

Matching Firms, Managers, and Incentives

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We combine unique administrative and survey data to study the match between firms and managers. The data include manager characteristics, firm characteristics, detailed measures of managerial practices, and outcomes for the firm and the manager. A parsimonious model of matching and incentives generates implications that we test with our data. We use the model to illustrate how risk aversion and talent determine how firms select and motivate managers. We show that empirical links between firm governance, incentives, and performance, which have so far been studied in isolation, can instead all be interpreted within our simple unified matching framework.

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I. Introduction

Personnel economics is concerned with two problems that firms face: how to find the right employees and how to motivate them. Moreover, matching and incentive provision are tightly related: different people pursue different goals. A firm should select a hiring policy in view of the incentive structure it has in place, and it should select an incentive structure in view of the people it wants to hire.

In a recent survey, however, Oyer and Schaefer (2011) conclude that while several studies in personnel economics have made progress on the understanding of incentive provision, much less attention has been devoted to matching. In particular, relatively little is known about the ways firms and workers generate economic surplus by matching appropriately and on the mechanism through which firms strategically design job packages to source appropriate workers. A key obstacle to advancement in this area has been the dearth of integrated evidence, due to the fact that most data sets only contain information on one side of the match.

In this paper, we shed light on the matching mechanism using a unique data set that provides detailed information on employees, firms, and the contracts that tie them. Our data, which cover a random sample of Italian managers, draw from a variety of sources: our own manager survey that contains information on contract, manager, and firm characteristics; managers' social security data on earnings throughout their career; and firm balance sheet data. The data contain direct measures of manager characteristics, like risk aversion and talent; firm characteristics, such as ownership and governance structure; contract characteristics, such as sensitivity to firm performance both through variable pay and implicit career incentives; and measurable outcomes, such as manager effort and firm performance. To the best of our knowledge, this is the first time that—for any category of workers—firm-level information is combined with such a rich characterization of managerial preferences and compensation data drawn from individual social security records.

Our empirical analysis is guided by a simple model where firms and managers match through the choice of incentive policies, and entry decisions, manager-firm matches, compensation schemes, effort exertion, and firm performance are endogenously determined. The model generates an array of predictions, which can be tested on our data. Our contribution is twofold. First, we show empirically for the first time that managers' risk aversion and talent are correlated with the incentives they are offered and, through these, with the characteristics of the firms that hire them. Second, we observe in our data a number of relations that have been reported, in

access to the data used in this article is available as supplementary material online. Contact the corresponding author, Oriana Bandiera, at o.bandiera@lse.ac.uk.

isolation, in other works. Hence, our contribution is to show that, for the set of workers and firms under consideration, these regularities can be understood within a parsimonious theoretical framework.

The model is based on the following primitives: a continuum of potential managers, who have heterogeneous talent and risk aversion; a continuum of potential firms, which differ by the weight their owners put on the private benefit of control vis-à-vis profits and by their idiosyncratic cost or revenue component; and a set of possible contracts that managers and firms can sign, defined by a fixed compensation and the slope of the performance-based component. The power of the contract should be viewed broadly, both as explicit incentives (bonus) and implicit incentives (promotions and dismissals).

Implicit and explicit incentives could also depend on other dimensions, like the willingness of the manager to provide private benefits to the firm owners. The incentive scheme could therefore be low-powered on performance but high-powered on other dimensions, which we do not observe directly. In what follows, unless explicitly mentioned, “incentive power” refers to the performance component only.

The framework illustrates how managers and firms match through incentives. Other things equal, managers who are risk averse and have little talent prefer low-powered incentives. Other things equal, firm owners who put a higher weight on the private benefit of control rather than profits also prefer low-powered incentives because high-powered incentives give managers a large stake in the firm’s profit and therefore increase the probability that managers will oppose owners who want to extract private benefits at the expense of profits. This means that certain owners may be willing to trade off higher profits arising from good management to contain the risk of losing control.¹

An equilibrium is such that (i) firms are active if and only if their expected payoff is nonnegative; (ii) managers are employed if and only if they receive at least their reservation utility; (iii) matches between firms, managers, and contracts are stable, even taking into consideration inactive firms and managers; (iv) contracts between matched firms and managers are optimal; and (v) managers exert the optimal amount of effort given their contract. It is important to stress that our model does not assume an exogenous distribution of active firms or managers. In equilibrium, only firms that generate a nonnegative payoff to their owners will be active. Similarly, only managers who can create a positive surplus for some

¹ The owner/manager of an Italian firm puts it in colorful terms: “I’d rather be worth 100 million euros, have fun now, and enjoy people’s respect when I am the senile chairman of my firm than be worth a billion and get paid fat dividends by a little ***** with a Harvard MBA, who runs my firm and lectures me at board meetings.” This comment was related to us in an e-mail by a top-50 European CEO with a Harvard MBA. Our translation.

firm will be employed as managers. Thus one can think of the underlying population as containing all potential firms and all potential managers. Rather than trying *ex post* to correct for a “survivor bias,” our model offers a set of testable predictions on observed matches that build on equilibrium entry conditions.

We show that there exists a unique equilibrium. The equilibrium is characterized by assortative matching and yields four testable implications: (i) in a stable assignment of managers to firms, the slope of the contract a firm offers is positively correlated to the talent of a manager and negatively correlated to his/her risk aversion; (ii) managerial outcomes are linked to incentives: in equilibrium managers who face steep contracts exert a higher level of effort, receive a higher expected compensation (both total and variable), and obtain a higher overall expected utility; (iii) firms whose owners put more weight on the private benefit of control are less likely to offer more performance-sensitive contracts; (iv) firms that offer more high-powered incentives have higher profits. While each individual prediction is consistent with other models, we are not aware of a framework that can account for all four of them.

The aim of our empirical analysis is to present evidence on the rich set of equilibrium correlations suggested by the theory. We base our results on a unique data set that we created with the purpose of studying both matching and incentives. As discussed above, its defining feature is that it combines detailed information on all three components of the match, namely, manager and firm characteristics and the contracts that tie them. The survey was administered to 603 individuals sampled from the universe of Italian service sector executives. Our sample managers rank high in the hierarchy of the firms they work for: 60% report directly to the CEO and a further 28% to the board. We also observe the managers' compensation history since their first appearance on the labor market from social security records, and we have standard accounting data on the firms.

We report four key findings in line with the four theoretical predictions above. First, we find that policies that create a tighter link between performance and reward attract managers who are more talented and more risk tolerant. Using an index that summarizes the “contract” between firms and managers—whether firms reward, promote, and dismiss managers based on their performance—we show that firms offering a one standard deviation steeper contract are 16 percentage points more likely to attract high-talent managers compared to the sample mean and that the ones they attract have a degree of risk tolerance that is 10% above the mean. The latter result speaks to the debate on the trade-off between risk and incentives. In line with classic agency theory, but contrary to most available evidence (Prendergast 2002), measures of risk tolerance and incentive power are positively related in our data. Our findings can, however, be reconciled with the existing evidence by noting that we measure the agent's risk preferences

directly rather than relying on proxies for risk aversion such as the agent's wealth or using variation in the riskiness of the environment instead of the agent's preferences. Our estimates therefore do not suffer from the endogenous matching or the bias correlated with unobservables discussed in Akerberg and Botticini (2002) and Prendergast (2002),² respectively.³

Second, we find that managers who are offered steeper contracts exert more effort, receive higher fixed and variable pay, receive more nonpecuniary benefits, and (not obviously) are more satisfied with their job. For instance, raising our incentive index by one standard deviation is associated with an increase in the probability that the manager works more than 60 hours a week by 16% of the sample mean, an increase in variable pay by a third of the sample mean, and higher chances that he/she is very satisfied with his/her job as large as 12% of the sample mean. Reassuringly, the estimated correlation between incentives and pay is robust to using administrative (and thus objective) social security earnings data instead of our survey measures: hence, the correlation is not due to reporting errors or to survey reporting biases. Even more interesting, when we use the time variation in social security earnings to compute the volatility of managers' earnings through time, we find that steeper incentives are correlated with observed higher earnings variability, consistent with the fact that steeper contracts (as measured in the survey) imply that the managers bear more risk (as measured in observed time series of earnings).

Third, we use information on the firms' ownership structure to test whether the incentive packages offered by firms depend on the weight their owners put on the benefit of private control. More specifically, we exploit the variation between family-owned and widely-held firms. This choice is rooted in the family firms literature (discussed below), which documents how family-owners often perceive the firm as an opportunity to address family issues and frictions. In this context, owners attribute a value to the firm as an "amenities provider," even though the provision of such

² Prendergast (2002) argues that delegation is more likely when the environment is more uncertain and that because performance pay is positively correlated with delegation, this generates a spurious positive correlation between environment uncertainty and incentive power when the degree of delegation is unobservable. Akerberg and Botticini (2002) argue that a spurious positive correlation can emerge because risk-loving agents are endogenously matched to risky environments and at the same time prefer high-powered incentives. Using agents' wealth as a proxy for risk aversion does not solve the problem because the riskiness of the environment is correlated with the error through the proxy error.

³ Our findings are complementary to existing evidence on executive pay that shows a negative correlation between stock volatility and pay performance sensitivity (Aggarwal and Samwick 1999). That literature focuses on endogenous variations in risk due to the characteristics of the environment, whereas we measure the characteristics of the managers that determine their preferences for performance pay.

amenities might not be profit maximizing. In this context, direct control is extremely valuable as it minimizes the probability that other external owners might oppose the extraction of such private benefits. On the other extreme, diffused ownership makes it much harder for a single owner to extract private benefits from the firm. In line with this view, we find that, compared to widely-held firms, family-owned firms offer flatter compensation schemes. Namely, family firms are less likely to offer bonuses as a function of individual or team performance, to promote and fire their managers based on their performance, and to use formal appraisals throughout a manager's career. Differences are sizable: unconditionally, the difference between the percentage of widely-held and family-owned firms that offer performance bonuses is 13 percentage points, and the corresponding difference among firms that offer fast track promotions for exceptional performers is 9 percentage points. Controlling for sector and firm size, we show that the incentive index is significantly weaker for family firms—up to 30% of one standard deviation. These findings are consistent with an established view that, compared to anonymous and institutional shareholders, large individual owners use corporate resources to generate ego rents, on-the-job amenities, or asset diversion (Demsetz and Lehn 1985). Such activities are mostly noncontractible, and they require effective direct control. They become more difficult when the firm is run by talented outsiders whose pay depends on firm performance—hence, the comparative disadvantage of family firms in the provision of managerial incentives.

Fourth, we estimate the correlation between incentives and firm performance measures from balance sheet data and find that firms that offer high-powered incentives have higher productivity, profits, and returns on capital. This is consistent with a Demsetzian view that, in equilibrium, active but underperforming firms must offer some other form of reward to their owners.

Although some of these findings have been observed in isolation by other authors (more detail is provided in the Literature Review section), the value-added of this paper lies in showing that these relations all hold for the same set of firms and managers and can all be accounted for by our parsimonious matching model. Furthermore, while our data do not allow us to identify causal relations directly, the consistency of all the correlations we estimate with the predictions of the model strongly supports its validity. Being able to observe all sides of the match allows us to rule out alternative theories that might be consistent with a subset of the correlations we report but not the whole set.⁴

⁴ One such prominent alternative is that family firms have a more effective monitoring technology and hence do not need to offer high-powered incentives. If that hypothesis were driving the results, however, we would expect managers who

The rest of the paper proceeds as follows. Section II is a review of the literature. Section III discusses the theoretical model and illustrates its main testable predictions. Section IV presents our data and shows how we map the model's variables into their empirical counterparts. Section V shows the evidence. VI discusses the robustness of our results. Section VII summarizes and concludes.

II. Literature Review

The main contribution of our paper is to integrate phenomena in personnel economics that are usually analyzed individually. On the theory side, our model belongs to the manager-firm assignment literature initiated by Rosen (1982). Two recent papers (Gabaix and Landier 2008; Terviö 2008) provide tractable CEO-firm matching models, where CEOs differ on talent and firms differ on size and productivity. Our model is particularly close to an independent paper by Edmans and Gabaix (2011), which endogenizes the contract between the CEO and the firm and obtains a concise close-form characterization of equilibrium incentives and matches. Like us, they endogenize both worker-firm matching and incentive provision. The main difference is that the main source of heterogeneity on the firm side is size in their model and governance in ours. Also, their managers differ only on talent (risk comes into play indirectly as talented managers are wealthier), while our managers differ on both talent and innate risk attitude.⁵

The argument that talented workers are matched to firms that offer high-powered incentives was made by Lazear (1986) and further developed by Balmaceda (2009). While in those models firms are *ex ante* identical, our firms differ because of ownership. Moreover, our managers differ on both talent and risk attitude.

On the empirical side, the four findings discussed above relate to four lively strands of literature that we now briefly discuss. The first set of results—equilibrium matching—is close to the large literature on firm-employee matching (see Lazear and Oyer [2007] for a review). The distinctive feature of our work is that we highlight one possible determinant of the match value, namely, the firms' and the managers' preferences over high-powered incentives. Our findings are complementary to Lazear

are better monitored to work harder and to have a higher fixed wage to compensate for the higher effort. Our estimates indicate that the opposite is true: managers who face weaker incentives work less hard and have a lower base wage. Section VI discusses this and other alternative explanations in more detail.

⁵ While Edmans and Gabaix (2011) and our paper utilize related models, the set of empirical questions that they ask is different. They calibrate their model with US data and show that the potential loss from talent allocation is much larger than the potential loss from inefficient contracting.

(2000), which shows that incentive pay attracts more productive blue-collar workers. Taken together the two sets of findings provide consistent evidence that incentives are an important determinant of the match between firms and workers at all levels of the hierarchy.⁶

An important determinant of matching patterns, explored by Gabaix and Landier (2008) and Terviö (2008), is firm heterogeneity in terms of size. While the main focus of this paper is governance, our empirical analysis always controls for size. Our analysis confirms the presence of the strong complementarity between size, talent, and pay predicted by the assignment models described above. In our sample, more talented managers are matched with larger firms, and the level of managerial pay increases with firm size. Friebel and Giannetti (2009) study endogenous matching between firms and workers. In their model, large firms have better access than small firms to financing, but they also investigate new ideas more thoroughly and are more likely to reject them. Workers differ in their creativity, namely, in how likely they are to have promising ideas. The authors characterize the matching equilibrium and analyze the effects of relaxing individual borrowing constraints. The key predictions of the model are consistent with evidence available from the US Survey of Consumer Finances. While we consider a different set of employees—managers rather than creative workers—and we utilize a different empirical approach—a purpose-designed employee-employer survey—our paper shares Friebel and Giannetti's goal of identifying the role of talent and risk aversion in the allocation of workers to firms.⁷

The second set of results relates to the vast literature (summarized in Lazear and Oyer [2007]) on how incentives affect worker behavior. In line with most of that body of work, our managers appear to work harder when they face steeper contracts. The results also relate to the literature that seeks to explain the correlation between pay for performance, pay levels, and inequality both for CEOs (Hall and Liebman 1998) and workers in general (Lemieux, MacLeod, and Parent 2009). We contribute to the debate by measuring contract steepness directly, as our survey records whether both pay and career progressions are related to performance. In

⁶ Our rich data allow us to overcome the identification issue pinpointed by Eeckhout and Kircher (2011). As they show, wage data alone are not sufficient to identify matching patterns. However, we have direct information on worker and firm characteristics.

