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# Empirical Evidence from Firms in Brazil

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**Abstract**

We investigate whether meritocracy affects firms' innovation performance. More specifically, we empirically evaluate the prediction that the use of higher performance-based pay and promotion should lead to a higher percentage of firm revenues coming from innovations in products and services. To test this prediction, we employ a survey of 370 Brazilian firms in a broad range of industries. Our two-stage regressions, devised to account for potential endogeneity, indicate that while the use of performance-based promotion strongly affects innovation, the effect of contingent pay is marginal.  Apparently, the long-term feature of promotion-based meritocracy is more effective to tap into individuals' creativity than is short-term pay.  Our study sheds light on the debate about how organizational practices can affect the innovative potential of firms.

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# 1    Introduction

The innovative ability of firms is commonly associated with external factors such as technological opportunities and property rights protection, as well as internal factors such as firm size, R&D investments, and human capital (Encaoua et al., 2000; Scotchmer, 2004). The latter may be of particular concern to firms in emerging economies characterized by the scarcity of skilled labor force. A recent report from the World Bank, for example, argues that human capital is the missing link between innovation and productivity in Brazil (Rodríguez et al., 2008). The role of human capital in the literature, however, has been examined mostly with respect to the recruiting and selection of qualified labor force.

Yet, firms are expected to become innovative not only by employing but also by rewarding those individuals who effectively contribute to key innovations—e.g. by adopting *meritocratic* systems of compensation that vary according to individual performance.  The underlying logic is straightforward.  Without proper compensation for the ideas that they generate, individuals may be less inclined to pursue valuable innovations; furthermore, skilled individuals who does not receive merit for their contributions may leave the firm and even found their own entrepreneurial ventures (e.g. Zenger, 1994).  The question we address in this paper, therefore, is whether firms can effectively use internal incentives—namely, performance-based pay and promotion—to encourage employees to turn their ideas into actual sources of revenue.

Previous studies have related features of the internal organization to the innovative potential of firms (e.g. Hoskisson et al., 1993; Balkin et al., 2000; Davila, 2003; Zenger and Lazzarini, 2004).  The paper that is closest to ours, however, is

Laursen and Foss (2003). Using a database of Danish firms, they examine the impact of myriad human resource practices on innovation and find a marginal positive effect performance-based pay. They, however, do not assess another aspect related to meritocracy: performance-based promotion. Our study contributes to this debate by jointly analyzing the impact of *both* performance-based pay and performance-based promotion, thereby allowing for a more complete assessment of the effect of meritocracy on innovation.

Using a survey of 370 Brazilian firms in a broad range of industries, we measure the effect of meritocracy on the percentage of firm revenues coming from innovations in products and services. Our two-stage regressions, devised to account for potential endogeneity, indicate that while the effect of contingent pay is marginal (as in Laursen and Foss, 2003), there is a strong positive effect associated with promotion-based incentives. Apparently, the long-term feature of promotion-based meritocracy is more effective to tap into individuals' creativity than is short-term pay. In addition, there seems to be a threshold above which the use of performance-based promotion is insignificant; thus, moderate levels of promotion-based meritocracy apparently suffice to yield innovation. Our study sheds light on the debate about how organizational practices can affect the innovative potential of firms, beyond what can be solely attained by investments in human capital.

The remainder of the paper is structured as follows: we first review the relevant literature from which we derive our hypotheses. Second, we describe our data and methods. We then present and discuss our findings. Concluding remarks follow.

## 2    Literature review and hypotheses

A firm's capacity to outperform its rivals relies to a large extent on its own ability to not only capture value from scarce and inimitable resources (Barney, 1991), but also constantly renew and upgrade resources so as to innovate and adapt to complex and changing markets (Teece et al., 1997; Wiggins and Ruefli, 2005). Whilst the innovation literature has long drawn attention to the environmental conditions that affect firms' innovative behavior (e.g. Encaoua et al., 2000), our knowledge as to the internal firm-specific elements that affect innovation is still scant. This is not unsurprising since well before research and development activities (R&D) were formally organized in firms "societies needed both the ability and the incentive to fund it" (Scotchmer, 2004, p.2). As a result scholars have become reasonably familiar with the effects of appropriability conditions, technological opportunities, and market structure on innovation. But our understanding of the impact of firms' attributes on innovation is limited to size, industrial sector and available resources for innovation (i.e. R&D expenses, qualified personnel). Although there are many elements that enhance firms' innovativeness, we focus on *organizational* issues—namely, the extent to which firms adopt mechanisms to incentivize and reward innovative ideas.

In tandem with the emergence of large corporations, the separation of ownership and control was quickly recognized as a challenge (Berle and Means, 1932). Namely, the fact that most employees were not owners or the original entrepreneurs who founded corporations raised a concern of whether those employees would act in ways that were consistent with the objectives of actual owners.  As a result, employees' behavior was soon detected as critical for corporations. Taylor's Principles of Scientific Management was one of the first initiatives to recommend the use of incentives within organizations

(Taylor, 1911). In addition to proper selection of qualified personnel, Taylor suggested the implementation of pay for performance scheme as a device to enhance productivity. Taylor's ideas were challenged later on, and are still disputed to date (Morgan, 1986).

