CORPORATE HIERARCHY AND VERTICAL INFORMATION FLOW INSIDE THE FIRM — A BEHAVIORAL VIEW

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Little is known about how corporate hierarchies influence managers' propensity to pass information upward within the firm. Two streams of literature arrive at seemingly conflicting and untested predictions. Information economists maintain that middle managers pass more suggestions up the firm's line of command as the corporate hierarchy increases in order to avoid corporate omission errors. In contrast, scholars of organizational psychology suggest that hierarchies lead to evaluation apprehension and foster a perceived lack of control among mid-level managers, leading to their reduced willingness to, and interest in, passing information up within the organization. Drawing on field data and model-guided experimental studies, we provide original empirical evidence for the relevance of all the mechanisms above, and we delineate the conditions under which either mechanism prevails. Copyright © 2014 John Wiley & Sons, Ltd.

INTRODUCTION

Hierarchies—layers of sequential authority—are ubiquitous in organizations and are introduced to solve two key design problems: enabling coordination and fostering cooperation among employees (Lawrence and Lorsch, 1967; March and Simon, 1958). To what extent hierarchies achieve these goals in knowledge-intensive firms, however, depends on at least two questions: how they help provide information to decision makers, and how they affect decision makers' behavior.

The first question has led strategy scholars to distinguish between different types of knowledge, notably tacit and codified knowledge, arguing for co-locating the place of decision making and the point where tacit and idiosyncratic knowledge is retained in the firm, for such knowledge can "be exercised only by those who possess it" (Grant, 1996: 118; see also Burgelman, 1991, 1994; Løvås and Ghoshal, 2000; Noda and Bower, 1996). The second question, however, of *how hierarchical organizations affect a manager's behavior*, notably her propensity to act on the information available to her, remains virtually unstudied by mainstream strategy scholars, and has so far been addressed only theoretically by two neighboring disciplines, which arrive at conflicting predictions.

Information economists, in the behaviorally most parsimonious way, suggest modeling managers as individuals whose utility is derived from their share in overall corporate profits and their investment in screening, including screening costs. Consequently, mid-level managers should use their superiors as rechecking devices to avoid omission errors and

should therefore pass up more information the more hierarchical is their environment (first prediction) (Sah and Stiglitz, 1986: 722).[1] Organizational psychologists, however, implicitly criticize the information economics view as failing to account for important behavioral tendencies that lead mid-level managers to pass up less information the more superiors they have (second prediction). More specifically, employees' perceived lack of control over their initiatives can lead them to psychologically withdraw from organizational goals (Greenberger and Strasser, 1986; Parker, 1993), a situation exacerbated by centralized decision making (a characteristic of hierarchical organizations) (Morrison and Milliken, 2000). Equally, mid-level managers' fear of negative feedback from superiors when erring in passing information up (referred to as *evaluation apprehension*) has been suggested to increase with the degree of organizational hierarchy, again reducing the amount of information mid-level managers would pass up the firm's ladder. Yet, as of today, neither information economists nor organizational psychologists have conducted robust tests that would shed light on the validity and the relative importance of these two conflicting predictions. The resulting lacunae in our understanding translate into two research questions: first, do behaviorally minimalistic models, as suggested by information economists, describe vertical information flows sufficiently well? And second, if not, which behavioral refinements are needed, and what are their boundary conditions?

Considering the omnipresence of hierarchies as means of governing organizations, and taking seriously the quest to better define the psychological underpinnings of strategy theory (Powell, Lovallo, and Fox, 2011: 1380), the current paper addresses both of these questions. We do so by deploying a three-pronged identification strategy, drawing on multiple methods and different sets of data (Van de Ven, 2007; Webb *et al.,* 1966). First, leveraging observations pertaining to approximately 10,000 idea-proposal assessments for product and process innovations in a large consumer goods corporation, we provide field evidence of instances in which mid-level managers pass up less information the steeper the hierarchical environment that surrounds them. Having thus challenged the all-embracing explanatory power of the information economics view, in a second step we introduce behavioral extensions to the information economic baseline model of decision making. Here, we formalize the effects of evaluation apprehension and lack of control in a simulation model of hierarchical decision making, which allows us to determine the parameter spaces in which hierarchies should either increase or decrease the propensity of middle managers to pass information up to their superiors. Third, and finally, we test the predictions derived from our model in a laboratory study, designed to identify (1) whether and when managerial agents recognize value in using their superiors as rechecking devices (as suggested by information economists), and whether and when (2) evaluation apprehension or (3) lack of control overrides such rational behavior. Our experimental findings suggest that subjects' propensities to pass ideas up to superiors dramatically drop and become overall negative when they believe that their efforts do not properly translate into control over the final outcome. Fear of negative feedback for committing errors, on the other hand, seems to play a minor role.