⁷ Other examples of recent worker-firm endogenous matching models include Garicano and Hubbard (2007), for law firms, and Besley and Ghatak (2005) and Francois (2007), for the nonprofit sector. See also Rose and Shepard's (1997) analysis of the link between firm diversification and CEO compensation. The authors provide evidence that managers of diversified companies appear to be paid more. By comparing the compensation of newly appointed and experienced CEOs, the paper shows that the premium is due to higher ability rather than entrenchment.

contrast, the existing literature relies on outcome measures either by regressing total pay on firm performance or by measuring whether workers have received bonuses during their employment with the firm.

The third set of results—how ownership affects managerial practices—relates to a number of works at the intersection of personnel economics and corporate governance (Bertrand and Schoar 2003; Burkart, Panunzi, and Shleifer 2003; Bloom and Van Reenen 2007; Leslie and Oyer 2008), which study firm ownership as the key firm characteristic that drives the adoption of different managerial practices. The distinction between concentrated and diffuse ownership is a particularly salient one in that literature.⁸

Our findings can be seen as a validation of the “cultural” view of family firms (Bertrand and Schoar 2003). The objective function of family owners contains a nonmonetary component. We interpret this as family firms valuing direct control *per se*, so that retaining direct control gives rise to private benefits that the owner (the family) can enjoy in addition to the utility from monetary profits. Private benefits can be derived from the status associated with leading a business, from the “amenity potential” of influencing the firm’s choices (Demsetz and Lehn 1985), from the use of firm resources for personal purposes, or from the opportunity to use the firm to address family issues, for example, finding a prestigious job for a low-ability offspring. Valuing direct control is not inconsistent with family ownership *per se* having a positive effect on performance because, for instance, trust among family members can substitute for poor governance, as suggested by Burkart et al. (2003). Our model indeed allows for family firms to have a comparative advantage on other dimensions.

Finally, the results on the link with firm performance relate to the literature on human resources management and, more specifically, managerial practices (Ichniowski, Shaw, and Prennushi 1997; Black and Lynch 2001; Bloom and Van Reenen 2007; Bonin et al. 2007). In particular, we contribute to the literature on the effect of family ownership on performance through the choice of CEO and management (Bertrand and Schoar 2003; Pérez-González 2006; Bennedsen et al. 2007; Lippi and Schivardi 2010). Like these papers, we find that family firms may twist the choice of the manager toward less talented ones and thus provide a rationale for why they might perform worse even when not intrinsically less efficient—as the family firm owner’s quote reported earlier seems to suggest. While in these papers what affects firm performance is the refusal to choose from a wider set of managers and instead rely on the restricted pool of family (or social network) members, in our case, performance may be affected

⁸ For evidence on the relevance of family ownership, see La Porta, Lopez-de-Silanes, and Shleifer (1999), Claessens, Djankov, and Lang (2000), and Faccio and Lang (2002).

because less able and risk-tolerant managers self-select into family businesses at any time, not only at succession. This may be the case even among family businesses that choose to be run by professional managers.

Our finding that family firms offer contracts that attract risk-averse and less talented managers and pay them less is consistent with Sraer and Thesmar (2007), which shows that, compared to widely-held firms, French family firms employ less skilled workers, offer long-run labor contracts that provide implicit insurance, and pay lower wages. Our paper is complementary with work by Cai et al. (2008). While in our study we compare managers in nonfamily firms with nonfamily managers in family firms, Cai et al. focus their attention on the difference between family managers and outside managers employed by family firms. Evidence from their detailed survey of Chinese family firms reveals that outside managers are offered contracts that are more performance sensitive. Our paper and theirs taken together indicate that governance issues play a key role in the process of selecting and motivating managerial talent.

III. Theory

This short theoretical section adapts a workhorse agency model—linear contracts, quadratic payoffs, and normally distributed additive noise—to the problem at hand. Our main contribution lies in allowing heterogeneity on both sides of the managerial market and in letting the terms of the contract be decided by the two parties. While some of our results have already been discussed individually elsewhere and none of them will surprise people familiar with agency problems, it is useful to provide a unified conceptual framework to interpret the rich set of patterns that emerge from our data.

This section presents an informal analysis of the model. A formal characterization and all the proofs are available in appendix A. As the model is quite rich and nonstandard—two dimensions of heterogeneity on the workers' side, two dimensions of heterogeneity on the firms' side, endogenous contracts—it is developed in a simple function environment that allows us to obtain close-form solutions.

A. Model

To produce, a firm requires one manager. Suppose firm i is matched with manager j . The manager generates a product

$$y_j = \sqrt{\theta_j}(x_j + \varepsilon_j),$$

where $x_j \geq 0$ is the effort level chosen by the manager, θ_j is the manager's talent, and ε_j is normally distributed with mean zero and variance σ^2 and is uncorrelated across firms (or managers). The parameter θ_j will be discussed shortly.

The wage that firm i pays to manager j is a linear function of the productivity signal:

$$w_j^i = a^i + b^i \gamma_j.$$

The parameter b^i represents the link between pay and performance. In its more direct interpretation, b^i captures an explicit variable pay scheme in the classic agency theory tradition (Ross 1973; Holmstrom 1979; Shavell 1979), with the restriction to linear contracts (Holmstrom and Milgrom 1987). In a less direct interpretation, b^i represents an implicit career-based incentive scheme, as modeled by Holmstrom (1999) and documented by Baker, Gibbs, and Holmstrom (1994a, 1994b). Compensation w_j^i is determined by promotions and wage increases, which in turn are connected to performance γ_j . This generates a reduced-form link between performance and wage, whose strength is summarized by b^i . Thus, broadly speaking, the parameter b^i can be seen as the power of the implicit and explicit incentive scheme that the manager faces in firm i .

The manager has a CARA (constant absolute risk aversion) utility function

$$U_j = -\exp\gamma_j\left(w_j^i - \frac{1}{2}x^2\right),$$

where γ_j denotes j 's risk aversion coefficient. There is a mass of potential managers whose human capital θ_j and risk aversion coefficient γ_j are uniformly and independently distributed on a rectangle $[0, \bar{\gamma}] \times [0, \bar{\theta}]$. The total mass is $\bar{\gamma}\bar{\theta}$.⁹ To avoid difficult signaling and screening issues, we assume that the characteristics of individual managers (θ, γ) are observable.¹⁰

We now turn to firms. The owners of firm i pursue the following objective:

$$V^i = \Pi^i + (1 - \phi_g)\Gamma^i,$$

where Π^i denotes the standard corporate profit, while Γ^i represents some other form of benefit that the owners may receive from the company. This benefit has to do with direct control and can be material (use of company resources for personal entertainment) or of a less tangible sort (the status

⁹ An important assumption here is that talent and risk aversion are independently distributed. While there is some evidence that (cognitive) ability is positively related to risk taking (Frederick 2005), in our data there appears to be no correlation between risk attitudes and measures of human capital.

¹⁰ If the characteristics were not observable, the manager would have an incentive to pretend that he/she is more talented than he/she actually is. However, given θ_j , the manager would have no incentive to misrepresent his/her risk attitudes because the contract that he/she is offered in equilibrium maximizes his/her expected utility given his/her risk aversion coefficient γ_j .

that derives from managing a company, the utility of keeping the firm “in the family,” or the guarantee of prestigious jobs for friends or relatives).¹¹ The expression $1 - \phi_g$ represents the weight that the owners put on the benefit of direct control, and it depends on g , the ownership form. For the sake of simplicity, in what follows we allow for two types of ownership, denoted by F and N , although the model can be extended to allow for a larger variety of ownership structures. The main difference between F and N lies in the size of parameters ϕ_F and ϕ_N . In particular, F firms place a greater weight on direct control than N firms,¹² namely, $\phi_F < \phi_N$.¹³

The firm’s profit is given by

$$\Pi^i = y_j - w_j^i + b_g - k^i,$$

where the production y_j and the compensation w_j^i have already been discussed. The third term, b_g , represents a profit base, which may vary between F and N firms. We remain agnostic as to whether the difference $b_N - b_F$ is positive or negative, and this allows our model to be consistent with arguments either in favor or against family-firm’s profit advantage. The fourth term, k^i , represents idiosyncratic fixed costs (or profit opportunities) faced by different firms. For any ownership type g , there is a potential mass of entrants, and each entrant i is characterized by an idiosyncratic cost k^i . We assume that firms are distributed as follows. For every $k \geq 0$, the mass of firms with $k^i \leq k$ is equal to k . Variation in k is needed to pin down the number of firms in equilibrium.¹⁴

The (potential) control benefit is given by

$$\Gamma^i = \Gamma_g - b^i \theta_j,$$

where Γ_g is a constant, which may depend on the ownership form g . The second term, $b^i \theta_j$, captures one of the key ideas of this paper: granting control to an outside manager dilutes the owners’ ability to extract private benefits from the firm.¹⁵

¹¹ In principle, we could allow explicit incentive schemes that reward the provision of private benefits to the owners. All our predictions would still hold as long as managerial talent is more important for firm performance than for the production of private benefits.

¹² In particular, one can assume—although it is not necessary—that N firms have no direct control benefit: $\phi_N = 1$.

¹³ The results would continue to hold if we assumed $V^i = \tilde{\phi}^g \Pi^i + (1 - \tilde{\phi}^g) \Gamma^i$.

¹⁴ Qualitatively, the results would be unchanged if one assumed that the distribution of potential F -firms is different from the distribution of potential N -firms. The entry condition could be extended to allow for the possibility of N -firms to be bought out by families and F -firms to be sold to the market.

¹⁵ Even if one assumes that the benefit Γ^i does not depend on the manager’s talent θ_j directly (namely, that $\Gamma^i = \Gamma_g - b^i$), there is still an indirect comple-

The second term is crucial for our analysis and requires a careful discussion. Why is the control benefit that an owner can extract from his/her firm decreasing in the manager's talent and incentive? We view the term as the reduced form of an unmodeled subgame between the owner and the manager. Suppose that the owner can obtain a private benefit by misusing some of the firm's productive inputs (buying a private jet, hiring friends and family, running a pet project, etc.). Suppose that the manager can spend effort to prevent the owner from appropriating resources. How motivated will the manager be to fight back?

Owner appropriation reduces the pool of resources that is available to the manager. It is reasonable to expect that the amount of resources available and the manager's talent are complements in the creation of profits. The manager's bonus is then the product of resources \times talent \times profit share. The manager's willingness to fight resource appropriation is an increasing function of $b^i\theta$.¹⁶

To keep notation to a minimum, we set $\Gamma_N = 0$, and $b_N = 0$. These two variables do not affect matching and contract choice; they only determine the number of N -firms and F -firms that are active in equilibrium. Note that Γ_F and b_F can be positive or negative.

Firm entry is endogenous. In equilibrium, (i) the owners of every active firm i maximize V^i , and (ii) a firm i is active if and only if the maximized V^i is greater than the outside option (normalized at zero).¹⁷

The time line is as follows: (i) each firm chooses whether to become active; (ii) a matching market between firms and managers opens; manager-firm pairs sign linear contracts; (iii) managers who are hired by firms choose how much effort they exert.

B. Equilibrium

An equilibrium (in pure strategies) of this model is a situation where (a) a firm is active if and only if it receives a nonnegative expected payoff; (b) all manager-firm matches are stable, namely, no pair made of one manager and one firm, who are currently not matched to each other, can increase their payoffs by leaving their current partners (if any) and signing an employment contract with each other; (c) all matched pairs select the

mentarity between incentives and talent because firms that offer high-performance schemes attract more talented workers. Hence, one should expect all our main results to go through (albeit in a less tractable setting).

¹⁶ One could make this argument explicit in the model. It would require adding a second dimension to the manager effort (fighting back the owner) and modeling the owner's strategic choices. The theory section would become even longer and more complex, without much gain.

¹⁷ One could have different outside options for F -firms and N -firms, but that would be equivalent to a change in b_F and b_N .

contract that maximizes joint surplus; (d) all managers choose the optimal level of effort, given the contracts they have signed.

The present section offers an informal analysis of the model. A formal result is provided at the end of the section and proven in appendix A.

Let us begin from the last step: effort choice. Given a contract with slope b^i , the manager chooses effort

$$\hat{x}_j = b^i \sqrt{\theta_j}.$$

As the surplus created by the relationship can be allocated costlessly to the firm or the manager through the fixed compensation variable a , the contract between the two parties must maximize the sum of their expected payoffs. The surplus-maximizing contract has slope

$$\hat{b}^i(\gamma_j) = \frac{\phi_g}{1 + \gamma_j \sigma^2}.$$

The contract power decreases with the risk aversion coefficient of the manager, γ_j , and in the profit weight of the firm owners, ϕ_g . The manager's product, given the optimal contract, is

$$y_j = \sqrt{\theta_j} \hat{x}_j = \frac{\phi_g}{1 + \gamma_j \sigma^2} \theta_j.$$

This means that there is a positive complementarity between the profit weight ϕ_g and managerial talent θ_j and a negative complementarity between ϕ_g and the risk aversion coefficient γ_j . *F*-firms have a comparative advantage for low-talent, risk-averse managers.

This comparative advantage translates into a matching equilibrium where managers with high talent and low risk aversion work for *N*-firms, managers with medium talent and higher risk aversion work for *F*-firms, and less talented managers are unemployed.

To see that this must be the case, consider two managers, *A* and *B*, and assume that *A* is more talented and less risk averse than *B*. Suppose, for contradiction, that *A* works for an *F*-firm and *B* works for an *N*-firm. The total surplus (the sum of V^i and U_j) generated by the two firms is lower than the total surplus that would be generated by the same two firms if they swapped managers. This means that either the *F*-firm and manager *B* or the *N*-firm and manager *A* can increase their joint payoff by leaving their current partners and forming a new match. The same line of reasoning applies to an unemployed manager who is more talented and risk tolerant than a manager who is currently employed.