Subsequent discussions on the effects of financial compensation on employees' behavior were developed (e.g. Herzberg et al., 1959; Jensen and Meckling, 1976; Vroom, 1964). Vroom's expectancy theory suggests that individuals have different needs and that the attraction they have for an outcome (i.e. valence) will be associated to their effort to perform in order to obtain that outcome (Vroom, 1964). Insofar as individuals place high value on many contingencies that depend on the availability of financial resources, one of the arguments for the use of pay as an incentive mechanism is that it can be used to satisfy many needs. Yet, Lawler (1971) observes that pay cannot motivate performance unless it is contingent on performance. In turn, Herzberg and colleagues (1959) consider that pay is not effective in motivating employees, but is a critical element to avoid employees' dissatisfaction.

Overall, it is well documented that the interests of employers and employees may diverge, and hence the design of mechanisms that induce workers to act upon employers' interest is pivotal. As a result, a body of literature has examined both whether individuals respond to incentives and whether firms design contracts that anticipate individuals' behavior (Prendergast, 1999). Principal-agent (or agency) theory arose by recognizing that the separation of ownership and control demanded owners (principals) to design contracts able to influence agents' behavior (Jensen and Meckling, 1976). Despite the observation of Holmstron and Milgron (1991, p.50) that "the problem of providing incentives to agents and employees is far more intricate than is

represented in standard principal-agent models," Sappington (1991) advocates that agency theory is helpful in identifying both possible sources of friction within organizations and efficient ways to mitigate these frictions. Principal-agent models, for example, have recognized that incentives play a dual role in encouraging productivity and attracting a qualified labor force (Cadsby et al., 2007). Although various difficulties constrain firms' ability to construct high-powered incentives, the prescription of agency theory is simple: firms must attract skilled personnel and elicit high effort through appropriate compensation schemes (Prendergast, 2002).

The adoption of performance-based compensation is consistent the notion of *meritocracy*. In a meritocratic system, "the basic criterion of social organization must be the performance of individuals, that is, the set of competencies, efforts, and skills of each person" (Barbosa, 1999, p.22). Meritocracy is thus associated with the infusion of high-powered incentives within the firm (Williamson, 1985; Zenger and Hesterly, 1997). Meritocracy should therefore be reflected in at least two organizational features. First, based on principal-agent logic, pay should be contingent on performance (Jensen and Meckling, 1976; Zenger, 1994; Lazear, 2000). Second, careers must be crafted such as to promote and retain only talented individuals. Internal procedures to recognize and promote internal talent are consistent with meritocracy (Baker et al., 1998; Brickley et al., 2002).

How would then meritocracy affect innovation? Following the logic outlined above, to foster innovation firms must attract and retain individuals who contribute with valuable ideas. On the one hand, highly skilled individuals will tend to be attracted to firms that provide appropriate reward for their innovate effort; otherwise, they will

themselves become entrepreneurs and commercially exploit their projects. On the other hand, once they are working for particular corporations, individuals will tend put emphasis on initiatives that should positively influence their career and their individual compensation. Innovative individuals who perceive that they are not receiving merit for their contributions may become dissatisfied and leave. Therefore, meritocratic systems should foster innovation by attracting talented individuals and by eliciting high effort in the generation of valuable ideas (Zenger, 1994; Zenger and Lazzarini, 2004).

This simple claim, however, is not free of controversy. Some observe that incentives—especially pay-to-performance schemes—have only a short-term impact by inducing temporary compliance, and hence may be deleterious in the long-run (Kohn, 1993). Others still propose that meritocratic systems only reward few restricted individuals, hence failing to benefit the organization as a whole (Appold, 2001). In addition, there is an argument that incentives based upon contingency pay and promotion should elicit extrinsic sources of motivation and crowd out intrinsic sources of motivation that may be critical for the transfer of tacit knowledge (Osterloh and Frey, 2000). The latter derives from the notion that individuals derive utility not only from what they are paid for but also from other aspects unrelated to wealth creation. Yet Murdock (2002) observes that firms may rely on implicit contracts in order to tap into individuals' intrinsic motivation, and hence create incentives towards goal identification and achievement. In any case, the alternative argument that performance-based schemes may, contrary to our claim, negatively affect innovation is ultimately a proposition that can be confronted with actual data and empirically tested.

Empirical evidence on the impact of incentives on performance has been mixed. Fein (1976), for example, observed that firms with formal bonus plans achieved higher returns than firms with no formal bonus plan (8.6% *vs*. 5%, respectively). Pearce, Stevenson, and Perry (1985), in turn, detected that the implementation of a performance-contingent pay program in five federal government agencies had no permanent effect on organizational performance. An experimental investigation carried out by Cadsby and collaborators (2007) has demonstrated that pay for performance both i) attracts higher-quality employees and ii) motivates employees to exert more effort (as compared to fixed wages). Analyses have also been undertaken for top executives and have suggested that incentives can be powerful tools for assuring performance according to stockholders' interest (Jensen and Murphy, 1990). Even nonprofit organizations have adopted performance-based incentives for CEOs. Brickley and van Horn (2002), for example, found that in both nonprofit and for-profit hospitals CEOs do not have explicit incentives to concentrate on altruistic activities. They detected that turnover and pay are strongly related to hospitals' financial performance, regardless of the hospital's profit orientation. Zajac and Westphal (1994), however, challenge the idea that organizations should arbitrarily use incentive compensation because CEOs might be risk averse and it might be too costly for principals to make agents bear risk. Zajac and Westphal's analysis of nearly 400 large U.S. corporations furnishes evidence that increased monitoring could be used to balance the lack of incentives, in particular for more risky firms, although the costs to do so should be accounted for.

