Q3	Q4
Ownership Conc	1.00					
Delegation (Q1-Q4)	0.039	1.00				
Del. Q1: Administr.	0.026	0.743	1.00			
Del. Q2: Financial	-0.015	0.633	0.760	1.00		
Del. Q3: Business	0.026	0.725	0.582	0.555	1.00	
Del. Q4: R&D	-0.009	0.609	0.508	0.527	0.656	1.00
Obs.	10,546					

a problem since it is costly. Their main observation is that the benefit from monitoring the management is increasing in the controlled share and thus when the controlled share is sufficiently large, this shareholder might incur the monitoring cost. Shleifer and Vishny analyzed a sample of Fortune 500 companies and found evidence consistent with their model. Similarly, Burkart, Gromb and Panunzi (1997) also provide a model generating positive correlation between monitoring and ownership concentration. We can investigate this relationship using our data, when we interpret our measure of delegation as the inverse of monitoring. Recall that an advantage of our data is that we have different measures of delegation, since the firms answered separate questions about delegation of administrative, financial, busines and R&D-related decisions.

In Table 2 we report the raw unconditional correlations between the ownership concentration (defined as the normalized sum of squares of the three largest shareholders) and different measures of delegation in our sample. It is perhaps surprising that the overall correlation is positive, even though not very large: 0.039. The negative correlation, which is the relationship predicted by Shleifer and Vishny's model is present for delegation of financial decisions and decisions related to R&D.

A possible explanation for the opposite relationship between delegation and ownership concentration might be that our sample consists of manufacturing firms that are rather small in size (especially when compared to Fortune 500 companies), and thus Shleifer and Vishny's logic may not necessarily apply. The main reason is that the monitoring cost might not be constant across different ownership structures. In fact it is reasonable that in many cases, especially for small or medium size firms, an excessive ownership concentration requires some minimum degree of delegation. For example, when a company is owned by a single owner, there may be non-negligible gains from delegation to the extent that keeping a close

Table 3: Conditional Correlations between delegation of decisions and ownership concentration

Conditioning:	Large	Small	L & Disp.	L & Conc.	S & Disp.	S & Conc.
Del. (Q1-Q4)	0.237	0.066	-0.120	0.201	-0.008	0.061
Del. Q1: Adm.	0.139	0.049	-0.182	0.067	0.006	0.020
Del. Q2: Fin.	0.137	0.011	-0.190	0.116	-0.021	-0.014
Del. Q3: Bus.	0.231	0.038	-0.146	0.332	-0.014	0.036
Del. Q4: R&D	0.209	0.020	0.188	0.211	-0.011	0.009
Obs.	368	5355	58	310	1452	3903

[a] Large firms (L): 10^{th} decile of employment size, Small firms (S): employment less than median (495), Dispersed ownership (Disp): index less than 0.5, Concentrated ownership (Conc): index more than 0.5.

control of all productive, administrative, financial and marketing activities influenced by firm's employees is too costly, especially when the company exceeds some size threshold. On the other hand, it seems reasonable to assume that a slightly less concentrated ownership structure (for example 2 owners with equal shares) allows owners to implement desired monitoring level at lower costs, hence there is less need for delegation.

To provide some evidence for the last claim, in Table 3 we present correlations between the ownership concentration and delegation conditional on the size of the firm and on whether a firm has more or less concentrated ownership. Consistently with Shleifer and Vishny's results, for firms with dispersed ownership, which are likely to be similar to their sample, the correlation between delegation and ownership concentration is negative. This correlation is even more negative when we look at the large firms in our sample. On the other hand, firms with concentrated ownership structure exhibit (with the exception of small firms and delegation of financial decisions) positive correlation between delegation and ownership concentration. This positive relationship is even stronger when we examine large firms with concentrated ownership, which suggests that perhaps either the cost of monitoring or the benefits to delegation or both are high for large firms with highly concentrated ownership structure.