See figure 1 for an example of such a matching equilibrium. Managers are uniformly distributed on a two-dimensional space of talent and risk aver-

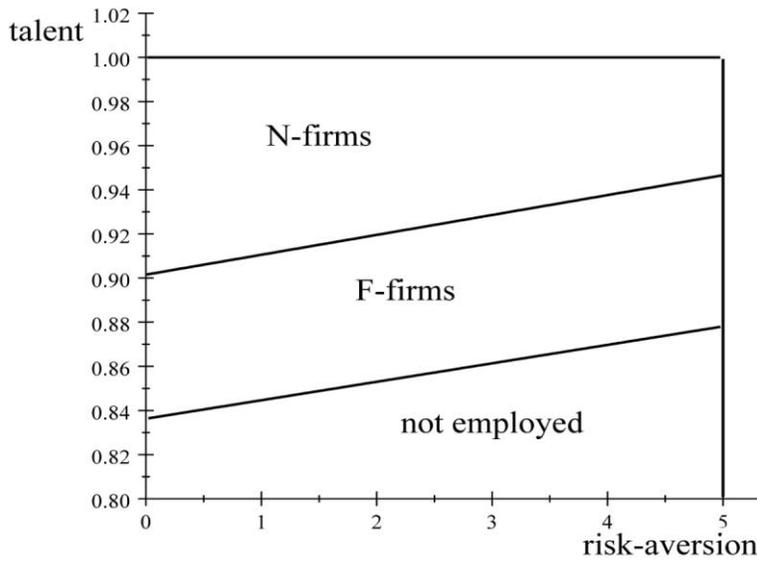


FIG. 1.—Equilibrium allocation of managers to firms

sion. The space is divided into three regions. The upper-left region contains talented risk-takers employed by *N*-firms. The middle region is made of less talented and more risk-averse managers who work for *F*-firms. The managers in the remaining region are unemployed.

The regions in the figure are determined by indifference conditions. Managers on the line that separates the *F*-region from the unemployment region receive an expected utility equal to their outside option. Managers on the line between the *F*-region and the *N*-region are indifferent between working for an *N*-firm or for an *F*-firm.

The expected payoff of firm *i* is

$$\begin{aligned}
 E[V^i] &= E[\Pi^i + (1 - \phi_g)\Gamma^i] \\
 &= \pi^i + E[b_g - k^i + (1 - \phi_g)\Gamma_g],
 \end{aligned}$$

where the term

$$\pi^i = E[y_j - w_j^i - (1 - \phi_g)b^i\theta_j]$$

can be seen as management-related payoff. Competition among firms guarantees that all active *F*-firms have the same management-related payoff π^F and all active *N*-firm have the same management-related payoff π^N .

The comparative advantage of N -firms in incentive provision means that $\pi^N > \pi^F$.

The size of the F -region in figure 1 corresponds to the mass of F -firms that are active, n_F . Similarly, the size of the N -region equals the mass of N -firms, n_N . The variables n_F and n_N are determined endogenously by the free entry condition. Firm i is active if and only if $E[V^i] \geq 0$. This means that the F -firm with the lowest payoff satisfies

$$\pi_F + h_F - k^i + (1 - \phi_F)\Gamma_F = 0,$$

while the N -firm with the lowest payoff satisfies

$$\pi_N - k^i = 0.$$

C. Testable Implications

The equilibrium characterization above yields an array of predictions regarding observable variables, which we group into four implications.

The first set of predictions relates to how managers are matched to incentive schemes:

IMPLICATION 1 (MANAGER-INCENTIVE MATCH). The slope of the contract that manager j faces in equilibrium is negatively correlated with his/her risk aversion coefficient and positively correlated with his/her talent.

Implication 1 shows how managerial human capital is matched to firms in equilibrium. Managers with high risk aversion and low talent face low-powered incentives. If that was not the case, there could be gains from breaking existing pairs and forming new matches.

We can also predict how the manager's effort and his/her performance will be related to the incentive scheme he/she faces:

IMPLICATION 2 (MANAGER PERFORMANCE). Controlling for risk aversion, the slope of the contract that manager j faces in equilibrium is positively correlated with the manager's (a) effort, (b) variable compensation, (c) total compensation, and (d) utility.

Implication 2 describes what happens to the manager once he/she is matched to a firm. Managers who face steep contracts work harder. That is both because of the direct incentive effect and because they are more talented (and talent and effort are complements). As a result, they produce more output, and they receive more performance-related compensation. Finally, a revealed preference argument shows that managers who are

offered a high contract slope must have a higher utility than managers who are offered a less steep contract (because being talented can obtain the same product with less effort).

The third set of predictions relates to incentive power. If an F -firm and an N -firm hire managers with identical risk aversion, the F -firm will offer a flatter contract because it has a higher control premium. Formally, $\phi_F > \phi_N$ implies

$$\hat{b}_F(\gamma_j) = \frac{\phi_F}{1 + \gamma_j \sigma^2} < \frac{\phi_N}{1 + \gamma_j \sigma^2} = \hat{b}_N(\gamma_j).$$

We can write this result as:

IMPLICATION 3 (FIRM-INCENTIVE MATCH). F -firms offer less steep contracts than N -firms.

This result constitutes a third testable implication: F -firms offer contracts that are less performance sensitive. Note that this prediction holds a fortiori if we do not condition for the manager's characteristics, as more risk-averse managers work for F -firms.

An additional prediction of our theory is that managers do not have an intrinsic productivity advantage in F -firms or N -firms. Implications 1 and 2 imply that all the effects on manager characteristics and performance come from the incentive structure. Once controlling for incentives, the data should display no residual firm ownership effect.

The model also makes some predictions on the link between incentive provision and firm performance. Before getting into that, it is important to stress that our theory does not say whether performance will be higher in N -firms or in F -firms. This is for two reasons. First, F -firms may have some intrinsic business advantage or disadvantage, captured by h_F . Second, the fixed component of Γ_F determines endogenously the threshold of idiosyncratic cost k^i that induces F -firms to be active and hence endogenously determines their performance. As a result, we can construct numerical examples where profits are higher in F -firms and numerical examples where they are higher in N -firms.

However, our model makes predictions on the correlation between firm performance and incentive provision, conditional on ownership:

IMPLICATION 4 (FIRM PERFORMANCE). Controlling for ownership, the slope of the contract is positively correlated with the firm's profit Π^i .

The intuition for this last prediction is immediate. As an increase in the contract slope b^i reduces control benefits, the firms who choose a higher slope must in equilibrium be compensated with a higher expected profit.

IV. Empirical Analysis: Data Description

A. Data Sources

Our empirical analysis exploits three data sources: (i) a novel survey of Italian managers that we designed to collect detailed information on their characteristics, the firms they work for, and the incentives they face, (ii) Amadeus and the Italian Company Accounts Database, which contain information on the firms' balance sheets, demographics, and employment levels,¹⁸ and (iii) the Social Security Database, which contains longitudinal information from administrative records on the managers' job position, pay, and employer since they joined the labor force.

The distinctive and unique feature of our survey is that it collects information on both sides of the market: the firms and the managers they employ. In particular, we collect measures of the firms' ownership structure and details on their incentive policies on three dimensions: bonus pay, promotion, and dismissal decisions. On the managers' side, we collect information on the managers' risk aversion, talent, work effort, compensation package, and job satisfaction.

One advantage of using data from a continental European country like Italy is that all-encompassing rules about collective labor bargaining result in unambiguous job definitions. The job title of "manager" (*dirigente* in Italian) applies only to the set of workers that have a manager collective contract, a fact that is recorded by social security data.¹⁹ Italy has four managerial collective agreements: manufacturing, credit and insurance, trade and services, and public sector.

To avoid dealing with sector-specific contractual provisions, we focused on the managers in the trade and services sector. Managers in our sample are selected from the members directory of Manageritalia, an association of professional managers operating in the Italian trade and services sectors. Importantly, Manageritalia members account for 96% of all managers in the trade and services sectors. Hence, by sampling from the Manageritalia directory, we are sampling from almost the full population of managers in that sector. These, in turn, make up 20% of all Italian man-

¹⁸ Amadeus is an extensive accounting database covering more than 9 million public and private companies across Europe, of which approximately 580,000 are in Italy. The Company Accounts Database is based on information provided by commercial banks that covers all the banks' largest clients. The data are collected by Centrale dei Bilanci, an organization established in the early 1980s by the Bank of Italy and Italian banks with the purpose of recording and sharing information on borrowers.

¹⁹ There is a very clear distinction between being a manager and the closest collective contract job title, which corresponds to "clerical employee" (*quadro* in Italian). Indeed the two categories are represented by different trade unions and have different pension schemes. The difference in terms of social status is also immediately perceived.

agers.²⁰ The Manageritalia members directory contains 22,100 managers employed by 8,739 firms. To make certain that we obtain balance sheet data, we sample from the 2,012 firms that can be matched with Amadeus and the Italian Company Accounts Database. The balance sheet data sets and, a fortiori, our sampling universe, are skewed toward large firms. To maintain comparability across managerial tasks, we focus on managers employed in the three main operational areas—general administration, finance, and sales. We randomly assign each firm to one of the three areas and randomly select one manager within each firm. The final sampling universe contains 605 each of general directors, finance directors, and sales directors, for a total of 1,815 observations.²¹

The administration of the survey was outsourced to Erminerio & Company—a well-established survey firm located in Milan, Italy. The 1,815 sample managers were contacted by phone to schedule a subsequent phone interview, administered by a team of 35 analysts trained by Erminerio & Company and closely monitored by our research team. The response rate was 33%, with an average duration of 21 minutes per interview. Thus, our final sample contains 603 observations, equally split across the three operational areas.²² Our sample managers are highly ranked in the firm hierarchy: most of them (60%) report only to the CEO, and a further 28% report directly to the board. Only 2% rank three levels below the CEO. Moreover, 97.5% of sample managers are outsiders; namely, they do not belong to the family when the firm is family owned. Reassuringly, respondents and nonrespondents are employed by observationally identical firms. Indeed we find no evidence that the probability of participating in the survey is correlated to firm size, labor productivity, profits, return on capital employed, or sector (table B1 in app. B). Respondents also look similar to nonrespondents on demographics (gender and age) and tenure on the job. Respondents, however, have lower wages, but the difference, while precisely estimated, is small as the median weekly wage for respondents is 8% lower than for nonrespondents (1,648 vs. 1,786). This is consistent with nonrespondents having a higher opportunity cost of time, as expected. Reassuringly, however, the pay distributions have considerable overlap, and,

²⁰ Social Security Data indicate that in 2006, the number of individuals employed on a “manager contract” in the private sector was 117,000. Of these, 23,000 belong to the trade and private services sectors, and 22,100 belong to Manageritalia. Managers working for Italian branches of multinational firms belong to the trade and services sectors even if the firm itself is classified as industry, e.g., car manufacturers, as long as no production plants are located in Italy.

²¹ We do not sample from the 197 firms for which the Manageritalia member list does not contain managers employed in the main three operational areas.

²² In our regressions, we always include controls for manager operational area. We also collected detailed information on the interview process, including information on the interviewees’ tenure in the company, tenure in the post, seniority, gender, and interviewer identifiers. We use these variables to account for measurement error in the survey variables across some specifications.

as discussed below, there is considerable variation within our sample. Moreover, despite this compensation level difference, respondents and nonrespondents have a similar career path, as we find no difference in the average yearly rate of pay growth. Finally, while social security data do not contain information on incentive policies, we can proxy sensitivity of pay to performance by calculating the standard deviation of pay of the same manager across years in the same firm. Table B1 in appendix B shows that respondents and nonrespondents do not differ on this dimension.

B. Firm Characteristics and Performance

The main characteristics of our sample firms are summarized in table 1, panel A. The table shows that family ownership is the most common ownership structure: 47% of the firms are owned by the founder (19%) or their family (28%). The percentage of family firms is in line with the findings of La Porta et al. (1999), who report that 60% of Italian medium-sized publicly traded firms belong to a family (including both founders and second-generation firms). Widely-held firms account for 30% of the sample.²³ The remaining 23% is divided between cooperatives and firms owned by the state (8%), firms owned by their management (2%), and firms owned by a group of private individuals (13%). As there is no a priori reason to believe that the importance attached to the “amenity potential” of control by these firms is similar to either family firms or widely-held firms, we keep this category separate in the analysis that follows.

The survey also contains information on firm size, sector, and multinational status. Over 90% of the sample firms employ fewer than 500 people. In more detail, 39% are small firms with 49 or fewer employees, a further 20% have between 50 and 100 employees, and the remaining 41% have more than 100 employees. All sample firms belong to the service sector, within which the three most frequent categories are wholesale (45% of the sample), business services (11%), and retail and specialized IT services (4%). Finally, 58% of the firms in our sample are subsidiaries of a multinational company, and in 21% of the cases the multinational’s headquarters are in Italy.²⁴

The last three rows of table 1, panel A, report measures of firm performance from Amadeus. For each firm, we use the last year for which data are available, which is 2007 for 62% of the sample firms and 2006 for 35% of them. We use three measures of performance: labor productivity (defined as operating revenues divided by the number of employees),

²³ Widely-held firms are companies for which no party owns more than 25% of the shares. We also include in this category private equity firms (8% of the sample), but the results are qualitatively similar once we include private equity in the residual ownership category.

²⁴ Most sample firms are incorporated in the region of Lombardy (58%), followed by Emilia (9%), Lazio (9%), Veneto (8%), Piedmont (5%), and Tuscany (5%). This reflects the uneven geographical distribution of firms across the country.

profits per worker (computed as earnings before interests and tax divided by the number of employees), and ROCE (operating income scaled with capital employed). For each measure we drop the top and bottom 1% to remove outliers possibly due to measurement errors. Table 1 shows that the distribution of productivity and profits is heavily skewed to the left and that the median is much smaller than the mean, indicating that there is a long tail of firms that perform considerably better than most of the sample. Finally, we observe considerable heterogeneity along all three measures—the standard deviation is between 1.3 and 2.3 times the mean.

C. Incentive Policies

The model in Section III illustrates how the choice of incentive policies attracts different types of managers. To provide evidence on this issue, we collected information on three types of firm policies that can be made conditional on manager performance: pay, promotions, and dismissals. This way we obtain a detailed picture of the firms' incentive policies and can exploit variation along all three dimensions. For each type of policy, we ask whether the outcome depends on the manager's performance and whether this is evaluated through a formal appraisal system. The latter is crucial to ensure that managers know the exact mapping from performance to reward, which determines the effectiveness of the incentive scheme. In fact, our data shows that two-thirds of the managers who are formally appraised know exactly how bonus payments are calculated, whereas the corresponding share in firms that do not have a formal appraisal system is one-half.

To measure the sensitivity of pay to performance, we asked whether managers can earn a bonus, whether this is a function of performance, and whether it is awarded through an established appraisal process. We summarize this information into two variables, *bonus 1* (equal to one if bonus is conditional on performance; zero otherwise) and *bonus 2* (equal to one if bonus is based on formal appraisal; zero otherwise). Half of the firms in our sample offer bonuses as a function of individual or team performance targets that are agreed in advance;²⁵ in 33% of firms, bonuses are awarded through a formal appraisal system (table 1, panel B).²⁶

²⁵ Overall, 70% of the firms offer a bonus scheme, but for 20% the bonus is either a function of firmwide performance or awarded at the discretion of the owners. All the findings that follow are robust to including firmwide or discretionary bonuses in the measure of performance pay.