Balkin and Gomez-Mejia (1990) observe that compensation schemes vary between corporate and business unit level strategies. The results corroborate initial (e.g. Salter, 1973) and more recent (Boyd and Salamin, 2001) thoughts that compensation

systems should match firms' strategies and that the effectiveness of pay systems is a function of firms' strategic characteristics (Balkin and Gomez-Mejia, 1987). Nevertheless, managerial rent-seeking may distort strategy choice, and hence CEOs pay may reflect strategic discretion more than compensation for effort (Dow and Raposo, 2005). However, Wade, O'Reilly, and Pollock (2006) have shown that CEOs are concerned not only with self-interest but also with fairness. Their findings indicate that CEO over- and underpayment is associated with over- and underpayment of managers at lower levels of organizations. The effects of compensation on middle-level managers have been studied from other lens as well. For example, based upon a survey of 309 middle managers, Stroh and collaborators (1996) provide evidence that variable pay is offered for managers involved with less predictable tasks and for those in more turbulent organizations. The latter is of particular interest to us because the concept of turbulence is closely related to innovation.

As noted before, innovation is conditional upon the creativity of individuals and in order to tap into individuals' talent firms may reward for their contributions. Yet incentives that motivate innovation should consider that innovation performance is hard to be effectively monitored due to unpredictable outcomes. Thus, agency theory advocates that principals and agents should share the risks, and hence agents should receive a risk premium (Holmstron, 1989; Aghion and Tirole, 1994). Stroh et al. (1996), however, have not found that middle managers receive a risk premium for working in more turbulent environments. Their results are consistent with the findings by Hoskisson et al. (1993) for managers in multidivisional organizations. The authors observed that incentive compensation schemes shift risk to division managers and they reduce risk by lowering the level of R&D expenses. These results alone are suggestive

that incentives are deleterious to innovation. Nevertheless, Davila (2003) has observed that new product development managers respond positively to variable compensation based upon project performance. In addition, Balkin, Markman, and Gomez-Mejia (2000) have noticed that in high-technology firms CEO pay is more strongly contingent on firms' innovation performance than on firms' financial performance.

Laursen and Foss (2003) have also examined the relationship between incentives and innovation. Their approach, however, was based on the notion of complementarities, that is, doing more of one particular organizational practice increases the returns of doing more of other practices (Milgrom and Roberts, 1995). The authors surveyed 1884 Danish firms in order to examine whether several human resources management practices (HRM) could increase the probability of a firm introducing an innovation. Indeed, the authors found evidence consistent with the notion of complementarities amongst HRM practices for as two groups of practices emerged from their clustering technique and both groups enhanced firms' likelihood of launching an innovation. In addition, the HRM practices alone were hardly able to achieve similar results. According to their findings there are just two practices that affect (at 5% significance level) the probability that a firm innovates: i) integration of functions and ii) firm-internal training; the impact of performance-based pay was positive but only at a 10% significance level.

Their study, however, did not account for promotion, an element that is expected to be an important aspect of meritocratic systems. This is an important shortcoming because, as Holmstron and Milgron (1991, p.50) observe, "the range of instruments that can be used to control an agent's performance in one activity is much wider than just

deciding how to pay for performance." In addition, Laursen and Foss's (2003) results do not elucidate how innovative firms become by adopting HRM practices. Thus, our contribution in this piece of research will be to examine whether the use of meritocratic systems in organizations, namely higher performance-based pay and promotion, impacts on the degree of innovativeness.

Based upon the literature reviewed above, we thus hypothesize the following:

**Hypothesis 1.** *Firms that adopt meritocratic systems associated with higher performance-based pay will be more innovative.*

**Hypothesis 2.** *Firms that adopt meritocratic systems associated with higher performance-based promotion will be more innovative.*

## 3    Data, variables and research method

### 3.1    Data

To test our hypotheses, we employ a survey with 370 firms in Brazil. Companies were randomly selected from a database of Brazilian firms published by the newspaper *Gazeta Mercantil* (a renowned periodical of the business press in Brazil). After selected and identified, firms were contacted and their managers were interviewed by phone. Since the survey is comprehensive, managers from different functional areas were requested to answer some particular questions. For instance, questions about innovation were answered by an executive dealing with technology issues within the company; questions about promotion and compensation practices where answered by an executive responsible for human resources; and so forth. Our final sample of firms covers around 22 sectors or industries in the economy: agriculture and livestock; food, beverages and tobacco; trading; retail; construction; car dealing; energy; electronics;

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timber and wood furniture; mechanics; metals; mining; pulp and paper; plastics; chemicals and petrochemicals; cleaning and sanitizing; health; specialized services; information technology; logistics; and leather and garment.