3.3 Determinants of Delegation

In a recent paper Acemoglu, Aghion, Lelarge, Van Reenen and Zilibotti (2007) (AALVRZ) propose a framework to analyze the relationship between decentralization of firms and the diffusion of new technologies. Using French and British data sets they provide evidence that

firms close to the technological frontier, firms in more heterogeneous environments and firms that are younger tend to be more likely to be decentralized. The measure of decentralization that AALVRZ employ is based on firms organizing themselves into profit centers. The idea is that managers of profit centers concern themselves with all aspects of the business affecting the profitability. Under the alternative organization into cost centers or production centers, the manager is reponsible for fulfilling cost or productions target, instead. Therefore, typically, firm delegates more authority to managers of profit centers. Our data does not contain information about whether or not a firm is organized into profit centers. The question about financial delegation which we used in our analyses is quite likely reflecting other aspects of internal organization since over 80% of firms answer positively, whereas only about 30% of firms in the AALVRZ sample are organized into profit centers. Nevertheless, we can construct the measures that AALVRZ found to be important determinants of firms' decision to organize themselves into profit centers and ask whether these measures are important in explaining the different delegation decisions of firms in our sample.

In particular, we construct a measure of heterogeneity as the dispersion of firm productivity growth and levels within four-digit industry. Heterogeneity (in levels) in four-digit industry l is thus defined as

$$H_l^L = (\log y_{il})^{90} - (\log y_{il})^{10}$$

where $(\log y_{il})^P$ is the P^{th} percentile of the distribution of productivity level across all firms in indsutry l. Further we construct a measure of the frontier by taking the 99^{th} percentile[12] of the distribution of labor productivity and we also use the dummies for young, medium-aged and old firms. The results from the probit regressions are reported in Table 9. These results are rather surprising. Virtually none of these measures seems be an important determinant of delegation as defined by the questions in our questionnaire. One of the few exceptions is the delegation of adminitrative decisions (and to certain extent also delegation of business decisions), which seems to be more likely in more heterogeneous industries. Unfortunately, when the heterogeneity is measured in growth rates of productivity rather than levels, this relationship disappears.

There is some limited evidence that cross-country differences are quite important for the determinants of decentralization already in Acemoglu et al. (2007). In particular, the authors present results from the British manufacturing industry in Table 5 and, for

[12]As in AALVRZ, by not taking the maximum we try to avoid the problem with potential outliers due to a measurement error.

example, the younger firms which tend to be decentralized in France are less decentralized (even though the coefficients are insignificant in all specifications) in Britain. The control for the productivity frontier is insignificant as in most of our specifications. Of course one possible explanation for our results is that the data sets (or variables) are not comparable.

In Table 10 we find that ownership concentration seems to be an important determinant of delegation – Table 3 documents that ownership structure and decentralization are indeed systematically correlated. Of course, we want to exercise care in interpreting the results as causal: ownership concentration might be clearly an endogenous decision.[13] There are many plausible stories in which firms' ownership structure seems to influence delegation and not the other way around. For instance, situations in which changes in the ownership structure of firms are more 'costly' or simply take more time than shifts in the control power of managers, which might be simply implemented by setting up more or less high-powered incentives or by the implicit use of replacement threats, would be in line with this interpretation. This seems to be the case also for family firms, for which changes in the ownership structure are rather rare over time and occur mainly by way of inheritance. In practice, however, there might be many other cases where the causal relationship goes in the opposite direction. Addressing this endogeneity issue seems a fundamental starting point for future research on this ground.

Summing up, from our exercise we conclude that different delegation decisions might be driven by different forces. While AALVRZ provide convincing evidence that organizing firms into profit centers is influenced by the heterogeneity of environment in which the firm operates, firm's age, and its distance to the frontier, whether the Italian firms in our sample delegate administrative, financial, commercial or R&D decisions seems not be influenced by these factors. More research – both theoretical and empirical – is needed to provide more nuanced answers to find determinants of a particular type of delegation.

4 Concluding Remarks

We have studied the relationship between delegation and innovation incentives. Our empirical results provide evidence that R&D activity exhibits a positive relationship with the decision of firms to adopt organizational structures relying more on delegation. This positive correlation is robust to controlling for the determinants of R&D within firms such as the level of human capital, capital intensity, sectoral and regional effects and to using different measures of R&D. We also investigate the determinants of delegation in our sample.

[13] See e.g. Demsetz and Lehn (1985).

We have also found a positive correlation between ownership concentration and delegation, which goes against the findings of Shleifer and Vishny (1986). Moreover, variables found as important determinants of delegation in French manufacturing by Acemoglu, Aghion, Lelarge, Van Reenen and Zilibotti (2007) do not appear important in our sample, and some even exhibit qualitatively opposite effect. These disparities can perhaps be explained by differences in the studied samples and observed variables, and call for further studies of cross-country differences.