²⁶ It is important to note that the fact that formal appraisal systems may have implications for the bonus does not necessarily imply the existence of bonuses related to individual performance. Managers report that formal appraisal systems may have implications for the bonus in 201 cases of 603. The vast majority of the times (77%) in which appraisals may have implications for the bonus, and the bonus exists, the bonus is linked—albeit not always exclusively—to individual or team performance. The rest of the times the bonus is independent of individual performance, but it is linked to firm performance and/or the discretionary judgement of the owners.

Table 1
Summary Statistics

	No. of Observations	Mean	Median	SD
A. Firm characteristics:				
Ownership:				
Family of founder	603	.47	0	.50
Widely held	603	.30	0	.46
Other	603	.23	0	.42
Size:				
Between 50 and 100 employees	603	.20	0	.27
Over 100 employees	603	.41	0	.49
Multinational (= 1 if firm is a subsidiary of a multinational)	603	.58	1	.49
Productivity (\times US\$1,000)	547	1720.14	895.80	2310.40
Profits (\times US\$1,000)	561	74.90	32.29	169.80
ROCE	541	17.04	15.71	23.36
B. Incentive policies:				
Bonus depends on team or individual performance (bonus 1)	603	.50	1	.50
Bonus based on formal appraisals (bonus 2)	603	.33	0	.47
The firm has fast tracks for star performers (promotion 1)	603	.37	0	.48
Promotions depend on performance (promotion 2)	603	.74	1	.44
Promotions based on formal appraisals (promotion 3)	603	.34	0	.47
Managers fired in the last 3 years due to poor performance (firing 1)	603	.05	0	.22
Decisions to dismiss based on formal appraisal (firing 2)	603	.23	0	.42
Incentive index (sum across variables listed in panel B)	603	2.56	2.00	1.74

C. Manager characteristics:

Demographics:				
Age	603	46.98	46	7.12
Gender (1 = male)	603	.90	1	.30
Risk and insurance:				
Risk preferences (investment lottery)	603	20.36	20	18.94
Risk choices	603	5.70	6	1.74
Father has college degree	603	.16	0	.37
Talent:				
College degree	603	.50	1	.50
Executive education	603	.56	1	.50
Manager has received offers over past 3 years	603	.71	1	.46
D. Manager outcomes:				
Works 60 or more hours per week	603	.37	0	.48
Fixed pay (euros/week)	603	1,903.70	1,682.7	568.2
Variable pay (euros/week)	603	299.60	216.3	325.6
Number of benefits	603	4.20	4	1.38
Manager is very satisfied about his/her job (= 1 if yes)	603	.50	0	.50
From social security records:				
Total pay, current firm, last available year (euros/week)	572	1,830.10	1,658.7	877.30
Average total pay, all past firms and years (euros/week)	527	588.90	521.9	324.3
Yearly standard deviation of pay, current firm	419	443.30	333.9	526.88
Average yearly standard deviation of pay, all firms and years	465	221.69	159.7	282.46

NOTE.—All variables are from the ManagerItalia survey, with the exception of productivity, profits, and ROCE (from AMADEUS) and compensation data in panel D (from INPS [social security] records). Other ownership includes government-owned, cooperatives, manager-owned, and firms-owned by a group of private individuals. Productivity is defined as operating revenues over the number of employees. Profits are defined as earnings before interests and taxation over the number of employees. ROCE is defined as operating income over capital employed. The number of observations for social security records variables is smaller due to missing values. The last available year is 2004 for 75% of the sample, 2005 for 2.5%, 2006 for 2.5%, and 2007 for the remaining 20%. The average fixed compensation is computed over all years and firms the manager has worked for (including nonmanagerial positions). The standard deviation is computed only if the manager has worked for at least 3 years in the same firm.

To measure the effect of performance on the manager's career prospects within the firm, we asked whether fast promotion tracks for star performers exist, whether promotions depend on performance (as opposed to tenure or good relationships with the owners), and whether they are decided through formal appraisals. The variable *promotion 1* equals one when fast tracks exist and zero otherwise. We define *promotion 2* to equal one if performance is an important factor for promotion. Finally, *promotion 3* equals one if promotions are decided within a well-defined system of formal appraisal. On average, 37% of sample firms report having fast tracks for star performers, promotions depend on performance in 74% of the cases, and 34% of firms have a formal appraisal system to determine promotions (table 1, panel B).

Finally, we measure whether poor performance can be cause for dismissal and, again, whether dismissals are decided through a formal appraisal system. The variable *firing 1* is equal to one if in the past 5 years managers have been dismissed due to failure in meeting their performance objectives and zero otherwise. Overall, only 11% of firms have dismissed managers in the last 5 years, and 5% report doing so because of poor performance.²⁷ Finally, *firing 2* equals one when dismissals are decided through a formal appraisal system (and zero otherwise), and this happens in 23% of the sample firms (table 1, panel B).

For parsimony, we combine the various incentive policies in a sole index that equals the sum of the measures described above (see fig. 2). The findings are qualitatively unchanged if we use other summary measures, such as the first principal component. The resulting index takes values between zero and seven, with higher values denoting policies that create a tighter link between reward and performance. The median firm adopts two out of the seven incentive policies we consider, and the standard deviation of the index is 1.74. Just under 10% of the sample firms offer no explicit reward for performance, while only 0.5% adopt all seven measures.

D. Manager Characteristics, Pay, and Performance

The manager survey provides a wealth of information on manager characteristics, summarized in table 1, panel C. Managers are on average 47 years old, and 90% of them are male.²⁸

The theoretical model of Section III implies that a key variable driving the firm-manager match is the manager's attitude toward risk. To shed light on this, we follow an emerging literature that tries to elicit individual

²⁷ The other nonexclusive reasons given for dismissals are "poor market conditions" (4%) and "disagreement with the owners" (6%).

²⁸ This is in line with the figures for the manager population as a whole from social security records. In the last available year (2004), average age was 47 and the share of males was 88%. See Bandiera et al. (2008) for details.

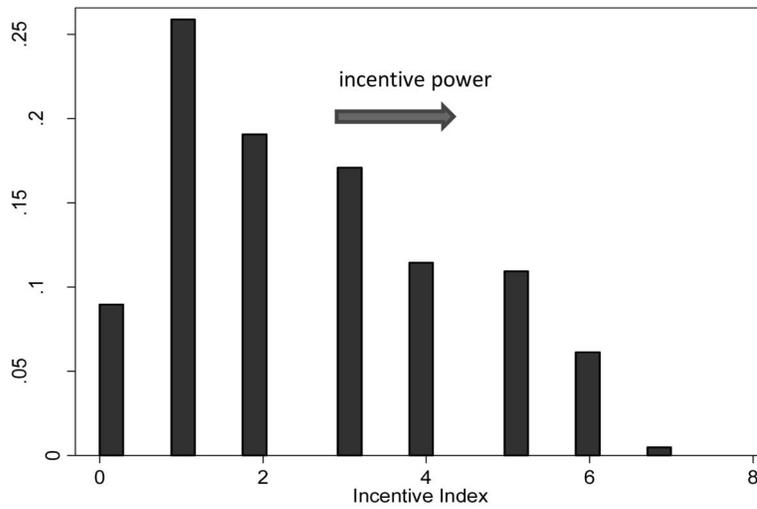


FIG. 2.—Incentive Index

risk preference parameters and characterize their heterogeneity by using large-scale surveys (e.g., Barsky et al. 1997; Dohmen et al. 2006; Guiso and Paiella 2008). Our approach differs from most of the literature that analyzes the risk-incentive trade-off using measures of the riskiness of the environment or agents’ wealth as a proxy for their risk aversion. As such, it does not suffer from the bias caused by endogenous matching and omitted variables discussed by Akerberg and Botticini (2002) and Prendergast (2002).

We collected a measure of risk attitudes that aims to measure the managers’ own preference for risk. Measures of this sort have been shown to correlate with actual risk taking in a field experiment by Dohmen et al. (2006).

To measure the managers’ own risk preference, we ask them to choose between a prospect that yields €1 million for sure (the safe choice) and a binary risky prospect that yields €0 with probability p and €10 million with the complementary probability $(1 - p)$, where p varies between 0.01 and 0.8 at intervals of size 0.1. Suppose that for very low probability of zero return (and thus a very high probability of making €10 million), the manager prefers the risky prospect to €1 million for sure. We take as our risk attitude measure p^* , defined to be the level of p at which the manager switches from the risky to the safe prospect. Obviously p^* is inversely related to risk aversion, that is, risk-averse managers are willing to bear losses only if the probability is low. Table 1 shows that the average manager prefers the safe prospect when the risky one fails with probability 0.2 or higher. More interesting, table 1 also shows that managers’ risk at-

titudes are quite heterogeneous—the standard deviation of our measure is 18.94.²⁹

The next set of variables aim to proxy for manager talent. The first two refer to the managers' human capital, as measured by college and executive education degrees. In our sample, 50% of the managers hold a college degree, and 56% hold an executive degree.³⁰ To capture additional aspects of managerial quality beyond education, we measure "desirability" by asking managers whether they received any job offer during the 3 years prior to the interview; 71% reported that this was the case.

It is important to note that the measures of risk attitudes and talent exhibit independent variation: no correlation between any two measures is higher than 0.06. This is crucial for our purposes as it allows us to identify matching on risk and talent separately.³¹

Finally, table 1, panel D reports measures of the managers' effort, remuneration, and job satisfaction. We proxy managerial effort by the number of hours worked over a week. In our sample 37% of managers work 60 hours or longer.³² The average annual fixed salary of a manager is approximately

²⁹ We also collect two other measures of the manager risk attitude. The first is an index of the managers' choice of risk when acting on behalf of the firm. This is obtained from the answers to the following question: "We would now like you to think of some important decisions you have taken or might take on behalf of your firm. These are strategic decisions with uncertain outcomes and a positive correlation between expected earnings and risk. On a scale from 0 to 10, where 0 means you would choose the safest option with the lowest expected earnings while 10 refers to very risky projects that have a very high rate of return in case of success, what would you choose?" The average manager is just above the midpoint (5.7), and again there is considerable heterogeneity across managers. The second proxy was obtained from a question asking the manager to state what would be the ideal proportion between fixed and variable pay linked to individual performance if he/she could choose among a menu of combinations where a higher proportion of variable pay corresponded to higher total average pay. Interestingly, these two risk attitudes measures are strongly correlated with our main indicator of risk tolerance (correlation coefficients 0.24 and 0.19, respectively, and both are highly statistically significant). However, compared to the managers' own risk tolerance, these two alternative measures may have some shortcomings. First, answers to the first question might reflect the type of incentives faced by the manager. Even for the second question, the chosen mix may also reflect the riskiness that the manager faces in the firm rather than preferences for risk. Therefore, we use these measures only for robustness checks (see footnote 36).

³⁰ This relatively low figure is consistent with the information arising from existing surveys of Italian managers (see Bandiera et al. 2008).

³¹ We discuss in more detail the validity of the risk aversion variable in the robustness section.

³² To minimize measurement error due to the choice of a particular week, the survey asks managers to pick the number of hours they work in the "typical" week out of five possible choices: (i) 40 hours or fewer, (ii) about 40 hours, (iii) about 50 hours, (iv) about 60 hours, (v) 60 hours or more.

€100,000, while the bonus amounts, on average, to 15% of the fixed salary. On average, managers in our sample receive 4.2 nonmonetary benefits out of a list of seven potential benefits.³³ Finally 50% of the managers in our sample report to be “extremely satisfied” with their job. Only 5% report to be “unsatisfied,” while the remaining part of the sample is “satisfied.”

V. Empirical Analysis: Findings

We organize the empirical evidence in four parts that match the set of four predictions obtained in Section III. We start by estimating the relation between the firms’ incentive policies and the risk and talent of the managers they hire in equilibrium. We will show that firms offering stronger incentives attract managers who are more risk tolerant and more talented. Second, we estimate the correlation between the strength of incentives and managers’ outcomes. We will show that managers who are offered stronger incentives exert more effort, receive higher fixed and variable pay, receive more nonpecuniary benefits, and are more satisfied with their job. Third, we estimate the correlation between the weight given to keeping direct control of the firm (as proxied by ownership) and the strength of managerial incentives. We will show that family ownership, which in our setting reveals a stronger preference for direct control, is negatively correlated with the adoption of bonus systems related to individual or team performance and with the adoption of practices that promote and fire employees based on their performance. Fourth, we estimate the correlation between incentives and firm performance. We will show that firms that offer high-powered incentives have higher productivity, profits, and returns on capital.

It is important to clarify that our aim is to present evidence on a rich set of equilibrium correlations that are suggested by the theory. We do not, at any stage, aim at identifying the causal effect of ownership on incentives or incentives on performance, as neither varies exogenously. However, at the end of this section, we discuss a number of alternative interpretations of our findings. We argue that, when taken together, our evidence, while consistent with the matching model, is not consistent with any of these alternatives.

A. Incentives and Managers’ Characteristics

We begin by testing implication 1, namely, that high-powered incentives attract managers who are less risk averse and, conditional on risk aversion, more talented. Starting with risk aversion, we estimate the conditional correlation:

³³ The list of benefits include: company car (available to 83% of our sample managers), flexible hours (85%), telecommuting (27%), training (71%), sabbatical periods (6%), health insurance (74%), and life insurance (74%).

$$R_i = \eta^R I_j + X_j \zeta^R + Y_i \sigma^R + \epsilon_{ij}^R, \quad (1)$$

where R_i is a measure of the manager risk aversion and I_j is the incentive policies index. Throughout the empirical analysis, X_j includes the firm's multinational status, employment levels, and SIC2 industry codes; Y_i includes the manager's tenure, seniority level, whether he/she belongs to the owner family, and his/her operational area (general administration, finance, sales).³⁴ Finally, we add interviewers' dummies and control for the duration of the interview to account for potential noise in the measurement of the incentive policies.

Columns 1 and 2 of table 2 estimate (1) for our measure of the manager's own risk preferences with and without the control vectors X_j and Y_i . Recall that our risk preference measure—the maximum probability of failure of the risky project that the manager is willing to bear—is inversely related to risk aversion. Columns 1 and 2 then show that risk-tolerant managers are more likely to be offered high-powered incentives. The estimates of η^R are positive and significantly different from zero at conventional levels. The coefficient estimated in column 2 implies that a one standard deviation increase in the index is associated with a 1.75 increase in the risk preference measure, or 10% of a standard deviation of the risk tolerance measure. This result is robust to adding as a control a measure of manager compensation, thus making certain that the correlation with the power of incentives does not just reflect a correlation of the latter with income.