*3.2    Variables*

*3.2.1    Response variable*

*Innovation.* To measure the innovativeness of the firm, we asked respondents to estimate the percentage of firm revenues in 2006 (the year immediately preceding the survey) coming from innovations in products or services carried out from 2003 to 2005. This measure, called *Innovation*, gives us an indication of whether the firm has pursued innovations that effectively turned into actual revenues.  An attractive feature of this measure is that it is more objective than measures based on agreement scales (e.g., Likert); hence, it should be potentially less affected by managers' subjective judgments about what is an effective innovation—i.e., innovation with a sizeable commercial impact.  It is also comparable across firms and sectors, given that all firms in our sample report revenues that can be potentially impacted by innovation-based efforts.  To be sure, some sectors may be more or less prone to such innovative efforts; thus, a firm in a mature sector reporting 5% of revenues coming from innovation can be considered highly innovative given the slow pace of new product introductions in its own sector. As we discuss later, in order to allow for comparisons, we control for such industry-based effects in our estimates.

*3.2.2    Explanatory variables*

*Meritocracy.* Following our theoretical discussion, our operationalization of meritocracy is based on two organizational features: whether pay and promotion are based on individual performance.  Thus, we asked respondents to answer two

questions[1]. First, "to what extend the compensation of most people is linked to their performance?" Respondents had to choose among three alternatives: (1) "none"; (2) "to some extent to some people;" or (3) "to some extent to several people." Our final measure of performance-based pay, referred to as *Pay*, is an ordinal variable with three values: low (1), medium (2) and high (3), based on the choice of the respondent.

In similar vein, to measure performance-based promotion, we relied on respondents' answer to the following question: "Which of the following alternatives best reflects how your personnel are promoted?" The three alternatives were: (1) "people are generally promoted based on tenure, subject to satisfactory performance;" (2) "people are generally promoted based on tenure, but there is possibility of fast-track promotion in case of top performance;" and (3) "people are promoted mainly based on their performance and skills, and those with top performance are actively identified." Our final measure of promotion-based pay, referred to as *Promotion*, is also an ordinal variable with three levels: low (1), medium (2) and high (3).

### 3.2.3 Control variables

We adopt a set of control variables, described below, which should influence both the adoption of meritocracy and the innovative potential of the firm.

*CEO Age* and *Company Age*. These variables code, respectively, the age of the CEO and the age of the company in the survey. They are included to control for demographic factors that can affect the adoption of organizational practices, both at the

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[1] These questions derive from the survey instrument used in a research project supported by the UK Department for International Development (DFID) and carried out by Basant et al. (2009) who investigated firms' adoption of information and communication technologies (ICT) in Brazil and India. This cross-country comparison encompassed the intellectual endeavor of academics from London Business School, Institute for Fiscal Studies (UK), Indian Institute of Management (Ahmedabad), and Ibmec Sao Paulo (Brazil).

individual (Zenger and Lawrence, 1989) and at the corporate level (Carroll and Hannan, 2000). For instance, older CEOs and organizations, with established routines developed in the past (Stinchcombe, 1965), may be less inclined to change organizational processes and attributes associated with existing products.

*Ln*(*Revenues*). This variable is used to control for firm size and corresponds to the logarithm of the company's revenues, in 1 000 reais.[2] The literature suggests that firm size can affect innovation both directly and indirectly through its effect on the choice of meritocracy. The direct effect is rooted in the idea that larger firms tend to have substantial investments in existing technologies and product lines, which would otherwise become obsolete if the firm pursue innovations (Foster, 1986; Christensen, 1997). Internal groups associated with older technologies and products may actively defend existing investments instead of engaging in new projects (Milgrom and Roberts, 1990). The indirect effect, in turn, occurs through the choice of internal organization. Namely, meritocracy should be more difficult to achieve in larger firms: individual performance in large groups is more difficult to meter; some individuals may free-ride on new ideas proposed by others; and, even if the firm adopts meritocratic systems, in large organizations such meritocracy may be perceived as "unfair" given that individuals tend to have biased, inflated perceptions of their own performance and their contribution to the firm (Garen, 1985; Zenger, 1994; Zenger and Lazzarini, 2004). Consequently, because new ideas will not be aggressively rewarded—at least compared to an alternative situation where innovators set up their own (small) firms—the incentives to propose new projects will be damped (Baumol et al., 2007).

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[2] Each real was worth approximately half a dollar by the time of the survey.

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*Board*. This is a variable coded 1 if the responded indicated that the company has a board of directors which "ratifies and monitors the decisions made by executives," and 0 otherwise. The presence of a formal board is a signal that the firm is concerned with internal governance (Jensen, 1998). Thus, the board may affect decisions to both establish internal organizational systems and carry out innovative projects.

*Skills*. The ability to craft complex compensation schemes and evaluate projects to improve or radically change products should be dependent on the sophistication of the personnel dealing with tactical or strategic issues within the corporation. We thus adopted a proxy for the analytic skills of managers based on their reported use of tools to assess investment opportunities. Respondents indicated whether they used the following tools to assess projects: net present value, internal rate of return, payback, accounting indexes, simulation techniques, real option analysis, and break-even analysis. For each tool, respondents had to declare whether they used it "as a major tool to guide decision-making" (coded 3); "frequently as a supporting tool" (coded 2); "sometimes as a supporting tool" (coded 1); or if they did not use the tool at all (coded 0). We then created the variable *Skills* by averaging the responses for all items.