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Appendix: The Capitalia Sample

Our main data source is a sample of Italian firms in the manufacturing industry collected in surveys distributed in years 1997, 2000 and 2003 by an Italian investment bank, Mediocredito Centrale (now Capitalia). The Capitalia Survey is the most important, periodically repeated, quantitative-qualitative survey of Italian firms. The survey has been repeated every three years, starting from 1989, on a sample of around 4,500 firms with (weakly) more than 10 employees. In order to maintain representativeness and take into account the high exit/entry rate of firms in the Italian market, the original sample has been reshaped for each wave. The different waves have been stratified by size classes based on the number of employees, geographical areas and macrosectors according to the Pavitt (1984) classification. The value added per employee has been used as a stratifying factor. Each wave contains separate questions for each of the three previous years – and answered various questions from 3 distinct categories: (i) balance sheet data, (ii) measurable company characteristics for each year in the 1995-2003 period, and (iii) questionnaire data regarding firm's relationship with customers and suppliers, details on competitive environment, industry characteristics, ownership structure and other qualitative information.

As reported by Becchetti, Castelli and Hasan (2009), all balance sheet data in the Capitalia Survey database are accurately checked. These data come from official sources: the CERVED database (first sample period) and AIDA – Bureau Van Dijk database (last two sample periods) which collects from CERVED all balance sheets for the same firms. CERVED obtains the information from the Italian Chambers of Commerce and is currently the most authoritative and reliable source of information on Italian companies. Qualitative data from questionnaire are filled by a representative appointed by the firm collecting information from the relevant firm division. The questionnaire has a system of controls based on 'long inconsistencies', namely inconsistencies between answers to questions placed at a certain distance in the questionnaire. In case of inconsistent information the firm is subject to a second phone interview. Firms which do not provide reliable information after being recontacted are excluded from the sample. A supplementary list of 8,000 firms is built for each of the three year surveys in order to avoid that exclusions generated by missing answers or inaccuracies in the questionnaire, may alter the sample design. Substitutions follow the criteria of consistency between the sample size and the population of the universe.

The unit of observation is the firm, not its plants or establishments. The procedures for data collection are mixed: a sampling procedure was adopted for firms hiring less than 500 employees. The stratification was made according to size, industry and location. The

sample dimension for each stratum was determined according to the Neyman's formula, so as to allow rescaling to the universe at the level of each administrative geographical region. For firms with more than 500 employees the survey covers the entire universe. Overall, the survey constitutes a statistically significant representation of the Italian manufacturing industry: 10% of the manufacturing total and 24% of national export as pointed out in the report on the 8th wave (Capitalia, 2002).

In the following we shall describe in more detail some of the relevant variables used in our empirical exercises. All monetary variables were reported in Italian liras prior to 2001 and in euros thereafter. We convert liras into euros by dividing by $1,936.27$, which was the rate fixed during the transition to euro. We used the CPI to express all monetary variables in 2003 prices.

R&D Expenditures: The definition of R&D expenditures used in the questionnaire is fairly broad: it includes expenditures on (i) product innovation activities including introduction of new products and quality improvements of old products; (ii) process innovation activities including introduction of new and more efficient production processes and quality improvements of old production processes; and (iii) any activity linked to a better organization and management of innovations.

Ownership Concentration: The questionnaire provides data about the shares' percentage of the three largest shareholders.

Delegation: Four questions in the questionnaire distributed among firms ask whether or not administrative, financial, business and R&D-related decisions within firms are made autonomously by separate divisions. For each question, different divisions are asked to pick one of the options: "no delegation", "intermediate level"and "high level"of delegation. More precisely, in the questionnaire each is asked the following question: *"for each of the following type of decisions – administrative, financial, sales management and R&D – report the degree of autonomy from the headquarter".* The three possible answers where: (1) *decisions are fully controlled by the headquarter,* (2) *there is some degree of autonomy*, and (3) *decisions are taken in full autonomy.*

Human Capital Index: is defined as the fraction of employees with any university degree among the total workforce of that firm.

Capital Intensity: is defined as the amount of physical capital per worker.