It is important to note that the interpretation of the findings is qualitatively unaffected if our measure captures the manager's risk attitudes when he/she takes a decision on behalf of his/her firm instead of his/her individual risk aversion parameter γ_j . If so, our measure effectively captures $b^i \gamma_j$, namely, the portion of the risk taken by the firm that goes to the manager through his/her incentive scheme. Note that the finding that $b^i \gamma_j$ is smaller when b^i is higher implies a fortiori that γ_j is smaller when b^i is higher.³⁵

³⁴ On average, managers have 6.6 years of tenure (standard deviation is 3.6). Seniority is characteristic of the standardized managerial contract. In our sample, 7% have a lower-management contract, 72% a middle-management contract, and 21% an upper-management contract. Only 2.5% of our sample managers belong to the family who owns the firm. Finally, by construction, managers are equally split between the three operational areas.

³⁵ The results shown in cols. 1 and 2 of table 2 are robust to the use of the other two measures of risk tolerance discussed in footnote 30. One standard deviation increase in the incentive index is associated with a 0.17 increase in the variable measuring risk aversion using the manager's own account of the risks he/she takes on behalf of the firm, or 10% of its standard deviation. Similar results are found when we proxy R_i with the manager's desired share of variable pay.

Table 2
Incentives, Manager Risk Preferences, and Manager Talent

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Risk: Individual Preference		Manager College Degree (= 1 if Yes)		Manager Executive Education (= 1 if Yes)		Desirability (= 1 if Manager Has Received Job Offers in Past 3 Years)	
Incentive index	.868** (.423)	.989** (.481)	.045*** (.012)	.043*** (.013)	.060*** (.011)	.050*** (.013)	.050*** (.010)	.043*** (.012)
Risk: individual preference			.001 (.001)	.001 (.001)	.001 (.001)	.001 (.001)	.002*** (.001)	.002** (.001)
MNE		-.157 (1.852)		-.013 (.047)		.118** (.048)		.014 (.044)
50-100 employees		-.686 (2.187)		.060 (.060)		.098 (.061)		-.003 (.057)
100+ employees		2.407 (2.200)		.100* (.052)		.117** (.051)		.063 (.045)
Constant	18.141*** (1.317)	14.132* (8.152)	.360*** (.040)	.301 (.300)	.380*** (.040)	.072 (.381)	.532*** (.038)	1.440*** (.317)
Controls	No	Yes	No	Yes	No	Yes	No	Yes

NOTE.—Number of observations = 603. Controls include the manager's seniority level, whether he/she belongs to the owner family, his/her tenure and category (general administration, finance, sales), indicators for the firm's SIC 2 codes, duration of the interview, and interviewer dummies. Risk preference is the probability of failure the manager is willing to bear to choose a risky investment project that yields €10 million if successful and €0 if not, instead of a safe project that yields €1 million with certainty. MNE = multinational enterprise. Robust standard errors are in parentheses.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

The second part of implication 1 indicates that, conditional on risk aversion, high-powered incentives attract more talented managers. To test this, in table 2, columns 3–8, we estimate the conditional correlation:

$$T_i = \eta^T I_j + \lambda^T R_i + X_j \zeta^T + Y_i \sigma^T + \epsilon_{ij}^T, \quad (2)$$

where T_i are measures of the manager's talent, R_i is the measure of the manager's own risk tolerance, and all the other variables are defined above. The findings provide broad support for the prediction that "better" managers are attracted by steep incentives. For all our measures of talent, η^T is positive and significantly different from zero at conventional levels. Namely, managers who work under high-powered incentives are more likely to have a college degree, to have attained executive education, and to be "desirable," defined as having received job offers from other firms in the last 3 years. Using the estimates with the full set of controls, we find that one standard deviation increase in the incentive index increases the probability that the manager has a college degree by 0.08 (16% of the unconditional mean), that he/she has an executive education degree by 0.10 (18% of the mean), and that he/she has received outside offers by 0.08 (17% of the mean). Finally, we note that there is a positive correlation between firm size and managerial talent: larger firms are more likely to hire more skilled managers. This is in line with the prediction of a large class of manager-firm matching models, from Lucas (1978) to Rosen (1982) to Terviö (2008).

B. Incentives and Managers' Outcomes

Implication 2 links the firms' incentive policies to managers' effort, pay, and job satisfaction. It predicts that, holding constant their risk tolerance, managers who are offered steeper incentives work harder, receive higher fixed and variable pay, and have higher utility. To provide evidence on this, table 3 reports estimates of the conditional correlation:

$$O_i = \eta^O I_j + \lambda^O R_i + X_j \zeta^O + Y_i \sigma^O + \epsilon_{ij}^O, \quad (3)$$

where O_i are measures of manager outcomes and all the other variables are defined above. Proxying effort by hours worked, columns 1 and 2 show that managers who are offered steeper incentives work longer hours. The estimate of η^O is positive and statistically and economically significant. One standard deviation increase in the incentive index is associated with a 0.06 increase in the probability that the manager works more than 60 hours per week, which corresponds to 16% of the sample mean.

Columns 3–6 of table 3 show that managers who are offered steeper incentives receive higher fixed and variable pay. The estimates of η^O with the full set of firm and manager controls indicate that one standard deviation increase in the incentive index is associated with an increase of €2,900 in fixed pay and an even larger amount of €4,375 in variable pay. These

**Table 3
Incentives and Manager Behavior**

	Works More than 60 Hours per Week		ln(Fixed Pay)		ln(1+Variable Pay)		Number of Benefits		Job Satisfaction (= 1 If Very Happy)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Incentive index	.036*** (.011)	.035*** (.013)	.025*** (.007)	.019** (.008)	.328*** (.028)	.306*** (.032)	.160*** (.031)	.136*** (.036)	.030*** (.011)	.035*** (.013)
Risk: individual preference	-.000 (.001)	-.000 (.001)	.001 (.001)	.001** (.001)	.008*** (.003)	.007** (.003)	.002 (.003)	.002 (.003)	.001 (.001)	.000 (.001)
MINE		-.060 (.045)		.014 (.027)		.507*** (.130)		.208 (.129)		-.020 (.049)
50-100 employees		-.042 (.059)		.074** (.036)		.241 (.163)		.093 (.155)		-.028 (.060)
100+ employees		.093* (.050)		.093*** (.030)		.181 (.134)		.056 (.138)		-.034 (.054)
Constant	.285*** (.039)	-.263 (.259)	.512*** (.025)	-.190 (.172)	-2.882*** (.107)	-4.896*** (.957)	3.745*** (.110)	7.099*** (.862)	.401*** (.041)	1.498*** (.359)
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes

NOTE.—Number of observations = 603. Controls include the manager's seniority level, whether he/she belongs to the owner family, his/her tenure and category (general administration, finance, sales), indicators for the firm's SIC 2 codes, duration of the interview, and interviewer dummies. Risk preference is the probability of failure the manager is willing to bear to choose a risky investment project that yields €10 million if successful and €0 if not, instead of a safe project that yields €1 million with certainty. MINE = multinational enterprise. Robust standard errors are in parentheses.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

correspond to 10% and 25% of one standard deviation in fixed and variable pay, respectively. In line with the predictions of Zabojsnik and Bernhardt (2001), we find that fixed pay is positively correlated with firm size.

Managers who are offered steeper incentives also receive a larger number of job benefits. The estimates in column 8 of table 3 imply that one standard deviation increase in the incentive index is associated with 0.24 more benefits, equal to 17% of a standard deviation of the number of benefits in the sample.

Finally, to measure the managers' level of utility, we ask them to report their level of satisfaction on the job. Only 5% report to be unsatisfied, while 45% are satisfied and 50% are very satisfied. Columns 9 and 10 show that managers who are offered steeper incentives feel happier. According to the estimate in column 10, one standard deviation increase in the incentive index is associated with a 0.06 increase in the probability that the manager reports to be very satisfied, which is as large as 12% of the sample mean.

C. Firm Ownership and Incentives

Implication 3 predicts that firms attaching a higher weight to direct control (F -firms in our notation) will tend to offer a weaker link between reward and performance than N -firms. We exploit the difference between family firms and firms owned by disperse shareholders to proxy for the F -firms and N -firms described in our model. In particular, our key assumption is that families put more weight on direct control than shareholders of widely-held firms, such that $\phi_F < \phi_N$.

This choice is rooted in the family firms literature (discussed in the Introduction), which documents how family-owners often perceive the firm as an opportunity to address family issues and frictions. In this context, owners attribute a value to the firm as an "amenities provider," even though the provision of such amenities might not be profit maximizing (Kets de Vries 1993). Alternatively, since the boundaries of the firm and those of the family are less clearly defined in family firms, the transfer of these amenities from the firm to the family is more efficient in family firms, and thus more of these amenities are transferred. In either case, $\phi_F < \phi_N$.

Unconditionally we find that family firms do offer a weaker link between reward and performance than dispersed shareholders firms. Family firms are less likely to offer bonuses based on individual performance (44% vs. 57%), to have promotion fast tracks (32% vs. 41%), and to have dismissed managers for failure to meet performance targets (3% vs. 6%). Family firms are also less likely to award bonuses, decide on promotions, and fire employees through a formal appraisal process, and in all cases the gap between the two types of firms is not only statistically significant (see the last column) but also substantial. Only performance seems to matter for promotions regardless of ownership.

In table 4, we test whether these differences are robust to controlling for a rich set of manager and firm characteristics, which might create a

Table 4
Firm Ownership and Personnel Policies

	Incentive Index		Bonus Index		Promotions Index		Dismissal Index	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Family or founder ownership	-.640*** (.164)	-.527*** (.186)	-.272*** (.072)	-.178** (.084)	-.250*** (.087)	-.197** (.100)	-.118** (.047)	-.152*** (.055)
Other ownership	-.203 (.194)	-.240 (.216)	-.063 (.085)	-.051 (.097)	-.118 (.103)	-.109 (.116)	-.021 (.056)	-.080 (.064)
MNE		.836*** (.159)		.417*** (.072)		.309*** (.086)		.110*** (.047)
50–100 employees		-.220 (.199)		-.060 (.090)		-.059 (.107)		-.102* (.059)
100+ employees		-.035 (.172)		.018 (.077)		.027 (.092)		-.080 (.050)
Constant	2.910*** (.129)	.196 (2.556)	.978*** (.056)	-.303 (1.149)	1.590*** (.068)	.346 (1.375)	.343*** (.037)	.153 (.752)
Controls	No	Yes	No	Yes	No	Yes	No	Yes

NOTE.—Number of observations = 603. The incentive index is the sum of all seven incentive policies listed in panel B, table 1. The bonus index is the sum of bonus1 and bonus2, as defined in table 1. The promotions index is the sum of promotion1, promotion2, and promotion3. The dismissal index is the sum of firing1 and firing2. Controls include the manager's seniority level, whether he/she belongs to the owner family, his/her tenure and category (general administration, finance, sales), indicators for the firm's SIC 2 codes, duration of the interview, and interviewer dummies. MNE = multinational enterprise. Robust standard errors are in parentheses.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

spurious correlation between firm ownership and incentive policies. We estimate the conditional correlation:

$$P_{ij} = \alpha^F D_j^F + \alpha^O D_j^O + X_j \beta + Y_i \delta + \varepsilon_{ij}, \quad (4)$$

where P_{ij} are the different incentive policies adopted by firm j as reported by manager i ; $D_j^F = 1$ if firm j belongs to its founder or a family, and 0 otherwise; and $D_j^O = 1$ if the firm belongs to the government, a cooperative, or its managers, and 0 otherwise. The coefficient of interest is α^F , namely, the difference in incentive policies between family-owned and dispersedly-owned firms, and X_j and Y_i are the vectors of firm, manager, and interview controls defined above.

Table 4 shows that the difference in personnel policies between family firms and firms owned by dispersed shareholders are robust to the inclusion of this rich set of controls. The first two columns estimate (4) for the aggregate index built as the sum of all seven policy measures. Both in columns 1 and 2, α^F is negative and significantly different from zero at conventional levels. The magnitude of the coefficient indicates that the differences between family and dispersed-shareholder firms are large: with the full set of controls, the incentive index is 0.51 points smaller in family compared to dispersedly-owned firms. This difference amounts to 18% of the sample mean and 30% of a standard deviation of the incentive index. The remaining columns estimate (4) for the three subcomponents of the index: bonuses, promotions, and dismissals. Throughout, α^F is negative and significantly different from zero at conventional levels, indicating that family firms choose low-powered incentives on all dimensions.

Table 4 also shows that high-powered incentives are more likely to be offered by firms that are part of multinational corporations. None of the other controls are correlated with incentive policies. Namely, the strength of incentives is not correlated with firm size or industry sector or with the managers' tenure, seniority, and operational area.³⁶

³⁶ The lack of correlation between the steepness of the incentive scheme and firm size is at odds with the findings reported in Schaefer (1998), which shows that the incentives of US CEOs fall in strength roughly with the square root of firm size. There are many possible reasons behind this discrepancy. First, it is important to emphasize that the two papers follow different approaches in measuring the strengths of incentives faced by managers. While this paper infers it from an index that captures the number and type of incentive tools used by the firm, Schaefer (1998) directly estimates the sensitivity of total manager's pay with his performance using CEO pay data. While the former approach is consistent with existing contributions in the personnel economics literature (e.g., Bloom and Van Reenen 2007), the latter approach is standard in the literature on incentive compensation. Second, Schaefer (1998) is based on a sample of very large (with assets worth \$3,775 million on average) and listed US firms, while we look at much smaller firms (\$3.3 million in assets on average and only 1.4% listed on the stock market). Third, our size measures

While the findings are consistent with implication 3, and hence with the assumption that family firms put more weight on the “amenity value” of control, ε_{ij} contains all other unobservable characteristics that differ by ownership and could be driving the results. For instance, family firms might have better monitoring technology and hence less need to offer performance incentives. We will discuss this and other alternative explanations in Section VI.

D. Incentives and Firm Outcomes

The final step of our analysis presents evidence on implication 4, which suggests a positive correlation between incentive policies and firm performance. Although, as previously stated, our data do not allow us to identify a causal relationship, we are nevertheless interested in establishing whether the data are consistent with this model prediction.

In table 5, we estimate the conditional correlation over a repeated cross section:

$$Z_{jt} = \theta I_j + X_{jt} \vartheta + \kappa_t + \omega_{jt}, \quad (5)$$

where Z_{jt} measures the performance of firm j in year t , κ_t are year fixed effects, and all other variables are as defined above. We consider three alternative measures of firm performance: (a) labor productivity (log of sales/employees), (b) profits per employee, and (c) return on capital employed, all measured yearly for the period 2004–7. To account for the fact that error terms ω_{jt} are correlated within firms across years, we cluster the standard errors at the firm level. Firm performance measures are obtained by matching our survey data with Amadeus, an extensive accounting database covering more than 9 million public and private companies across Europe, of which approximately 580,000 are in Italy.³⁷ Once we clean the

(dummies for the average number of employees in the firm) might simply be too rough to estimate the effects reported by Schaefer. Fourth, and perhaps more important, Schaefer focuses exclusively on CEOs and top managers, while our sample also includes managers lower down the hierarchy. Interestingly, in spite of all the differences mentioned above, when we restrict the sample to the set of 126 managers who report to be “top managers” (i.e., reporting directly to CEOs), we find some evidence that the incentive index decreases with firm size. In fact, when we repeat the regression shown in table 5, col. 2, relating the incentive index with firm ownership and firm characteristics, the coefficient (standard error) on the dummy denoting firms with 50–100 employees is -0.670 (0.690), and the coefficient (standard error) on the dummy denoting firms with 100 employees or more is -1.076 (0.584) (with the omitted category being firms with less than 50 employees). This finding is driven by all components of the incentive index, and in particular by the set of questions measuring the presence of monetary bonuses linked to individual performance and awarded through formal appraisal systems.