Our results have implications for both theorists and managers in the field of strategy and organizational economics. Strategy scholars may find it edifying to explore the fact that organizational structure, apart from creating principal agent problems (Guth and Macmillan, 1986), also appears to be an antecedent of motivational barriers to information transfer within the firm—barriers that may exist independently of the dyadic relationships that information senders and receivers entertain with one another (Hansen, 1999; Szulanski, 1996). Organizational economists may find it warranted that the theoretical predictions by Sah and Stiglitz (1986) may neglect important behavioral biases in managers' decision making. Last, organizational psychologists may consider our theoretical integration of evaluation apprehension and lack of control with a rational model of information processing to be insightful and our empirical test on their relative impact on decision making in hierarchies to be novel contributions to the growing literature on employee voice.

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[1] This view is compatible with other works in the field of organizational economics, which suggest that different forms of hierarchies will lead to different levels of opportunism by mid-level managers, all else being equal (see, e.g., Burton and Obel, 1988).

HIERARCHY AND MIDDLE MANAGERS' PROPENSITY TO PASS UP INFORMATION

A behaviorally minimalistic view — information screening among incentive-aligned agents

In the field of economics, there is a long tradition of modeling agents' (optimal) decision making and information revelation within organizations in a behaviorally parsimonious fashion. Starting from the premise that (1) information asymmetries and (2) sub-goal differences exist among (3) utility-maximizing agents at different levels in the firm, information economists embarked on award-winning works dealing with moral hazard (Holmstrøm, 1979) and principal agent conflicts (Jensen and Meckling, 1976), as well as their resolution (Spence, 1973; Stiglitz, 1975). Not surprisingly, many organizational economists followed their tradition in an effort to better understand how organizational structure fosters or mitigates the propensity of self-interested lower-level agents to pass up information (Burton and Obel, 1988; Gibbons, 1998; Tirole, 1986).

In the absence of meaningful sub-goal differences, however, another branch of the same theoretical field describes the effects of organizational structure on intraorganizational information flow in an even more parsimonious way, namely, the literature on information screening within hierarchies. Its earliest contributions date back to Marschak and Radner's team theory (1972: 130 ff.), which examines the influence of team properties on employees' information and decision costs and payoffs. While acknowledging effort-minimizing behavior of agents in a hierarchy, team theory assumes that individuals work towards the same superior goal and benefit largely from maximizing the organization's overall utility. Sah and Stiglitz (1986) elaborate on Marschak and Radner's (1972) approach, and formalize the relationship between organizational structure and the type of error it produces. At the core of Sah and Stiglitz (1986) is a comparison of two stylized decision-making regimes: a so-called polyarchy, in which different managers independently decide whether to pursue an idea/project proposed to them,[2] and a

hierarchy,[3] in which several managers sequentially depend on one another in their decision making. These two organizational forms produce different ratios of commission and omission errors under a simple set of additional assumptions: First, managers prefer more-profitable projects to less-profitable ones. Second, managers' screening is imperfect, and they can err in both directions (that is, in either under- or over-valuing the true quality of a project). Under these two assumptions, the sheer serial connection of decision makers in a hierarchy increases the comparative likelihood that a project will eventually not be supported even though its objective quality recommends it. Similarly, the likelihood of a bad project being supported increases in the polyarchy (compared with the hierarchy). Elaborating on these two core insights, Sah and Stiglitz's (1986) arguably most important proposition results when endogenizing agents' behavior in the hierarchy: assuming that mid-level managers, being aware that their judgment will be rechecked by other managers in the hierarchy, rationally adjust their decision making, Sah and Stiglitz (1986) pose that middle managers will display less-conservative screening the steeper the degree of hierarchy they operate in. Put differently, mid-level managers will pass on more ideas to their superiors for rechecking the more superiors they have.