Table 4: Relationship between delegation and log R&D expenditures

Dependent variable:	log (R&D Expenditures)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Delegation	0.37		0.43		0.44		0.39	
	(0.15)**		(0.15)***		(0.15)***		(0.15)***	
Delegation (Financial)		0.2		0.22		0.18		0.16
		(0.11)*		(0.11)**		(0.11)		(0.11)
Human Capital Index	3.07	3.11	2.53	2.57	2.88	2.88	2.89	2.89
	(0.39)***	(0.39)***	(0.4)***	(0.4)***	(0.41)***	(0.42)***	(0.4)***	(0.4)***
log Capital Intensity	-.05	-.05	-.04	-.04	-.10	-.09	-.10	-.09
	(0.01)***	(0.01)***	(0.01)***	(0.01)***	(0.06)	(0.06)	(0.06)*	(0.06)
Workers	0.0005	0.0005	0.0004	0.0004	0.0002	0.0002	0.0003	0.0003
	(0.0000943)***	(0.0000939)***	(0.0000857)***	(0.0000852)***	(0.0000843)***	(0.0000849)***	(0.0000868)***	(0.000087)***
log Revenue	0.61	0.61	0.63	0.64	0.65	0.66	0.64	0.64
	(0.05)***	(0.05)***	(0.05)***	(0.05)***	(0.05)***	(0.05)***	(0.05)***	(0.05)***
Ownership	0.02	0.04	-.04	-.02	-.13	-.11	-.12	-.10
	(0.14)	(0.14)	(0.13)	(0.13)	(0.14)	(0.14)	(0.14)	(0.14)
Industry Dummies (22)	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Provincial Dummies (107)	No	No	No	No	Yes	Yes	No	No
Provincial Controls	No	No	No	No	No	No	Yes	Yes
Obs.	2,498	2,495	2,498	2,495	2,388	2,385	2,354	2,351
R^2	0.3614	0.3602	0.4192	0.4173	0.4798	0.4773	0.4584	0.4561

[a] Newey-West standard errors robust to heteroscedasticity and auto-correlation in parentheses.
[b] *,**,*** denotes significance at 10, 5, 1% level respectively

Table 5: Relationship between delegation and log R&D expenditures

Dependent variable:	log (R&D Expenditures)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Delegation	0.36		0.41		0.43		0.37	
	(0.15)**		(0.15)***		(0.16)***		(0.15)**	
Delegation (Financial)		0.24		0.25		0.23		0.19
		(0.11)**		(0.11)**		(0.11)**		(0.11)*
Human Capital Index	3.15	3.19	2.57	2.59	2.85	2.85	2.87	2.88
	(0.38)***	(0.38)***	(0.39)***	(0.39)***	(0.39)***	(0.39)***	(0.37)***	(0.37)***
log Value Added per Empl	-.03	-.03	0.03	0.03	0.06	0.06	0.04	0.05
	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
log Capital Intensity	-.05	-.05	-.04	-.04	-.05	-.05	-.05	-.04
	(0.01)***	(0.01)***	(0.01)***	(0.01)***	(0.01)***	(0.01)***	(0.01)***	(0.01)***
Workers	0.0005	0.0005	0.0004	0.0004	0.0003	0.0003	0.0003	0.0003
	(0.0000958)***	(0.0000956)***	(0.0000874)***	(0.0000873)***	(0.0000869)***	(0.0000881)***	(0.00009)***	(0.0000907)***
log Revenue	0.61	0.61	0.63	0.63	0.64	0.64	0.62	0.63
	(0.05)***	(0.05)***	(0.05)***	(0.05)***	(0.05)***	(0.05)***	(0.05)***	(0.05)***
Ownership	-.02	-.009	-.08	-.06	-.18	-.17	-.16	-.14
	(0.14)	(0.14)	(0.13)	(0.13)	(0.14)	(0.14)	(0.14)	(0.14)
Firm age < 5 years	0.47	0.51	0.53	0.57	0.57	0.6	0.55	0.58
	(0.28)*	(0.27)*	(0.22)**	(0.21)***	(0.24)**	(0.23)***	(0.22)**	(0.21)***
$5 \leq$ Firm age < 10 years	0.36	0.37	0.32	0.33	0.41	0.42	0.39	0.4
	(0.21)*	(0.21)*	(0.2)	(0.2)	(0.2)**	(0.2)**	(0.2)*	(0.21)*
$10 \leq$ Firm age < 20 years	-.19	-.20	-.15	-.17	-.19	-.21	-.16	-.18
	(0.13)	(0.13)	(0.12)	(0.12)	(0.13)	(0.13)	(0.13)	(0.13)
Industry Dummies (22)	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Provincial Dummies (107)	No	No	No	No	Yes	Yes	No	No
Provincial Controls	No	No	No	No	No	No	Yes	Yes
Obs.	2,482	2,479	2,482	2,479	2,373	2,370	2,339	2,336
R^2	0.3668	0.3665	0.4228	0.4219	0.4847	0.4832	0.4631	0.4618