³⁷ To match the two data sets, we use the unique company identifier *Codice Cerved*.

Table 5
Incentives, Ownership, and Performance

	Ln(Sales/Employees) (1)	Profits/Employees (2)	ROCE (3)	Ln(Sales/Employees) (4)	Profits/Employees (5)	ROCE (6)
Incentive index	.044* (.023)	7.606** (3.717)	1.185** (.574)	.038* (.023)	7.287** (3.705)	1.225** (.575)
Family or founder ownership				-.221** (.100)	-15.406 (13.051)	.956 (2.191)
Other ownership				-.082 (.121)	-26.486* (14.816)	-1.239 (2.993)
MNE	.059 (.080)	12.536 (10.578)	-3.074* (1.764)	-.011 (.083)	8.677 (10.634)	-2.709 (1.817)
50–100 employees	.153 (.108)	42.616*** (13.162)	6.934*** (2.334)	.154 (.108)	43.345*** (13.133)	6.969*** (2.328)
100+ employees	.746*** (.119)	77.305*** (19.358)	5.461** (2.427)	.727*** (.118)	77.194*** (19.311)	5.629** (2.436)
Constant	8.827*** (.365)	65.308 (50.027)	-12.018 (7.626)	8.911*** (.356)	65.505 (50.376)	-11.970 (7.833)
No. of observations	1,813	1,851	1,792	1,813	1,851	1,792
No. of firms	557	568	567	557	568	567
Controls	Yes	Yes	Yes	Yes	Yes	Yes

NOTE.—The number of observations varies due to the different availability of the performance measures. In all columns, we drop the top and bottom 1% firms ranked by performance. Controls include indicators for the firm's SIC 2 codes, duration of the interview, and interviewer dummies. ROCE is defined as operating income over capital employed. MNE = multinational enterprise. Robust standard errors clustered at the firm level are in parentheses.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

accounting data, dropping the first and the bottom percentiles of the performance variables and taking into account missing observations for some items, we end up with a sample of 554 observations.³⁸

The estimation results are reported in table 5. Two points are worth noting. First, the incentive index carries a positive coefficient significant at conventional levels for all measures of productivity. A one standard deviation increase in the incentive index is associated with a 5%, 8%, and 9% of a standard deviation increase of log-productivity, profits, and return on capital, respectively. Second, this finding is robust to controlling for ownership structure; namely, it is not merely due to the incentive index capturing systematic differences in performance directly due to different ownership structures. The estimates of the coefficient on family ownership is negative throughout but only precisely estimated for labor productivity. Thus, once differences in the power of incentives are accounted for, we find no evidence of a systematic difference in profits between family and shareholder owned firms, a feature itself in line with the implications of our model with endogenous firm entry.

VI. Robustness and Alternative Interpretations

A. Unobserved Heterogeneity in Manager Characteristics

The residuals in (1), (2), and (3) contain unobservable manager characteristics that can generate a spurious correlation between the incentive index and the outcome of interest. This concern is particularly serious in survey data because unobservable psychological characteristics of the respondent may lead to systematic misreporting. For instance, managers who are more self-confident might be more likely to overestimate their control over their pay; hence, they are more likely to report facing high-powered incentives and at the same time more likely to take risks and to overestimate their earnings. Unobservable self-confidence could therefore generate a spurious correlation between incentive power and risk tolerance and between incentive power and earnings.

We note that this concern is relevant for all the findings that rely on self-reported measures on the left-hand and right-hand side of the equation, namely, those in tables 2 and 3. Findings that rely on variation in firm ownership or performance (tables 4 and 5) are unaffected as these are not subject to reporting bias.

We can probe the robustness of our survey data directly using social security records that contain detailed information on the managers' pay and occupation since the beginning of their careers. Hence, we can estimate (3) using the social security administrative earnings data that are not affected by perception errors or other managers' unobservable traits, which

³⁸ The results are qualitatively similar without these cleaning procedures.

could in turn contaminate self-reported variables. Table 6 reports the estimates of

$$Q_i = \varphi I_j + \lambda^Q R_i + Y_i \psi + \zeta_i, \quad (6)$$

where Q_i is the logarithm of manager i 's pay, R_i is the measure of the manager's own risk tolerance, and the vector of controls Y_i includes the manager's seniority level, whether he/she belongs to the owner family, his/her tenure in the current firm, firm category (general administration, finance, sales), overall tenure since his/her first job, the number of firms he/she has worked for, the average number of weeks worked in a year, duration of the interview, and interviewer dummies. For comparison, columns 1 and 2 table 6 report the estimate of (6) using pay data from the survey, whereas in columns 3 and 4, we use pay data from the social security records. Throughout, φ is positive and precisely estimated. Moreover, the estimates of φ obtained with our survey data or with the social security records are quantitatively similar, reassuring us directly on the reliability of our survey earnings and indirectly on our incentive index.

Since the social security records contain information on the managers' entire careers, we can further refine the evidence that incentive policies are matched to the managers' type by regressing managerial pay in previous jobs on current incentives. Under the plausible assumption that managers' risk attitudes and ability are stable traits, one should find that a given manager matches with firms that offer similar types of incentive contracts. Consistent with this, columns 5 and 6 show that managers who currently face high-powered incentives had higher levels of pay throughout their career.

Furthermore, while the social security records do not contain information on the managers' risk preferences, they allow us to measure earnings variability, which, by revealed preference, is an indicator of the risk the manager is willing to bear. To provide further evidence on the validity of our incentive measure, we exploit the time variation in earnings in the social security records and test whether high-powered incentives result in a higher earnings variability, as they should if the managers who face steep incentives bear more risk in equilibrium.³⁹ We estimate the same specification as in (6) with the standard deviation of yearly pay computed over the managers' time at the firm on the left-hand side. Columns 7–10 show that earnings variability and the power of incentives are correlated:

³⁹ In our model, earnings variability can be computed directly. The realized wage variance is

$$\text{Var}(w) = \text{Var}(b^i y_i) = (b^i)^2 \sigma^2.$$

Hence, the realized standard deviation is linear in the power of the incentive contract faced by the manager.

Table 6
Incentives and Managerial Pay (Social Security Data)

Statistics computed over . . .	Dependent Variable											
	ln(Pay) Survey Data					ln(Pay) INPS Records					ln(Standard Deviation Pay)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)		
	Current firm	Current firm	Current firm—last available year	Current firm—last available year	Average over past jobs	Average over past jobs	Current firm	Current firm	Average over past jobs	Average over past jobs		
Incentive index	.026*** (.007)	.028*** (.008)	.038*** (.012)	.033*** (.012)	.046*** (.015)	.037** (.015)	.070*** (.021)	.055** (.025)	.059** (.023)	.062*** (.029)		
Risk: individual preference	.001 (.001)	.001** (.001)	.001 (.001)	.002** (.001)	.002 (.001)	.000 (.001)	.000 (.002)	.001 (.002)	-.000 (.002)	-.002 (.002)		
MNE	-.006 (.028)	-.006 (.028)	.066 (.040)	.066 (.040)	.101* (.056)	.101* (.056)	.035 (.092)	.035 (.092)	.031 (.094)	.031 (.094)		
50–100 employees	.072** (.035)	.072** (.035)	.060 (.051)	.060 (.051)	.043 (.075)	.043 (.075)	.064 (.115)	.064 (.115)	.022 (.118)	.022 (.118)		
100+ employees	.090*** (.031)	.090*** (.031)	-.004 (.043)	-.004 (.043)	.042 (.057)	.042 (.057)	.045 (.099)	.045 (.099)	.072 (.103)	.072 (.103)		
Constant	.510*** (.026)	.288 (.266)	.149*** (.040)	-.900*** (.295)	-.833*** (.052)	-1.279*** (.421)	5.631*** (.074)	4.682*** (.848)	4.930*** (.079)	5.040*** (.958)		
No. of observations	573	573	573	573	528	528	420	420	466	466		
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes		

NOTE.—The number of observations is smaller due to missing values in the social security records. The last available year is 2004 for 75% of the sample, 2005 for 2.5%, 2006 for 2.5%, and 2007 for the remaining 20%. The average compensation in cols. 5 and 6 is computed over all years and firms the manager has worked for (including nonmanagerial positions). The standard deviation in cols. 7 and 8 is computed over the years worked in the current firm. The dependent variable in cols. 9 and 10 is computed as the mean of the standard deviations of yearly earnings in all the firms the manager has worked for. All standard deviations are computed only if the manager has worked for at least 3 years in the same firm. Controls include the manager's seniority level, whether he/she belongs to the owner family of the current firm, his/her tenure in the current firm and category (general administration, finance, sales), overall tenure since his/her first job, the number of firms he/she has worked for, and the average number of weeks worked in a year, duration of the interview, and interviewer dummies. MNE = multinational enterprise. Robust standard errors are in parentheses.

* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.

managers hired by firms that offer high-powered incentives face more earnings variability and have done so throughout their careers. This is additional evidence in support of our matching model: throughout his/her career, a bold, talented manager tends to be matched with firms that offer steep incentives.

Another potential concern is that our risk aversion measure is correlated with other unobservable personal characteristics, which in turn may determine matching and incentive preferences. While this hypothesis cannot be verified within our data set, we can explore this question using another survey of 2,295 Italian entrepreneurs and managers, which is focused on the measurement of risk aversion (measured in the very same way used in this paper) and its link with other managerial characteristics (Guiso and Rustichini 2011). In line with our results, risk aversion is not statistically correlated with measures of cognitive ability. Reassuringly, the risk aversion measure is also not statistically correlated with managerial personality traits that could affect the matching process, such as optimism, confidence, and the ability to sustain effort. On the other hand, we find evidence that our risk aversion measure is correlated with actual risk-taking behavior of managers outside their work environment. Appendix B discusses data and results of the external validation analysis in more detail.

A final cause for concern is that the incentive structure faced by an individual manager might not be representative of all managers in the firm. Two points are of note. First, to the extent that different managers within the same firm face different incentive structures, so that the structure reported by the managers we interview is a noisy proxy for the firms' "average" policy, all correlations between the incentive index and firm-level variables (ownership and performance) are biased downward because of measurement error. Second, managers can only report about their own incentives on dimensions they have experienced, that is, bonuses and promotions. Their report on dismissal policies, however, must reflect the firm's average practices as the managers themselves have not been dismissed by the current firm. The fact that our findings are robust to using only the dismissal dimension provides reassurance on the practical relevance of this concern.

B. Alternative Interpretations

Taken together our findings are consistent with the rich set of equilibrium correlations suggested by the model outlined in Section III. Incentive policies are correlated with the type of managers hired in equilibrium: the strength of incentives is positively correlated with the managers' risk tolerance and with their talent. Incentive policies are also correlated with managers' effort, their compensation package, and their utility: managers who face stronger incentives work harder, receive higher fixed and variable

pay, and (not obviously) are happier. Ownership type is correlated with incentive policies: compared to firms owned by disperse shareholders, family firms offer lower-powered incentives. Finally, stronger incentives are positively correlated with firm performance.

Although some of these results have already been observed in isolation in previous work, this is the first time that specific personnel policies are analyzed in conjunction with such a rich array of firm and manager characteristics. Compared to prior studies, this gives us the unique opportunity to explore the validity of alternative theories that have been proposed in the past, especially with regard to the understanding of the difference between family firms and other types of ownership.

For example, similarly to what we show in table 4, Bloom and Van Reenen (2007) report that family-owned firms are less likely to adopt “modern” management practices, which include basic practices related to the provision of performance incentives and the adoption of practices that promote and dismiss workers based on their performance. The absence of detailed information on workers’ effort and characteristics, however, complicates the interpretation of this finding. First, family firms may have better monitoring technology and hence less need to offer explicit performance incentives (Roe 2003; Mueller and Philippon 2006). This would explain the observed correlation between ownership and incentives. A related hypothesis is that family firms may have access to other technologies to motivate managers, for example, nontaxable benefits, and hence do not need to offer explicit monetary incentives to reward performance, so that effective performance is better rewarded even if incentives are low.

Having data on all sides of the match, we are able to show that both hypotheses—the family firm advantage in monitoring and motivating their employees—are actually not supported by the data. For example, if family firms were better at monitoring their employees, this would imply a comparative advantage in incentive provision, which in turn would lead to three conclusions, which are all falsified in the data. First, managers who face better monitoring should work harder. To the extent that hours worked are a proxy for effort, the estimates of (3) indicate that the opposite is true: managers who face weaker explicit incentives work less hard.⁴⁰ Second, better monitoring implies higher productivity. In a competitive labor market, where firms are competing to hire managers, more productive managers should be paid more. The findings suggest that the opposite is true: both fixed and variable pay are lower in family firms. Third, if effort and talent are complements in the production function (as it is standard to assume), a comparative advantage in monitoring should

⁴⁰ Of course, one can always argue that the number of hours and weekends worked is not a good proxy for effort.

translate into a comparative advantage in employing talented managers. But the estimates of (2) suggest the opposite: managers who face stronger incentives are more talented. Similarly, if family firms were better at motivating their employees, we should observe low-powered incentives to be correlated with higher managerial talent and effort. The estimates of (2) and (3) indicate the opposite.

As a further check, we investigate whether family firms might offer flatter incentives as they happen to be in sectors where managerial effort is less relevant. To shed light on this hypothesis we estimate (4) without industry controls, then with SIC2 industry codes, and finally with SIC3 industry codes. The estimated coefficient of family ownership in the three specifications is $-.57$, $-.53$, and $-.59$, significantly different from zero at the 5% level. The fact that the estimated coefficient of family ownership remains constant as we add increasingly fine industry controls rules out the possibility that family-owned and widely-held firms sort into different sectors. While it remains possible that firms sort within each three-digit industry, for instance, different types of beauty salons or dry cleaners, the extent to which the returns to managerial effort can differ within such narrowly defined groups is likely to be limited.

VII. Conclusions

Personnel economics models produce an array of testable predictions on how workers and firms match, how firm characteristics drive incentive schemes, how incentives determine worker behavior, and how worker behavior determines firm performance. Due to data limitations, previous empirical work focused on individual predictions.

This paper has explored the potential of utilizing integrated personnel data, combining information about the worker's characteristics, the firm's characteristics, and the terms of the (implicit and explicit) contract linking the worker and the firm. A wide array of empirical regularities can be accounted for by a simple model where incentives and matches are endogenously determined.