While the predictions of Sah and Stiglitz (1986) have influenced much subsequent *theoretical* work in the field of organizational economics (Beggs, 2001; Christensen and Knudsen, 2010; Demange, 2004; Harris and Raviv, 2002; Hart and Moore, 2005), scholars have only recently begun to subject Sah and Stiglitz's (1986) predictions to *empirical* scrutiny. The only large-scale empirical test at present is by Csaszar (2012), in the mutual funds industry, corroborating Sah and Stiglitz's (1986) key prediction that centralized institutions are more prone to commission errors than decentralized organizations are. Whether mid-level managers pass up

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[2] A typical example of a polyarchical organizational setup was that of Danish hearing aid manufacturer Oticon in the early 1990s, when the CEO Lars Kolind allowed literally dozens of projects to

develop in parallel as part of his radical reorganization of the firm (for more details, see Løvås and Ghoshal, 2000).

[3] As Csaszar (2012) notes, Sah and Stiglitz's (1986) notion of a hierarchy is not necessarily identical to others in the field of organizational design, as none of the mutually dependent evaluators in their hierarchy needs to be a superior of the other. For the purposes here, we consider the special case of two evaluators connected by a line of command. This specification should not affect the generality of Sah and Stiglitz's (1986) predictions, although it puts more emphasis on the notion of a middle manager's "reservation value" (more details below).

more information the steeper the hierarchy that surrounds them, as a simple information economics model would suggest, however, is still an open question. Here, one of the crucial simplifying premises is that the middle managers' decision making is not otherwise "behaviorally" affected by their organizational environment. This assumption appears uncritical as long as hierarchies are conceptualized as peer-level organizations, in which equally senior members of the organization sequentially control one another and work towards the same superior goal and face equal costs of achieving it. This assumption, however, may have to be relaxed when applying Sah and Stiglitz's (1986) predictions to empirical reality. Hierarchies, in most organizational settings, denote managers' rank ordering along a dimension of authority. Thus, lower- and mid-level managers may not just regard their superiors as a low-cost rechecking opportunity for their own decisions. Instead, mid-level managers will likely ponder a series of other considerations before they pass information up. Even if the benefits of their actions, like those of their superiors, are tied solely to the achievement of the overall organizational goal, and as such *neither moral hazard nor principal agent considerations apply*, mid-level managers may still perceive specific "costs" in passing on information to their superiors. Notably, these costs may arise in the form of a behavioral discomfort, which has been conceptualized in the field of organizational psychology.

Adding behavior—the organizational psychology perspective

In the field of organizational psychology, scholars have long been interested in the extent to which employees communicate ideas, suggestions, concerns, or complaints upward in a hierarchy, as intraorganizational information flow may have tremendous implications for a firm's profitability and ultimately for its survival (Morrison, 2011).

The earliest contributions linking employee communication to organizational structure date back to Athanassiades (1973) and Roberts and O'Reilly (1974). These empirical studies identified upward communication distortions in hierarchies as a function of personality variables (e.g., ascendance drive, security, trust) and organizational structure (e.g., degree of authority), suggesting that individuals were particularly reluctant to convey negative information to superiors. This finding is in line with earlier empirical evidence showing that the mere introduction of hierarchical structures in group settings impedes upward communication to higher-status individuals (Festinger, 1950).

Later work introduced the broader notion of "employee voice," including not only communication but any expression of ideas, information, opinions, and concerns with the intent to improve organizational or unit functioning (Greenberg and Edwards, 2009; Van Dyne and LePine, 1998). The flip side, "silence," or "organizational silence," is referred to as the process of withholding voice (Brinsfield, Edwards, and Greenberg, 2009). In a recent literature discussion of the main drivers of information distortion in hierarchical settings, Fang, Kim, and Milliken (2014) identify two main psychological mechanisms, evaluation apprehension and lack of control, which we discuss next.

Evaluation apprehension

Evaluation apprehension refers to a term coined by Cottrell (1972), and is defined as the fear of being assessed. Evaluation apprehension inhibits knowledge sharing (Bordia, Irmer, and Abusah, 2006) and may be the result of perceiving one's knowledge as inaccurate or as not valued, leading to unfavorable assessments (Wang and Noe, 2010). Hierarchy or status differences may also cause employees to believe that their inputs are not taken seriously or are perceived as inappropriate, or that they would be sanctioned for speaking up (Detert and Edmondson, 2011; Morrison and Milliken, 2000; Morrison and Rothman, 2009; Pinder and Harlos, 2001).