[a] Newey-West standard errors robust to heteroscedasticity and auto-correlation in parentheses.
[b] *,**,*** denotes significance at 10, 5, 1% level respectively
[c] The omitted category for firm age is Age$\geq$ 20 years. See text for variable definitions.

Table 6: Relationship between delegation and log R&D expenditures (last year per survey)

Dependent variable:	log (R&D Expenditures)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Delegation	0.54		0.55		0.54		0.49	
	(0.2)***		(0.2)***		(0.2)***		(0.19)***	
Delegation (Financial)		0.31		0.31		0.29		0.26
		(0.14)**		(0.14)**		(0.14)**		(0.13)*
Human Capital Index	3.29	3.33	2.79	2.82	3.28	3.24	3.17	3.16
	(0.48)***	(0.48)***	(0.48)***	(0.49)***	(0.38)***	(0.39)***	(0.36)***	(0.38)***
log Value Added per Empl	-.04	-.04	0.05	0.06	0.21	0.22	0.09	0.09
	(0.09)	(0.09)	(0.09)	(0.09)	(0.14)	(0.14)	(0.09)	(0.09)
log Capital Intensity	-.04	-.04	-.03	-.03	-.16	-.15	-.04	-.04
	(0.02)**	(0.02)**	(0.02)*	(0.02)*	(0.09)*	(0.09)*	(0.02)**	(0.02)**
Workers	0.0005	0.0004	0.0004	0.0004	0.0003	0.0003	0.0003	0.0003
	(0.0000801)***	(0.0000796)***	(0.0000755)***	(0.000075)***	(0.0000885)***	(0.000089)***	(0.0000894)***	(0.0000898)***
log Revenue	0.57	0.58	0.6	0.6	0.6	0.6	0.58	0.58
	(0.05)***	(0.05)***	(0.05)***	(0.05)***	(0.07)***	(0.07)***	(0.06)***	(0.06)***
Ownership	0.02	0.04	-.03	-.005	-.13	-.11	-.10	-.07
	(0.15)	(0.16)	(0.15)	(0.16)	(0.15)	(0.15)	(0.14)	(0.15)
Firm age $<$ 5 years	0.52	0.57	0.6	0.65	0.54	0.57	0.51	0.54
	(0.35)	(0.33)*	(0.29)**	(0.27)**	(0.29)*	(0.28)**	(0.28)*	(0.27)**
$5 \leq$ Firm age $<$ 10 years	0.27	0.28	0.25	0.27	0.27	0.3	0.27	0.29
	(0.27)	(0.27)	(0.27)	(0.27)	(0.27)	(0.27)	(0.27)	(0.27)
$10 \leq$ Firm age $<$ 20 years	-.32	-.34	-.28	-.30	-.33	-.36	-.33	-.36
	(0.17)*	(0.17)**	(0.16)*	(0.16)*	(0.17)*	(0.17)**	(0.17)*	(0.17)**
Industry Dummies (22)	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Provincial Dummies (107)	No	No	No	No	Yes	Yes	No	No
Provincial Controls	No	No	No	No	No	No	Yes	Yes
Obs.	855	854	855	854	818	817	806	805
R^2	0.3602	0.3580	0.4283	0.4257	0.4894	0.4866	0.4673	0.4648

[a] Robust standard errors corrected for arbitrary variance-covariance matrix on 4-digit industry level in parentheses.
[b] *,**,*** denotes significance at 10, 5, 1% level respectively
[c] The omitted category for firm age is Age$\geq$ 20 years. See text for variable definitions.