*State-owned* and *Foreign*. These variables are used to control for differences in ownership across firms in the sample. It is widely discussed, for instance, that state-owned companies have more difficulty structuring internal promotion and compensation systems based on merit because of rigidities in public bureaucracies (Barbosa, 1999). In this sense, *State-owned* and *Foreign* are dichotomous variables coded 1 if the company is, respectively, state-owned and controlled by foreign entities (e.g., a local subsidiary

of a multinational corporation).  Thus, the baseline category is the set of domestic, private firms.

*Industry-specific effects*.  We control for industry-specific effects by including in our regressions dichotomous variables for each of the 22 industries in our database.

Table 1 shows summary statistics for all variables in our study (except for the industry-specific variables, which are too numerous to report here).

*<<Insert Table 1 around here>>*

### 3.3    Method

A straightforward way to test our hypotheses would be to run simple regressions where *Innovation* is the dependent variable and the meritocracy-related measures *Pay* and *Promotion* are used as independent variables.  Indeed, a visual inspection of the relationship among those variables does suggest that performance-based pay and promotion are positively associated with the reported percentage of revenues coming from innovations (Figure 1).  As usual in research in organization and strategy, however, this simple approach may be problematic because the choice of meritocracy and innovation is likely endogenous (Hamilton and Nickerson, 2002).  For instance, firms may be, at the same time, more innovative and meritocratic not because the latter has an effect on the former, but because they have a high proportion of competent people—an attribute we did not directly observe and measure—who managed to get promoted and rewarded.  Failing to control for endogeneity may lead to biased and inconsistent estimates.

*<<Insert Figure 1 around here>>*

To correct for endogeneity, we adopt a standard two-stage procedure (Nelson and Olson, 1978; Hamilton and Nickerson, 2002). In the first stage, we model the choice of meritocracy by using *Pay* and *Promotion* as dependent variables in distinct regressions. Given the ordinal nature of those variables, we employ the ordered probit model (Greene, 2000) in the first stage. The ordered probit model allows us to examine the impact of explanatory variables on the probability that the level of performance-based pay or promotion will be increasingly high. The higher the coefficients of the explanatory variables, the higher their effect on the intensity of meritocracy chosen by the firm. The model is fitted via maximum likelihood.

As explanatory variables in the first stage, we include all control variables plus an instrumental variable, *Authority*, which is included in the first stage but omitted in the second stage. Based on a 7-point Likert scale, *Authority* is simply constructed as an average of managers' agreement with the following statements: "In my organization, subordinates need to obey their boss without questioning and should not argue with their boss when they disagree with something"; and "In my organization, personal influence is chiefly based on the ability and contribution of the individual to the organization, instead of functional authority" (reverse scored). To show effective results and get properly compensated, individuals must some degree of autonomy to pursue certain types of actions. An increase in vertical authority should precisely curtail autonomy and, consequently, reduce the effectiveness of meritocratic schemes (Brickley et al., 2002). Thus, we expect that *Authority* should be negatively correlated with the intensity of performance-based pay and promotion.

In the second stage, where *Innovation* is the dependent variable, we use as explanatory variables the predicted values obtained in the first stage of our regressions, plus all the controls. We employ the predicted probabilities associated with two particular levels of the *Pay* and *Performance* variables: medium and high. Therefore, the baseline category (not included in the regressions, to avoid multicolinearity) is the lowest level of performance-based promotion and pay. Thus, *Pay – Medium* and *Pay – High* are, respectively, the predicted probabilities (obtained from the first stage) that the firm will exhibit medium and high levels of performance-based pay. Likewise, *Promotion – Medium* and *Promotion – High* are, respectively, the predicted probabilities that the firm will exhibit medium and high levels of performance-based promotion. This procedure allows us to capture possible nonlinear effects of the effect of meritocracy on innovation depending on each predicted level of pay and promotion (for an application of this procedure in another empirical context, see Maskey et al., 2006). The second-stage regression is estimated via ordinary least squares (OLS).[3]

In both the first- and second-stage regressions, the estimation method employs the Huber-White estimator to compute standard errors. This procedure generates robust estimates that control for potential heteroscedasticity in the data.

## 4    Results and discussion

### 4.1    *First stage: choice of performance-based pay and promotion*

Columns (1a) and (1b) show the results of the ordered probit regressions (first stage). The coefficient of instrumental variable *Authority* is negative and highly

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[3] A caveat is that, in the second stage, the dependent variable (i.e., *Innovation*) has clear upper and lower bounds (from 0 to 1), thus potentially violating the assumption of normality of the error term. To check the robustness of our results, we fitted Tobit regressions to our data, which accommodate such bounds. The inference about the variables was, however, fairly similar to the OLS procedure (results not reported here, but available upon request).

significant ($p < .01$): an increase in perceive vertical authority—and, hence, a reduction in perceived autonomy—is negatively associated with the choice of both performance-based pay and promotion.[4] This result supports the idea that a low propensity of top management to decentralize decisions dampens the benefit to adopt meritocratic systems.