The combination of novel and comprehensive data and a simple theory that features widely shared heterogeneity in firms' governance has allowed us to make progress along two lines. First, we showed the key relevance of a manager's willingness to bear risk as well as talent as key factors in driving matching with firms. Highly talented and risk-tolerant managers tend to match with firms that value these characteristics the most. Second, we offered a unified account of several findings in the literature treated so far in isolation and sometimes thought to be independent instead of stemming from the same problem.

Appendix A

Formal Result and Proofs

The entire model presented in Section III yields the following equilibrium characterization.⁴¹

Proposition 1

Suppose that $\bar{\gamma}$ is sufficiently small. In equilibrium, N -firms and F -firms use contracts with slopes

$$\hat{b}_N(\gamma_j) = \frac{\phi_N}{1 + \gamma_j \sigma^2}.$$

$$\hat{b}_F(\gamma_j) = \frac{\phi_F}{1 + \gamma_j \sigma^2}.$$

Manager j is matched with an N -firm if and only if

$$\theta_j \geq \frac{2(\pi_N - \pi_F)}{\phi_N^2 - \phi_F^2} (1 + \gamma_j \sigma^2), \tag{A1}$$

and, if not, he/she is matched with an F -firm if and only if

$$\theta_j \geq \frac{2\pi_F}{\phi_F^2} (1 + \gamma_j \sigma^2), \tag{A2}$$

where

$$\pi_F = \frac{\phi_F^2(2 + \bar{\gamma}\sigma^2)\bar{\gamma}\bar{\theta}\bar{\gamma}}{D},$$

$$\pi_N = \frac{\phi_N^2(2 + \bar{\gamma}\sigma^2)\bar{\gamma} + \phi_F^2(\phi_N^2 - \phi_F^2)\bar{\theta}\bar{\gamma}}{D},$$

with

$$D = (\phi_F^2 + \phi_N^2)(2 + \bar{\gamma}\sigma^2)\bar{\gamma} + (2 + \bar{\gamma}\sigma^2)^2\bar{\gamma}^2 + \phi_F^2(\phi_N^2 - \phi_F^2).$$

Equation (A1) is the condition that determines the boundary between the N -region and the F -region. Similarly, (A2) describes the boundary between the F -region and the unemployment region. The proposition also provides precise expressions for the management-related equilibrium payoffs π_F and π_N , which in turn pin down the region boundaries. It is immediately visible that the management-related payoff is greater in N -firms

⁴¹ The technical condition that $\bar{\gamma}$ is sufficiently small (i.e., there is more heterogeneity in talent than in risk aversion) guarantees that the regions depicted in fig. 1 are trapezoids rather than triangles. If the condition fails, one would have a different characterization but with similar properties.

than in F -firms, which, as we discussed above, is due to the comparative advantage that N -firms have when it comes to incentive provision.

The proof of proposition 1 follows the informal discussion above, with the addition of a somewhat laborious computation of the actual fixed point of the matching problem.

Proof of Proposition 1

Given the CARA assumption, if w is normally distributed, the manager's expected payoff can be written as

$$E[u] = E[w] - \frac{1}{2}\gamma V[w] - \frac{1}{2}x^2.$$

Given a and b , the manager chooses x to maximize $E(u)$:

$$\begin{aligned} \hat{x} &= \arg \max_x E[w] - \frac{1}{2}\gamma V[w] - \frac{1}{2}x^2 \\ &= \arg \max_x a + bE[y] - \frac{1}{2}b^2\gamma V[y] - \frac{1}{2}x^2 \\ &= \arg \max_x a + bE[\sqrt{\theta_j}(x + \varepsilon)] - \frac{1}{2}b^2\gamma V[\sqrt{\theta_j}(x + \varepsilon)] - \frac{1}{2}x^2 \\ &= \arg \max_x a + b\sqrt{\theta_j}x - \frac{1}{2}b^2\gamma\theta_j\sigma^2 - \frac{1}{2}x^2. \end{aligned}$$

The first-order condition on x yields

$$\hat{x}_j = b^i \sqrt{\theta_j}.$$

The manager's expected payoff is, hence,

$$\begin{aligned} E[U_j] &= a^i + b^i \sqrt{\theta_j} \hat{x}_j - \frac{1}{2}(b^i)^2 \gamma_j \theta_j \sigma^2 - \frac{1}{2} \hat{x}_j^2 \\ &= a^i + (b^i)^2 \theta_j - \frac{1}{2}(b^i)^2 \gamma \theta_j \sigma^2 - \frac{1}{2}(b^i)^2 \theta_j. \end{aligned}$$

The expected payoff for a firm that employs manager j at wage (a, b) is

$$\begin{aligned} E[V^i] &= E[y_j - w_j^i + b^s - k^i] + (1 - \phi_g)(\Gamma - b^i \theta_j) \\ &= b^i \theta_j - a^i - (b^i)^2 \theta_j + b^s - k^i + (1 - \phi_g)(\Gamma - b^i \theta_j). \end{aligned}$$

Let $S_j^i = E[U_j] + E[V^i]$ denote the total surplus generated by the match between firm i and manager j . As the fixed component can be used to distribute the surplus between the firm and the worker, it is easy to see that the firm will always want to maximize surplus and pay the manager his/her reservation wage (determined in equilibrium by what he/she could get if he/she worked for another firm).

The surplus is

$$S_j^i = E[U_j] + E[V^i] \\ = \left(\phi_g b^i - \frac{1}{2}(1 + \gamma\sigma^2)(b^i)^2 \right) \theta_j + (b^g - k^i + (1 - \phi_g)\Gamma).$$

Differentiating the surplus function with respect to b^i , we obtain the optimal contract slope:

$$b^i = \frac{\phi_g}{1 + \gamma_j\sigma^2}.$$

Hence, the maximal surplus is

$$S_j^i = \left(\phi_g \frac{\phi_g}{1 + \gamma_j\sigma^2} - \frac{1}{2}(1 + \gamma_j\sigma^2) \left(\frac{\phi_g}{1 + \gamma_j\sigma^2} \right)^2 \right) \theta_j + (b^g - k^i + (1 - \phi_g)\Gamma) \\ = \frac{1}{2} \frac{\phi_g^2}{1 + \gamma_j\sigma^2} \theta_j + (b^g - k^i + (1 - \phi_g)\Gamma).$$

Restrict attention to the first term of S_j^i , which can be thought of as the management-related component of the match surplus. It depends on ϕ_g . We let

$$S_F(\theta_j, \gamma_j) = \frac{1}{2} \frac{\phi_F^2}{1 + \gamma_j\sigma^2} \theta_j, \\ S_N(\theta_j, \gamma_j) = \frac{1}{2} \frac{\phi_N^2}{1 + \gamma_j\sigma^2} \theta_j.$$

Next we examine match stability. Note that for all θ_j and γ_j ,

$$S_N(\theta_j, \gamma_j) > S_F(\theta_j, \gamma_j).$$

Also, given $\theta_j \geq \theta_k$ and $\gamma_j \leq \gamma_k$ (with at least a strict inequality), the following three inequalities hold:

$$S_N(\theta_j, \gamma_j) > S_N(\theta_k, \gamma_k), \\ S_F(\theta_j, \gamma_j) > S_F(\theta_k, \gamma_k), \\ S_N(\theta_j, \gamma_j) - S_F(\theta_j, \gamma_j) > S_N(\theta_k, \gamma_k) - S_F(\theta_k, \gamma_k).$$

Given two managers j and k with $\theta_j > \theta_k$ and $\gamma_j < \gamma_k$, the following three statements are always false (because they contradict, respectively, one of the three inequalities just stated—a new match could be formed with a higher surplus):

- Manager k works for an N -firm and manager j is unemployed.
- Manager k works for an F -firm and manager j is unemployed.
- Manager k works for an N -firm and manager j works for an F -firm.

This restricts the shape of the regions of manager types that work for N , F , or are unemployed. It is easy to see that if $\bar{\gamma}$ is sufficiently small, the regions must be trapezoids, as in figure 1.

Note that we can write

$$S_F(\theta_j, \gamma_j) = E[U_j] + \phi_F b^i \theta_j - a^i - (b^i)^2 \theta_j,$$

$$S_N(\theta_j, \gamma_j) = E[U_j] + \phi_N b^i \theta_j - a^i - (b^i)^2 \theta_j.$$

Perfect competition among firms means that all F -firms must have the same management-related payoff:

$$\pi_F = \phi_F b^i \theta_j - a^i - (b^i)^2 \theta_j,$$

and all N -firms must have the same management-related payoff

$$\pi_N = \phi_N b^i \theta_j - a^i - (b^i)^2 \theta_j.$$

A manager j who is employed by an F -firm receives expected utility

$$u_j = S_F(\theta_j, \gamma_j) - \pi_F,$$

and every manager j that is employed by an N -firm receives utility

$$u_j = S_N(\theta_j, \gamma_j) - \pi_N.$$

The managers on the line that separates the F region from the unemployment region receive their outside option: zero. Hence, all the surplus goes to the firm

$$S_F(\theta_j, \gamma_j) = \pi_F.$$

The managers on the line that separates the F region and the N region are indifferent between working for an N -firm and an F -firm. Hence,

$$S_N(\theta_j, \gamma_j) - \pi_N = S_F(\theta_j, \gamma_j) - \pi_F.$$

These two indifference conditions can be applied to the extreme cases: $\gamma_j = 0$ and $\gamma_j = \bar{\gamma}$, yielding

$$\begin{aligned}
 S_F(t_F, 0) &= \pi_F, \\
 S_F(s_F, \bar{\gamma}) &= \pi_F, \\
 S_N(t_N, 0) - S_F(t_N, 0) &= \pi_N - \pi_F, \\
 S_N(s_N, \bar{\gamma}) - S_F(s_N, \bar{\gamma}) &= \pi_N - \pi_F.
 \end{aligned}$$

We can rewrite the first four equations as

$$\begin{aligned}
 \frac{1}{2} \phi_F^2 t_F &= \pi_F, \\
 \frac{1}{2} \frac{\phi_F^2}{1 + \bar{\gamma}\sigma^2} s_F &= \pi_F, \\
 \frac{1}{2} \phi_N^2 t_N - \frac{1}{2} \phi_F^2 t_N &= \pi_N - \pi_F, \\
 \frac{1}{2} \frac{\phi_N^2}{1 + \bar{\gamma}\sigma^2} s_N - \frac{1}{2} \frac{\phi_F^2}{1 + \bar{\gamma}\sigma^2} s_N &= \pi_N - \pi_F.
 \end{aligned}$$

That is,

$$\begin{aligned}
 t_F &= \frac{2\pi_F}{\phi_F^2}, \\
 s_F &= \frac{2\pi_F}{\phi_F^2} (1 + \bar{\gamma}\sigma^2), \\
 t_N &= \frac{2(\pi_N - \pi_F)}{\phi_N^2 - \phi_F^2}, \\
 s_N &= \frac{2(\pi_N - \pi_F)}{\phi_N^2 - \phi_F^2} (1 + \bar{\gamma}\sigma^2).
 \end{aligned}$$

The area of the regions (trapezoids) correspond to the mass of firms in business. Hence,

$$\begin{aligned}
 \frac{(t_F + s_F)\bar{\gamma}}{2} &= \bar{\theta}\bar{\gamma} - n_F - n_N, \\
 \frac{(t_N + s_N)\bar{\gamma}}{2} &= \bar{\theta}\bar{\gamma} - n_N.
 \end{aligned}$$

Then

$$\frac{\pi_F}{\phi_F^2} (2 + \bar{\gamma}\sigma^2)\bar{\gamma} = \bar{\theta}\bar{\gamma} - n_N - n_F, \tag{A3}$$

$$\frac{\pi_N - \pi_F}{\phi_N^2 - \phi_F^2} (2 + \bar{\gamma}\sigma^2)\bar{\gamma} = \bar{\theta}\bar{\gamma} - n_N. \tag{A4}$$

Finally, the entry condition on F -firms implies that the expected payoff of the least profitable F -firm (let us call it \bar{i}) is zero:

$$\begin{aligned} E[V^i] &= E\left[\gamma_j - \omega_j^i + b_F - k^i\right] + (1 - \phi_F)(\Gamma_F - b^i\theta_j) \\ &= b^i\theta_j - a^i - (b^i)^2\theta_j + b_F - k^i + (1 - \phi_F)(\Gamma_F - b^i\theta_j) \\ &= \pi_F + b_F - k^{\bar{i}} + (1 - \phi_F)\Gamma_F = 0, \end{aligned}$$

implying

$$k^{\bar{i}} = \pi_F + b_F + (1 - \phi_F)\Gamma_F.$$

As there are $k^{\bar{i}}$ F -firms with a lower k , the mass of active F -firms is

$$n_F = \pi_F + b_F + (1 - \phi_F)\Gamma_F.$$

Similarly, the mass of active F -firms is

$$n_F = \pi_F.$$

Hence, (A3) and (A4) become

$$\begin{aligned} \pi_F(2 + \bar{\gamma}\sigma^2)\bar{\gamma} &= \phi_F^2(\bar{\theta}\bar{\gamma} - \pi_N + b_N + (1 - \phi_N)\Gamma - \pi_F - b_F - (1 - \phi_F)\Gamma), \\ (\pi_N - \pi_F)(2 + \bar{\gamma}\sigma^2)\bar{\gamma} &= (\phi_N^2 - \phi_F^2)(\bar{\theta}\bar{\gamma} - \pi_N). \end{aligned}$$