Table 7: Relationship between delegation and log R&D expenditures normalized by revenues

Dependent variable:	log (R&D Expenditures / Revenues)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Delegation	0.38		0.42		0.45		0.4	
	(0.17)**		(0.16)***		(0.16)***		(0.16)**	
Delegation (Financial)		0.29		0.3		0.26		0.25
		(0.12)**		(0.11)***		(0.12)**		(0.11)**
Human Capital Index	3.22	3.25	2.72	2.73	2.99	2.97	2.95	2.94
	(0.39)***	(0.39)***	(0.41)***	(0.41)***	(0.39)***	(0.39)***	(0.38)***	(0.39)***
log Value Added per Empl	-.16	-.16	0.06	0.05	0.07	0.07	0.05	0.05
	(0.07)**	(0.07)**	(0.09)	(0.09)	(0.1)	(0.1)	(0.09)	(0.1)
log Capital Intensity	-.05	-.05	-.27	-.26	-.23	-.22	-.25	-.24
	(0.02)***	(0.02)***	(0.07)***	(0.07)***	(0.08)***	(0.08)***	(0.08)***	(0.08)***
Workers	0.0000662	0.0000659	-.0000145	-.0000154	-.0001	-.0001	-.0001	-.0001
	(0.0000621)	(0.000062)	(0.0000604)	(0.0000602)	(0.0000656)*	(0.0000655)*	(0.0000656)*	(0.0000655)*
Ownership	-.22	-.21	-.25	-.24	-.33	-.32	-.32	-.30
	(0.14)	(0.14)	(0.14)*	(0.14)*	(0.14)**	(0.14)**	(0.14)**	(0.14)**
Firm age < 5 years	0.43	0.48	0.47	0.52	0.56	0.59	0.5	0.54
	(0.31)	(0.3)	(0.22)**	(0.22)**	(0.23)**	(0.23)**	(0.21)**	(0.21)***
$5 \leq$ Firm age < 10 year	0.38	0.39	0.27	0.3	0.39	0.41	0.32	0.34
	(0.22)*	(0.22)*	(0.2)	(0.2)	(0.21)*	(0.21)*	(0.21)	(0.21)
$10 \leq$ Firm age < 20 years	-.09	-.11	-.10	-.12	-.10	-.12	-.10	-.13
	(0.13)	(0.13)	(0.13)	(0.13)	(0.14)	(0.14)	(0.14)	(0.14)
Industry Dummies (22)	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Provincial Dummies (107)	No	No	No	No	Yes	Yes	No	No
Provincial Controls	No	No	No	No	No	No	Yes	Yes
Obs.	2,482	2,479	2,482	2,479	2,373	2,370	2,339	2,336
R^2	0.0823	0.0829	0.1728	0.1725	0.2662	0.2649	0.2322	0.2309

[a] Newey-West standard errors robust to heteroscedasticity and auto-correlation in parentheses.
[b] *,**,*** denotes significance at 10, 5, 1% level respectively
[c] The omitted category for firm age is Age$\geq$ 20 years. See text for variable definitions.

Table 8: Relationship between delegation and log R&D expenditures (separate answers to survey questions)

Dependent variable:	log (R&D Expenditures)			
	(1)	(2)	(3)	(4)
Medium Delegation of Administrative Decisions	-.23	-.35	-.31	-.34
	(0.15)	(0.14)**	(0.16)**	(0.15)**
Medium Delegation of Financial Decisions	0.42	0.61	0.52	0.56
	(0.14)***	(0.14)***	(0.15)***	(0.15)***
Medium Delegation of Business Decisions	-.02	-.13	-.10	-.09
	(0.12)	(0.12)	(0.13)	(0.12)
Medium or High Delegation of Administrative Decisions	0.23	0.43	0.53	0.59
	(0.24)	(0.23)*	(0.23)**	(0.23)**
Medium or High Delegation of Financial Decisions	-.05	-.29	-.29	-.35
	(0.22)	(0.2)	(0.21)	(0.2)*
Medium or High Delegation of Business Decisions	-.03	0.08	-.02	-.09
	(0.17)	(0.17)	(0.18)	(0.18)
Human Capital Index	3.12	2.45	2.73	2.74
	(0.38)***	(0.39)***	(0.39)***	(0.37)***
log Value Added per Empl	-.03	0.03	0.06	0.04
	(0.07)	(0.07)	(0.07)	(0.07)
log Capital Intensity	-.05	-.04	-.04	-.04
	(0.01)***	(0.01)***	(0.01)***	(0.01)***
Workers	0.0004	0.0003	0.0002	0.0003
	(0.0000952)***	(0.0000864)***	(0.0000853)***	(0.0000883)***
log Revenue	0.61	0.63	0.64	0.62
	(0.05)***	(0.05)***	(0.05)***	(0.05)***
Ownership	-.04	-.14	-.22	-.20
	(0.14)	(0.14)	(0.14)	(0.14)
Firm age < 5 years	0.54	0.58	0.59	0.58
	(0.28)*	(0.22)***	(0.23)***	(0.21)***
$5 \leq$ Firm age < 10 years	0.39	0.37	0.44	0.41
	(0.21)*	(0.21)*	(0.2)**	(0.21)**
$10 \leq$ Firm age < 20 years	-.21	-.19	-.23	-.21
	(0.13)	(0.12)	(0.13)*	(0.13)*
Industry Dummies (22)	No	Yes	Yes	Yes
Provincial Dummies (107)	No	No	Yes	No
Provincial Controls	No	No	No	Yes
Obs.	2,467	2,467	2,358	2,324
R^2	0.3727	0.4333	0.4935	0.4733