<<*Insert Table 2 around here*>>

The other variables show varying effects depending on the type of choice (i.e., *Pay* or *Promotion*). The decision to adopt performance-based pay (column (1a)) is positively affected by both the presence of a board of directors (*Board*) and the level of skills to analyze investment opportunities (*Skills*): the coefficients of those variables are highly significant ($p < .01$). In our sample, firms with improved governance (i.e., firms with at least an active board of directors) and firms adopting more sophisticated analytical techniques are also more likely to adopt performance-based pay. These variables, however, do not significantly explain the choice of performance-based promotion (column (1b)). Such choice is better explained by the ownership form of the firm; namely, as evidenced by the coefficient of *State-owned*, meritocratic promotion schemes are less likely observed in firms controlled by the government ($p < .05$). This result is aligned with the expectation that state-owned firms suffer higher bureaucratic constraints to adopt performance-based promotion. Finally, the coefficient of *CEO Age* is positively significant in column (1b): firms with older CEOs are more likely to adopt performance-based promotion. However, the level of significance is marginal ($p < .10$).

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[4] Furthermore, as is appropriate in an instrumental variable, *Authority* is insignificantly correlated with *Innovation* when added in the second-stage regression.

*4.2    Second stage: effect on innovation*

The last three columns of Table 2 report OLS estimates of the effect of meritocracy on innovation, where the predicted values (obtained in the first stage) of performance-based pay only (2a), performance-based promotion only (2b), and both performance-based pay and performance (2c) are included in the regressions. Results provide only marginal support for Hypothesis 1: according to the estimates reported in column (2a), firms with the highest level of performance-based pay (*Pay – High*) are slightly more innovative than other firms ($p < .10$). However, this effect becomes insignificant when the performance-based promotion variables are included (column (2c)). Our results for performance-based pay are in line with the findings of Laursen and Foss (2003), who observed a marginal role of contingent pay.

The effect of the promotion variables, on the other hand, is highly significant: firms with moderate (*Promotion – Medium*) and high (*Promotion – High*) levels of performance-based promotion are more innovative than other firms ($p < .01$), even when the performance-based pay variables are included in the regression. Although the coefficient of *Promotion – Medium* is larger than the coefficient of *Promotion – High*, the difference between the coefficients is significant ($p < .05$) only in the model without the pay-related variables (column (2b)). In sum, having a high level of promotion-related meritocracy apparently does not provide gains in innovation beyond what is obtained with a moderate level. However, results do indicate that an increase in the level of promotion-related meritocracy—from low to at least medium—increase the percentage of corporate revenues coming from innovations, thus supporting Hypothesis 2.

Prior studies have focused on the effects of both CEOs and managers compensation on innovation. We, however, test whether a more encompassing compensation scheme impacts on firms' innovation performance. Although our pay-related results confirm existing evidence (e.g. Laursen and Foss, 2003), our results shed new light on the effects of organizational incentives on firms' innovativeness. Following Holmstrom and Milgron's (1991) advice to consider a broader range of incentive mechanisms than just performance-based pay, we find that performance-based promotion is pivotal to foster innovation.

A possible explanation is that promotion-based incentives are associated with a long-term horizon that is more appropriate to compensate individuals for their innovations. Although the cycle between the generation of an idea and its commercial exploitation has been shortened (Nault and Vandenbosch, 1996), it takes a little longer for a firm to fully realize the returns it will accrue from its innovations. Thus, meritocratic systems based on promotion for those who effectively contribute to new ideas may be effective because the actual promotion can occur after the idea is generated, executed and commercially tested. This long-term perspective of the innovation process is consistent with the recent study of Lerner and Wulf (2006) who investigated the effects of high powered incentives on corporate R&D heads' behavior, and detected that more long-term incentives are associated with more heavily cited patents.

By contrast, performance-based pay may be purely short-term (e.g. profit sharing or bonuses based on yearly revenue goals); aiming at increasing their short-term compensation, individuals may eventually devote less attention to valuable ideas that

would however require time to be effectively developed and tested. Therefore, our results indicate that critics of performance-based incentives (e.g. Osterloh and Frey, 2000) are, at best, partially right: while incentives based on contingent pay appear to marginally affect innovation, the role of promotion-based incentives can be profound.

Some additional results involving the control variables are worth noticing. The effects of *CEO Age* and *Company Age* are significant across all model specifications ($p < .05$): younger firms and firms with younger CEOs are more likely to be innovative. This finding is intuitive, as older CEOs and older firms may be more committed to routines and processes developed in the past, and thus less willing to pursue innovative projects that would otherwise create new configurations.

Aligned with expectations, an increase in firm size (*Ln*(*Revenues*)) is negatively associated with innovation, although only moderately so ($p < .10$) in regressions (2b) and (2c). This finding provides moderate support for the conjecture, discussed earlier, of a direct negative effect of firm size on innovation due to increased commitment to past technologies and processes in large firms. However, contrary to previous findings (e.g. Zenger and Lazzarini, 2004), the indirect effect of firm size on innovation— through the choice of meritocracy—is not supported, given the insignificant effect of *Ln*(*Revenues*) on the choice of *Pay* and *Promotion* (columns (1a) and (1b)).