Let $G_F = b_F + (1 - \phi_F)\Gamma_F$, $H = (2 + \bar{\gamma}\sigma^2)\bar{\gamma}$, $F \equiv \phi_F^2$, and $N \equiv \phi_N^2 - \phi_F^2$. Then

$$\begin{aligned} \pi_F H &= F(\bar{\theta}\bar{\gamma} - \pi_N - \pi_F - G_F), \\ (\pi_N - \pi_F)H &= N(\bar{\theta}\bar{\gamma} - \pi_N), \end{aligned}$$

with solution

$$\begin{aligned} \pi_F &= F \frac{H\theta\gamma - (H + N)G_F}{2FH + FN + HN + H^2}, \\ \pi_N &= \frac{FH\theta\gamma + FN\theta\gamma + HN\theta\gamma - FHG_F}{2FH + FN + HN + H^2}, \end{aligned}$$

which can be written as

$$\begin{aligned} \pi_F &= \frac{\phi_F^2(2 + \bar{\gamma}\sigma^2)\bar{\gamma} - (2 + \bar{\gamma}\sigma^2 + \phi_N^2 - \phi_F^2)G_F}{D} \bar{\theta}\bar{\gamma}, \\ \pi_N &= \frac{\phi_F^2(2 + \bar{\gamma}\sigma^2)\bar{\gamma}\bar{\theta}\bar{\gamma} + \phi_F^2(\phi_N^2 - \phi_F^2)\bar{\theta}\bar{\gamma} + (2 + \bar{\gamma}\sigma^2)\bar{\gamma}(\phi_N^2 - \phi_F^2)\bar{\theta}\bar{\gamma} - \phi_F^2(2 + \bar{\gamma}\sigma^2)\bar{\gamma}G_F}{D} \\ &= \frac{\phi_F^2(\phi_N^2 - \phi_F^2)\bar{\theta}\bar{\gamma} + \phi_N^2(2 + \bar{\gamma}\sigma^2)\bar{\theta}\bar{\gamma}^2 - \phi_F^2(2 + \bar{\gamma}\sigma^2)\bar{\gamma}G_F}{D}, \end{aligned}$$

with

$$\begin{aligned}
 D &= 2FH + FN + HN + H^2 \\
 &= 2\phi_F^2 H + \phi_F^2 (\phi_N^2 - \phi_F^2) + H(\phi_N^2 - \phi_F^2) + H^2 \\
 &= \phi_F^2 H + \phi_F^2 (\phi_N^2 - \phi_F^2) + \phi_N^2 H + H^2 \\
 &= \phi_F^2 (2 + \bar{\gamma}\sigma^2)\bar{\gamma} + \phi_N^2 (2 + \bar{\gamma}\sigma^2)\bar{\gamma} + (2 + \bar{\gamma}\sigma^2)^2 \bar{\gamma}^2 + \phi_F^2 (\phi_N^2 - \phi_F^2) \\
 &= (\phi_F^2 + \phi_N^2)(2 + \bar{\gamma}\sigma^2)\bar{\gamma} + (2 + \bar{\gamma}\sigma^2)^2 \bar{\gamma}^2 + \phi_F^2 (\phi_N^2 - \phi_F^2).
 \end{aligned}$$

Proof of Implication 1

Manager j is characterized by talent θ_j and risk aversion γ_j . An increase in the risk-aversion coefficient γ_j leads to a decrease in

$$\hat{b}^i(\gamma_j) = \frac{\phi_g}{1 + \gamma_j \sigma^2},$$

both because $\phi_g/(1 + \gamma_j \sigma^2)$ is decreasing in γ_j and because, for γ_j large enough, the value of $\hat{b}^i(\gamma_j)$ jumps from $\phi_N/(1 + \gamma_j \sigma^2)$ down to $\phi_F/(1 + \gamma_j \sigma^2)$.

The contract slope \hat{b}^i is nondecreasing in θ_j ; while $\phi_g/(1 + \gamma_j \sigma^2)$ does not depend on θ_j , for θ_j large enough, the value of $\hat{b}^i(\gamma_j)$ jumps from $\phi_F/(1 + \gamma_j \sigma^2)$ up to $\phi_N/(1 + \gamma_j \sigma^2)$.

Proof of Implication 2

For part *a*, note that the manager's effort is $\hat{x}_j = b^i \sqrt{\theta_j}$. Hence, it is positively correlated to b^i both directly and indirectly (because by implication 1 the contract slope is positively correlated with θ_j).

Part *b* is immediate as the (expected) variable compensation is $b^i \hat{x}_j$. Hence, it is increasing in b^i both directly and indirectly (through \hat{x}_j , as per part *a*).

It is useful to show part *d* before part *c*. The proof relies on a revealed preference argument. Consider two employed managers with the same risk aversion coefficient γ , but different talent levels: $\theta'' > \theta'$. In equilibrium, the first manager has contract (a'', b'') , while the second receives (a', b') . We already know that $b'' \geq b'$, but we cannot say anything about the fixed part.

The two managers have, respectively, the following expected utilities

$$\begin{aligned}
 U'' &= a'' + (b'')^2 \theta'' - \frac{1}{2} (b'')^2 \gamma \theta'' \sigma^2 - \frac{1}{2} (b'')^2 \theta'', \\
 U' &= a' + (b')^2 \theta' - \frac{1}{2} (b')^2 \gamma \theta' \sigma^2 - \frac{1}{2} (b')^2 \theta'.
 \end{aligned}$$

If the θ'' -manager were offered contract (a', b') and exerted the same effort as the other manager, he/she would still have a higher utility because he/she is more productive. By a revealed preference argument, if the manager chooses to work for a firm that offers contract (a'', b'') and chooses a higher level of effort, he/she must get a utility level that is at least as high.

For part c, consider the same two managers as in point d and note that $U'' \geq U'$ implies that the difference between the expected total compensation of the two managers can be written as

$$\begin{aligned} (a'' + (b'')^2\theta'') - (a' + (b')^2\theta') &\geq \left(\frac{1}{2}(b'')^2\gamma\theta''\sigma^2 + \frac{1}{2}(b'')^2\theta'' \right) \\ &\quad - \left(\frac{1}{2}(b')^2\gamma\theta'\sigma^2 + \frac{1}{2}(b')^2\theta' \right) \\ &= \frac{1}{2}(\gamma\sigma^2 + 1) \left((b'')^2\theta'' - (b')^2\theta' \right) \\ &\geq 0. \end{aligned}$$

Proof of Implication 4

As we saw in the proof of proposition 1, in equilibrium all F -firms have the same management-related payoff π_F and all N -firms have the same management-related payoff π_N .

Recall that management-related payoff is defined as

$$\pi_g = \phi_g b^i \theta_j - a^i - (b^i)^2 \theta_j.$$

Hence, if π_g is constant and the direct-control part of the payoff, namely $-(b^i)^2 \theta_j$, becomes more negative, the profit part $\phi_g b^i \theta_j - a^i$ must increase.

Appendix B

Risk Aversion Measures: External Validation

In this appendix, we provide some support for the risk aversion measure we use, in order to address the main concern that it raises: that it may reflect attributes that we do not observe and cannot control for that happen to be correlated with the matching between the manager and the firm. We have already provided evidence that elicited risk attitudes are unlikely to reflect skills, as measured by educational attainment. Here we use an external validity test in order to support our contention that answers to our lottery measures do indeed reflect risk preferences of the managers and not other potentially matching-relevant traits.

To this end, we rely on a sample of 2,295 Italian entrepreneurs and managers who participated in the Ania Survey on Small Companies, con-

ducted in 2008 using face-to-face interviews. This survey targeted the CEO of the company and elicited a large number of relevant traits, including measures of risk attitudes and abilities. A detailed description of the data is available in Guiso and Rustichini (2011).

The managers were asked the exact same investment lottery question that we employ in this paper, that is, they were asked to reveal their preferences over a lottery. The average level of the risk tolerance indicator is 20.06, which is very similar to the one in our sample; the standard deviation is 26.6, a bit larger than that in our sample. The Ania survey also provides additional measures of business relevant personality traits and ability: (a) optimism, (b) an indicator of (over)confidence, (c) an index of obstinacy and will power, and (d) a measure of ability to sustain enduring effort. Additionally, the survey provides a rich set of information on managers' physical traits and job experience. Finally, matching may be related to some dimension of personal connections, which could in turn be correlated with risk attitudes. For instance, firms may have a preference for a manager born in the same area where the firm is located. If there is a systematic relation between place of birth and risk preferences, our correlations may reflect matching on networking and not on risk preferences. We test this hypothesis including dummies for the region where the manager was born.

In this appendix, we analyze the correlation between our risk aversion measures and these additional variables. The results of these regressions, controlling also for CEO demographics and education (a dummy for college degree), are shown in table B2. Risk tolerance is decreasing in age and higher for males, a pattern that has been found in many other studies of risk attitudes (e.g., Barsky et al. 1997; Dohmen et al. 2006). Reassuringly, other measures of managerial ability that could in principle be relevant for the matching mechanism are in fact uncorrelated with risk aversion. For example, job experience, measured by the number of years the CEO has been in control of the firm and the year he started working, is uncorrelated with risk tolerance. We also do not find evidence of any statistical correlation between our measure of risk aversion and CEO height (which has been found to capture economic success by Persico, Postlewaite, and Silverman 2004), whether the manager was the firstborn, and whether the father was an entrepreneur (proxying for inherited entrepreneurial ability). We cannot reject the hypothesis that region of birth fixed effects have some explanatory power—we cannot reject them being jointly equal to zero—but their size is small.

The second column of table B2 adds to the specification the grade obtained by the manager at the end of secondary school (*Esame di Maturità*), a possibly more precise proxy for cognitive ability that we do not have in our main sample (since some managers have not completed secondary

school, the sample size is slightly smaller). Even this more sophisticated measure of cognitive ability turns out not to be correlated with risk attitudes.

In the third column of table B2, we include as additional regressors the managerial personality traits described above. Three of the four measures—optimism, confidence, and ability to sustain effort—are not statistically correlated with risk tolerance. The only variable that appears to be correlated with our measure of risk preferences is obstinacy. CEOs who do not give up easily when faced with an unanticipated problem are more risk tolerant. In so far this attitude is important in the matching mechanism, our measure of risk preferences captures it as well. On the other hand, obstinacy may be regarded as a dimension of a person's risk attitudes in so far as being less afraid of obstacles because of high persistence means one is also more prepared to take risks.⁴²

Finally, the Ania survey allows us to verify whether the elicited measure of risk tolerance is able to capture actual risk taking behavior even outside the manager's workplace using information on the portfolio allocation of their private wealth. table B3 shows the results of a Probit regression, where the dependent variable is a dummy for whether the CEO has any stock of listed companies—an indicator of willingness to take extra risk in addition to those involved in managing the firm (and owning shares of private business wealth). Measured risk tolerance is strongly and positively correlated with stock ownership, suggesting that our lottery question is indeed capturing managerial preferences for risk. Interestingly, obstinacy has no predictive power once we control for risk attitudes.

⁴² The obstinacy indicator is based on the following question: "If you are trying to achieve an objective and all of a sudden you are faced with an obstacle, would you give up as the first difficulties show up or would you never give up?" Provide your answer on a scale between 0 and 10, with 10 meaning that you would never give up and zero that you would give up immediately.

Table B1
Sample Selection: Probit Estimates

	Panel A. Firm Characteristics				
	(1)	(2)	(3)	(4)	
Log (employment)	-.032 (.024)	-.041 (.026)	-.034 (.024)	-.033 (.024)	
Log (sales/employees)		-.027 (.033)			
Profits/employees			-.000 (.000)		
ROCE				-.001 (.001)	
No. of observations	5,500	5,286	5,389	5,202	
Time period	2004–7	2004–7	2004–7	2004–7	
No. of firms in population	1,660	1,660	1,660	1,649	
No. of firms in sample	560	560	560	557	
Sic2 dummies	Yes	Yes	Yes	Yes	
Year dummies	Yes	Yes	Yes	Yes	
	Panel B. Manager Characteristics				
	(1)	(2)	(3)	(4)	(5)
Log (age)	-.149 (.220)	-.097 (.227)	.205 (.237)	.185 (.239)	.138 (.295)
Gender (1 = men)	.145 (.099)	.141 (.099)	.191* (.101)	.191* (.101)	.221* (.115)
Log (tenure in current firm)		-.032 (.035)	-.028 (.035)	-.030 (.035)	.000 (.078)
Log (current pay)			-.298*** (.072)	-.286*** (.073)	-.223* (.128)
Log (mean yearly pay growth)				-.046 (.065)	-.052 (.083)
Log (standard deviation of pay)					-.068 (.079)
No. of observations	1,731	1,731	1,731	1,731	1,295
No. of managers in population	1,731	1,731	1,731	1,731	1,295
No. of managers in sample	572	572	572	572	419

NOTE.—*Panel A*: Dependent variable equals one if the firm is in the sample, zero otherwise. The number of firms is lower than the population we sampled from (1,815) due to missing values in the balance sheet data. ROCE = operating income scaled with capital employed. *Panel B*: Dependent variable equals one if the firm is in the sample, zero otherwise. The number of observations (1,731) is smaller than the number of managers we sampled from (1,815) due to missing values in the social security records. Tenure is the number of years the manager has been working for the current firm. Current pay is equal to total annual pay divided by weeks worked in 2004. Mean yearly pay growth equals the mean yearly change in pay since the manager's first job until 2004. The standard deviation of pay is computed over the years worked in the current firm if the manager has worked for at least 3 years. *Both panels*: Robust standard errors clustered at the firm level are in parentheses.

* Significant at the 10% level.

*** Significance at the 1% level.

Table B2
Risk Preference, Demographics, Psychological Traits, and Talent

Dependent Variable	Risk Preference		
	(1)	(2)	(3)
Age	-.109*	-.177**	-.140*
	(.099)	(.041)	(.050)
Age started working	.132	.238	.232
	(.450)	(.303)	(.216)
No. of years in control	-.067	-.045	-.072
	(.230)	(.535)	(.239)
Male	6.913***	8.462***	7.653***
	(.000)	(.000)	(.000)
Height (centimeters)	-.052	-.177	-.073
	(.591)	(.140)	(.474)
First born	-.806	-2.500	-.662
	(.513)	(.114)	(.614)
Father entrepreneur	1.154	.727	.844
	(.367)	(.647)	(.533)
College degree	3.344**	3.126	1.478
	(.049)	(.126)	(.410)
Grade at secondary school diploma		.011	
		(.908)	
Optimism			.008
			(.984)
(Over)confidence			2.383
			(.133)
Obstinacy			.961**
			(.020)
Ability to stand effort			-.133
			(.598)
Constant	20.412	65.291**	29.004
	(.255)	(.012)	(.191)
No. of observations	1,952	1,290	1,738
Regional dummies includes (<i>F</i> -test all equal to zero)	4.21	4.35	3.68

NOTE.—Risk tolerance is the probability at which the manager switches from choosing the risky prospect yielding €10 million with that probability (and €0 otherwise) to the safe prospect that yields €1 million with certainty. Robust standard errors are in parentheses.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

Table B3
Financial Risk Taking and Risk Preference

Dependent Variable	Financial Risk Taking	
	(1)	(2)
Risk tolerance	.001*** (.000)	.001*** (.000)
Age	.003** (.012)	.002* (.059)
Age started working	.003 (.310)	.004 (.122)
No. of years in control	.001 (.252)	.001 (.313)
Male	.032 (.213)	.031 (.262)
Height (centimeters)	.002 (.191)	.002 (.210)
First born	-.000 (.983)	.005 (.814)
Father entrepreneur	.023 (.223)	.013 (.542)
College degree	.089*** (.000)	.066** (.013)
Optimism		-.002 (.756)
(Over)confidence		.027 (.246)
Obstinacy		.008 (.214)
Ability to stand effort		.002 (.585)
No. of observations	1,952	1,738

NOTE.—Financial risk taking is a dummy equal to one if the manager has stocks of listed companies in his personal portfolio besides owing any stock of his/her firm. Risk tolerance is the probability at which the manager switches from choosing the risky prospect yielding €10 million with that probability (and €0 otherwise) to the safe prospect that yields €1 million with certainty. Robust standard errors are in parentheses.

* Significant at the 10% level.

** Significant at the 5% level.

*** Significant at the 1% level.

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