[a] Newey-West standard errors robust to heteroscedasticity and auto-correlation in parentheses.
[b] *,**,*** denotes significance at 10, 5, 1% level respectively
[c] The omitted category for firm age is Age$\geq$ 20 years. See text for variable definitions.

Table 9: Probit of delegation of decisions

Dependent variable:	Firm delegates decisions								
	Q1-Q4	Q1		Q2		Q3		Q4	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Heterogeneity (level)	0.16	0.16	0.23	-.008	0.07	0.13	0.08	0.04	0.01
($95^{th} - 5^{th}$ percentile)	(0.07)**	(0.06)***	(0.07)***	(0.05)	(0.06)	(0.06)**	(0.07)	(0.05)	(0.06)
Frontier, 99^{th} percentile	-.01	0.03	0.08	0.07	0.12	0.04	0.09	0.0001	-.005
(ln y_{Fl})	(0.07)	(0.06)	(0.07)	(0.05)	(0.06)*	(0.06)	(0.07)	(0.05)	(0.06)
log Value Added per Empl	0.07	0.04	0.009	-.02	-.06	0.04	0.006	-.05	-.07
(ln y_{il})	(0.04)	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.04)	(0.03)	(0.04)*
Firm age < 5 years	0.34	0.51	0.48	-.18	-.40	0.54	0.36	0.05	-.09
	(0.26)	(0.25)**	(0.26)*	(0.17)	(0.17)**	(0.24)**	(0.25)	(0.18)	(0.19)
$5 \leq$ Firm age < 10 years	0.05	0.18	0.03	-.02	-.18	-.19	-.44	-.08	-.23
	(0.12)	(0.11)	(0.12)	(0.1)	(0.11)*	(0.1)*	(0.11)***	(0.09)	(0.1)**
$10 \leq$ Firm age < 20 years	-.19	-.07	-.11	-.04	-.07	-.12	-.24	-.03	-.08
	(0.08)**	(0.07)	(0.07)	(0.06)	(0.07)	(0.07)*	(0.07)***	(0.06)	(0.07)
Workers	0.0000159	0.0000394	0.0000748	7.36e-06	0.0000378	7.65e-06	0.0000575	-.0000767	-.0000819
	(0.0000424)	(0.0000476)	(0.000067)	(0.0000314)	(0.0000386)	(0.000037)	(0.0000479)	(0.0000337)**	(0.0000394)**
Human Capital Index	0.42	-.18	-.26	-.003	0.008	0.19	0.08	-.43	-.66
	(0.29)	(0.2)	(0.25)	(0.19)	(0.23)	(0.22)	(0.26)	(0.18)**	(0.21)***
Industry Dummies (22)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Provincial Dummies (107)	No	No	Yes	No	Yes	No	Yes	No	Yes
Obs.	4,532	4,689	4,033	4,686	4,246	4,643	3,995	4,601	4,119
Mean of dependent variable	0.92	0.86	0.85	0.82	0.81	0.85	0.84	0.79	0.78

[a] Probit coefficients (not marginal effects) are reported.

[b] Q1: Delegation of administrative decisions, Q2: financial decisions, Q3: business decisions, Q4: R&D decisions.

[c] Robust standard errors (not corrected for autocorrelation) in parentheses.

[d] *,**,*** denotes significance at 10, 5, 1% level respectively

[e] The omitted category for firm age is Age$\geq$ 20 years. See text for variable definitions.