As of today, however, little empirical evidence exists that organizational silence is truly co-determined by organizational hierarchy. Direct empirical evidence is scarce and limited to a few studies, two of which appear most relevant to the current paper. Milliken, Morrison, and Hewlin (2003) conducted a survey of 40 employees and find that 20 percent of the cases mentioned refer to hierarchical structure as a reason for silence (p. 1462). Detert and Trevino (2010), in another survey study, with 89 individuals, also find qualitative evidence that employees may be inhibited from speaking up to their superiors. For both studies, however, it is (and, given the data, must remain) unclear to what extent these results may be confounded by/correlated with other explanations.

Indirect empirical evidence for the effect of organizational hierarchy on employee silence is

inconclusive, too. Laboratory studies of small groups and teams as well as field studies of organizational structure and compensation systems showed "that sometimes steeper hierarchies help groups perform better and sometimes they do not. Sometimes flatter, more egalitarian structures were better for group and organizational performance" (Anderson and Brown, 2010: 65, reviewing the empirical literature), a finding inconsistent with viewing hierarchies as error-prevention mechanisms.

Lack of control

The theoretical starting point for the mechanism of lack of control stems from psychological research on (the lack of) control, suggesting that failure to control one's environment adversely affects a person's responsiveness to the outside world. For instance, (experimentally induced) uncontrollable noise lowered the thresholds of subjects to tolerate frustrations and diminished task performance (Glass and Singer, 1972). Lack of control has even been linked to depression (Seligman, 1975) and has been shown to increase physical symptoms (Pennebaker *et al.*, 1977). Thus, the importance of controlling one's surrounding environment has also been emphasized by organizational psychologists (Burris, Detert, and Chiaburu, 2008; Greenberger and Strasser, 1986; Parker, 1993; Wortman and Brehm, 1975) and has been linked to the notion of voice, or, in the absence of control, "organizational silence" (Morrison and Milliken, 2000, 2003). For example, Lind and Tyler (1988) suggest that it is vital for employees to participate in the control of their environment by being able to voice their opinion. In the absence of this ability, detrimental effects for organizations may develop that can lead to, among other things, reduced motivation, dissatisfaction, and psychological withdrawal (see Burris *et al.,* 2008; Greenberger and Strasser, 1986; Parker, 1993).[4]

Centralized decision making within a corporation, as is characteristic of hierarchical organizations, has been suggested as one factor that can induce a perceived lack of control in subordinate employees and lead to organizational silence (Morrison and Milliken, 2000). Such psychological withdrawal need not be limited to the core processes governed by the organizational structure. Instead, employees who believe they have been muted in one context (e.g., their daily organizational environment) tend to overgeneralize and might stop passing any information up the hierarchy, no matter what initiative this information is related to (e.g., a project-specific initiative; see Ashforth, 1985; Greenberger and Strasser, 1991).

From the above, it follows that formally accounting for evaluation apprehension and lack of control in hierarchies would require making important changes to the information economists' baseline model. Formally speaking, both evaluation apprehension and lack of control would introduce specific costs to an agent's utility function: in terms of fear of negative feedback on commission errors in the case of evaluation apprehension, and in terms of administrative trouble for enquiries on ideas submitted in the case of lack of control. In both instances, repeated layers of authority (i.e., hierarchies) will exacerbate the relative costliness for employees to pass ideas up because their direct superiors—themselves reporting to higher (top-level) managers and behaving just like their subordinates—will forward fewer ideas to their bosses, in turn reducing management's overall value in rechecking decisions.

As a result, two conflicting predictions about the effects of organizational hierarchy emerge from the two literature streams we contrasted above. Economists have argued that hierarchies should decrease lower- and mid-level managers' conservatism in passing information on to superiors, and organizational psychologists expect to find opposite results—and both predictions may appear sensible within certain parameter spaces. However, neither research stream has, as of yet, provided a robust empirical study that shows that any parameter spaces exist in which their predictions would hold. In fact, organizational scholars have not even stated the precise conditions under which their predictions should hold.