Results from models (2a) to (2c) also show that *Board* significantly explains innovation: firms with an established board of directors are apparently more innovative ($p < .05$). *Skills*, in turn, is moderately significant in column (2b) and significant in column (2c): firms with superior analytic skills to judge new investment opportunities are more innovative. Collectively, these results suggest that an increase in governance

and in the sophistication of the firm to analyze investments have a direct effect on innovation. A tentative explanation is that these two factors may partially capture the quality of corporate management, which in turn may be associated with superior competencies to identify new opportunities and turn them into commercial products. Even though there is also a positive effect of *Board* and *Skills* on the choice of performance-based pay, the effect of this choice on innovation is weak. Thus, there is no strong evidence of an indirect effect of *Board* and *Skills* on innovation via their effect on the choice of meritocracy

## 5    Concluding remarks

Our results indicate that organizational choices—namely, mechanisms to signal and reward merit—matter when it comes to promoting innovation. More specifically, we unveil the distinct effects of performance-based pay and promotion on the ability of firms to turn ideas into actual sources of revenue. In line with previous work (e.g. Laursen and Foss, 2003), we find that contingent pay marginally influence innovation; however, we find that the effect of performance-based promotion—i.e. whether firms promote individuals who excel in the organization—is highly significant. Moreover, our results indicate that moderate levels of performance-based promotion suffice: there seems to be a threshold above which the use of performance-based promotion does not further improve innovativeness.

Our study contributes to both theory and practice. We show that, beyond the usual recommendations (e.g. investments in R&D, protection of property rights, training, etc.), firms interested in spurring innovation should also pay attention to organizational practices that can elicit effort towards the generation of new ideas. We

show that the effect of implementing performance-based promotion schemes can be effective in that sense.  As for theory, the findings reinforce the notion that the provision of organizational incentives is an important element to make firms more innovative. Our results, however, suggest that scholars should pay attention to incentive mechanisms that go beyond pay-to-performance schemes.  Apparently, incentives with a long-term nature, such as performance-based promotion, are particularly relevant. Thus, developing more refined theoretical models that careful discern the differential effects of alternative incentive mechanisms on firms' innovativeness is warranted.

We would like, however, to point out some important limitations of our study. We do not examine whether the adoption of incentives vary according to the innovative orientation of the firm, namely if firms tend to promote incremental innovation in existing technologies or processes, or innovations with a more radical nature.  The effect of meritocracy may vary depending on the type of innovation that the firm is pursuing.  Moreover, although we measure whether innovations effectively turn into revenues, we do no assess the quality or the sustainability of the innovation created by firms that use incentive schemes. For instance, employees may be tempted to pursue new product introductions that have a momentary effect on sales, but that are easily imitated by rivals in the long run.  Finally, as is usual in most survey-based research, measures for the relevant variables are proxies that can be subject to criticism.  The use of broader indicators of innovation and organizational patterns can circumvent such limitation.   For instance, one can assess innovation not only based on self-reported measures but also with some externally observed indicators such as number of patents, product turnover, and so on.

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**Table 1**
Summary statistics and correlation matrix

|  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. *Innovation* | 1 | | | | | | | | | | |
| 2. *Pay* | 0.15 | 1 | | | | | | | | | |
| 3. *Promotion* | 0.07 | 0.22 | 1 | | | | | | | | |
| 4. *CEO Age* | -0.06 | 0.06 | 0.10 | 1 | | | | | | | |
| 5. *Company Age* | -0.16 | 0.05 | 0.02 | 0.26 | 1 | | | | | | |
| 6. *Ln*(*Revenues*) | -0.06 | 0.04 | 0.15 | 0.16 | 0.24 | 1 | | | | | |
| 7. *Board* | 0.11 | 0.08 | 0.13 | -0.05 | 0.03 | 0.17 | 1 | | | | |
| 8. *Skills* | 0.15 | 0.17 | 0.10 | 0.05 | 0.15 | 0.25 | 0.08 | 1 | | | |
| 9. *State-owned* | -0.07 | -0.09 | -0.10 | 0.06 | -0.01 | 0.08 | 0.13 | -0.05 | 1 | | |
| 10. *Foreign* | -0.01 | -0.02 | -0.03 | -0.02 | 0.01 | -0.13 | 0.10 | -0.12 | -0.17 | 1 | |
| 11. *Authority* | -0.08 | -0.22 | -0.21 | 0.05 | -0.13 | -0.05 | -0.05 | -0.05 | 0.02 | -0.07 | 1 |
| Mean | 0.14 | 2.30 | 2.56 | 52.02 | 31.69 | 9.69 | 0.64 | 1.20 | 0.07 | 0.29 | 1.71 |
| Standard deviation | 0.18 | 0.72 | 0.64 | 10.92 | 23.81 | 2.27 | 0.48 | 0.65 | 0.25 | 0.45 | 1.21 |