Table 10: Probit of delegation of decisions (with ownership concentration)

Dependent variable:	Firm delegates decisions								
	Q1-Q4	Q1		Q2		Q3		Q4	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Heterogeneity (level)	0.2	0.19	0.28	0.005	0.1	0.16	0.11	0.05	0.03
($95^{th} - 5^{th}$ percentile)	(0.07)***	(0.06)***	(0.08)***	(0.06)	(0.07)	(0.07)**	(0.07)*	(0.05)	(0.06)
Frontier, 99^{th} percentile	-.004	0.04	0.1	0.08	0.13	0.04	0.09	0.008	-.0005
(ln y_{Fl})	(0.07)	(0.06)	(0.07)	(0.06)	(0.06)**	(0.06)	(0.07)	(0.05)	(0.06)
log Value Added per Empl	0.05	0.03	0.008	-.02	-.06	0.03	-.01	-.06	-.08
(ln y_{il})	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.05)	(0.04)	(0.04)*
Firm age $<$ 5 years	0.3	0.48	0.46	-.19	-.42	0.53	0.35	0.05	-.08
	(0.26)	(0.25)**	(0.25)*	(0.17)	(0.17)**	(0.24)**	(0.24)	(0.18)	(0.18)
$5 \leq$ Firm age $<$ 10 years	-.007	0.15	-.001	-.05	-.25	-.21	-.46	-.10	-.24
	(0.13)	(0.11)	(0.12)	(0.1)	(0.11)**	(0.1)**	(0.11)***	(0.09)	(0.1)**
$10 \leq$ Firm age $<$ 20 years	-.21	-.06	-.09	-.06	-.09	-.13	-.25	-.03	-.09
	(0.08)***	(0.07)	(0.07)	(0.06)	(0.07)	(0.07)*	(0.07)***	(0.06)	(0.07)
Ownership	0.49	0.29	0.36	0.16	0.24	0.26	0.34	0.18	0.25
	(0.09)***	(0.08)***	(0.08)***	(0.07)**	(0.08)***	(0.07)***	(0.08)***	(0.07)***	(0.08)***
Workers	-.000022	0.0000114	0.0000454	-.0000186	-4.85e-06	0.0000239	0.0000838	-.0000769	-.000084
	(0.0000403)	(0.0000454)	(0.000062)	(0.0000337)	(0.0000402)	(0.0000369)	(0.0000511)	(0.0000343)**	(0.0000405)**
Human Capital Index	0.37	-.28	-.46	0.09	0.01	0.16	-.01	-.44	-.72
	(0.3)	(0.21)	(0.25)*	(0.2)	(0.25)	(0.22)	(0.26)	(0.19)**	(0.22)***
Industry Dummies (22)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Provincial Dummies (107)	No	No	Yes	No	Yes	No	Yes	No	Yes
Obs.	4,377	4,529	3,903	4,503	4,064	4,488	3,858	4,453	3,986
Mean of dependent variable	0.92	0.86	0.85	0.82	0.81	0.85	0.84	0.79	0.78

[a] Probit coefficients (not marginal effects) are reported.

[b] Q1: Delegation of administrative decisions, Q2: financial decisions, Q3: business decisions, Q4: R&D decisions.

[c] Robust standard errors (not corrected for autocorrelation) in parentheses.

[d] *,**,*** denotes significance at 10, 5, 1% level respectively

[e] The omitted category for firm age is Age$\geq$ 20 years. See text for variable definitions.

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Delegation and R&D Spending: Evidence from Italy

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Abstract

We use data from the Italian manufacturing industry to document a positive relation- ship between delegation of decisions within organizations and involvement in research and development. This positive correlation is robust to controlling for the determi- nants of R&D within firms such as the level of human capital, capital intensity, sectoral and regional effects and to using different measures of R&D. We also investigate the determinants of delegation in our sample. We find a positive correlation between ownership concentration and delegation, which goes against the findings of Shleifer and Vishny (1986). We also find that variables found as important determinants of delegation in French manufacturing by Acemoglu, Aghion, Lelarge, Van Reenen and Zilibotti (2007) do not appear important in our sample, and some even exhibit qualita- tively opposite effect. These disparities can perhaps be explained by differences in the studied samples and observed variables, and call for further studies of cross-country differences.

Keywords: R&D, Delegation, Ownership Concentration, Asymmetric Information

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