**Table 2**

Two-stage estimation of the effect of meritocracy (performance-contingent pay and promotion) on innovation (percentage of revenues coming from new products)

| Coefficients | Pay[a] (1a) | Promotion[a] (1b) | Innovation[b] (2a) | (2b) | (2c) |
|---|---|---|---|---|---|
| Pay - Medium | | | 0.318 (0.203) | | 0.021 (0.163) |
| Pay - High | | | 0.221 † (0.113) | | -0.244 (0.165) |
| Promotion - Medium | | | | 1.520 ** (0.352) | 1.391 ** (0.313) |
| Promotion - High | | | | 0.982 ** (0.166) | 1.163 ** (0.206) |
| CEO Age | 0.011 (0.009) | 0.017 † (0.010) | -0.002 * (0.001) | -0.002 * (0.001) | -0.002 * (0.001) |
| Company Age | -0.004 (0.003) | -0.004 (0.004) | -0.002 * (0.001) | -0.002 * (0.001) | -0.002 * (0.001) |
| Ln(Revenues) | 0.003 (0.041) | 0.044 (0.030) | -0.014 (0.008) | -0.014 † (0.008) | -0.017 † (0.008) |
| Board | 0.398 ** (0.136) | 0.401 (0.259) | 0.053 * (0.024) | 0.051 * (0.024) | 0.056 * (0.025) |
| Skills | 0.371 ** (0.143) | 0.121 (0.212) | 0.032 (0.024) | 0.042 † (0.021) | 0.062 * (0.026) |
| State-owned | -0.318 (0.309) | -0.795 * (0.319) | 0.070 (0.054) | 0.054 (0.057) | 0.092 (0.066) |
| Foreign | 0.354 (0.545) | 0.024 (0.566) | 0.015 (0.083) | 0.024 (0.079) | 0.050 (0.078) |
| Authority | -0.288 ** (0.100) | -0.245 ** (0.091) | | | |
| $R^2$/pseudo $R^2$ | 0.12 | 0.11 | 0.29 | 0.32 | 0.32 |
| N | 305 | 300 | 209 | 209 | 209 |

*Notes*
[a] Ordered Probit estimates [b] OLS estimates. Robust (Huber-White) random errors in parenthesis. All models include industry-specific dummy variables. The second-stage regressions – (2a), (2b) and (2c) – include the predicted values of the *Pay* and *Promotion* variables obtained in the first-stage – (1a) and (1b).
** $p < .01$  * $p < .05$  † $p < .10$.
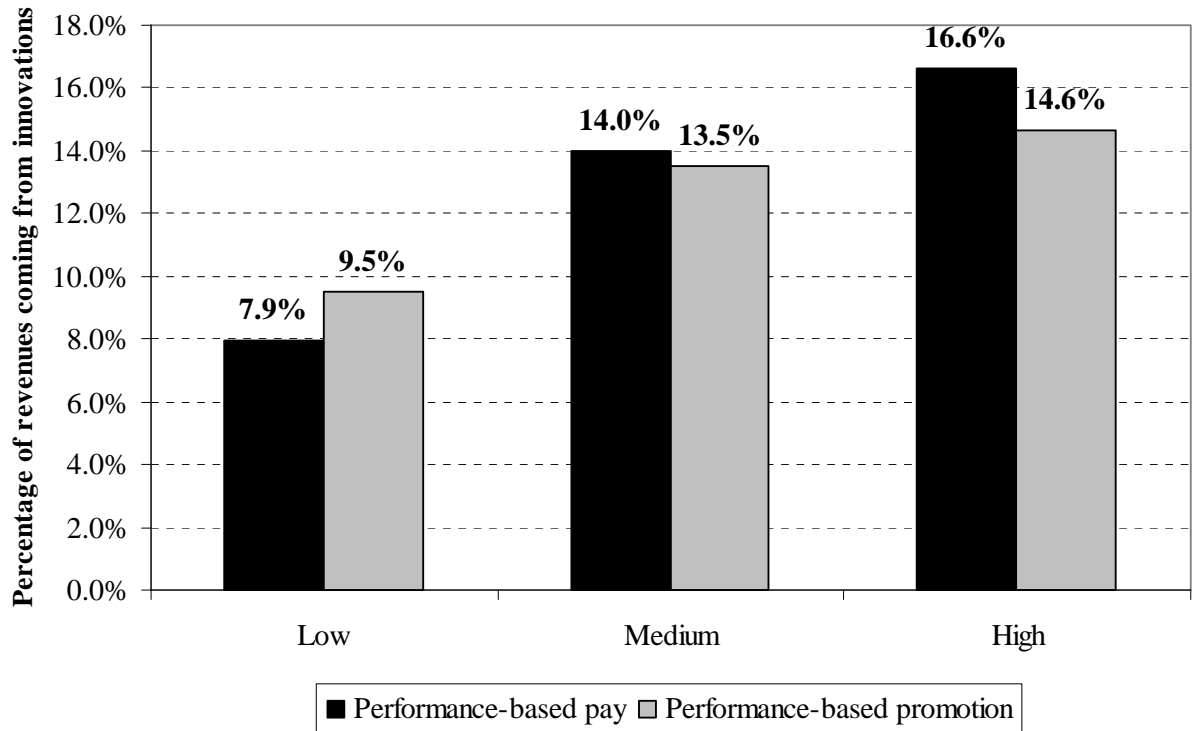
**Fig. 1.** Percentage of revenues coming from innovations reported by a sample of Brazilian firms, according to different levels of meritocracy (performance-based pay and performance-based promotion)