DO HIERARCHIES INDUCE COMPLEX BEHAVIORS AMONG MANAGERS? A FIELD STUDY

To bridge the two schools of thought described above and to contribute to a more comprehensive theoretical view on the question of how

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[4] Reactions such as sabotage or other forms of deviance have been reported, too, and have been rationalized as attempts to regain control (Brehm, 1966).

organizational structure shapes agents' screening functions (Levinthal, 2011: 1517), we recall that, whereas information economists would predict that agents become more risk friendly (i.e., shift their screening function towards the left) to avoid corporate omission errors (1), all else being equal, organizational psychologists argue for an opposite effect, which may be due to agents' fear of being evaluated negatively (2), their perceived lack of control over corporate decisions (3), or a combination of both 2 and 3. Mechanisms 1 through 3 are not mutually exclusive, and they may operate at the same time. That said, empirical identifications of either mechanism 1, 2, or 3 are missing from the research literature, and boundary conditions for their relative importance have not even been stated theoretically.

Adhering to Occam's principle of theory building (see Simon, 1979: 495), the first question to pursue in order to better understand whether and how hierarchies affect managerial decision-making behavior is to ask whether behaviorally minimalistic models, as suggested by information economists, describe agents' decisions to pass information up hierarchies sufficiently well. If not, it will be immediately clear that formalizing and testing more complex behavioral mechanisms—mechanisms that account for agents' further perceptions of what constitutes benefits and costs when passing up information—will be needed to craft more-powerful theory. Within the confines of the theories we draw on, the above question is structurally equivalent to the following proposition, the conditional part of which is testable:

Proposition: If an organization exists in which mid-level managers pass less information on to their superiors the greater the degree of hierarchy that surrounds them, all else being equal, then the interplay between corporate hierarchies and managerial decision making is more complex than information economists would predict.

Our first empirical field study (below) is thus dedicated to testing the conditional part of this proposition.

Data

The setting

We test our proposition on a large dataset comprising idea submissions and evaluations, focusing on the *idea evaluation stage*. The data were collected from a single, fast-moving, consumer goods firm, headquartered in Europe. The firm is publicly listed, although many shares are held by a small number of individuals. Although the company employs about 50,000 people across 66 countries, it is known for strongly emphasizing cultural values that transcend national boundaries and that tie employees from different business unit areas together.[5] At the same time, in order to best cater to different markets, the firm is structured as a matrix, and has three broad product divisions (business units) as its primary dimension of organization and countries as its secondary dimension of organization.[6] Important for this paper, the different business units vary considerably in size and formal organizational structure, notably hierarchy (see below for further details).

In 2006, the corporation launched an initiative to spur innovation throughout the firm. Management offered gift bonuses, as well as recognition, to employees who submitted ideas for improving the firm's operations in any way (focusing on products and processes mainly, however). The data gathered during the submission and evaluation process, comprising information about the idea and biographic data on the evaluating managers and submitters, were made accessible for this study in anonymous fashion.

As part of the innovation initiative, any employee could submit an idea through an online interface. The submitter would give the idea a title, type in a short description of it (usually around 50 words), and classify it according to 1 of 54 idea categories (e.g., body care or packaging adhesives), and possibly also to 1 of 18 idea subcategories. The system would then automatically assign the idea to a set of potential first-stage evaluators who were middle managers with local/regional responsibilities in the organization (usually situated geographically close to the submitter). When reading proposals, evaluators would have to make two considerations: (1) whether the idea was relevant for their local/regional business, and (2) whether it was potentially relevant for their business unit at a global, more specifically corporate-wide (i.e., not

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[5] This feature is important. It means that the effect of the overall corporate culture on individuals' decision-making behavior is controlled for by design (one firm).

[6] The corporation underwent organizational restructuring during our data-collection period. Unfortunately, the changes pre- and post-shock are not documented well enough to exploit this exogenous feature.

necessarily worldwide) level. Ideas could thus fall into one of four potential categories: (1) entirely irrelevant, (2) solely locally relevant, (3) solely globally relevant, or (4) locally and globally relevant.[7] Importantly, an idea considered locally relevant would be pursued further by the local/regional unit in which the middle-level manager operated, and the decision on how to pursue the idea further would rest entirely with the same mid-level manager and her local peers. An idea considered (solely) globally relevant would be further evaluated by global superiors to determine its global relevance to the firm, and the local mid-level manager would not be involved in that part of the decision-making process. An idea considered to be both locally and globally relevant would undergo two separate but parallel evaluation processes—one by the local mid-level manager and her peers, and one by the global superiors. An idea deemed irrelevant during the middle manager's initial assessment would exit the process without being rechecked. Figure S1 in the online supporting information illustrates the decision-making cascade. Thus, each mid-level (local) manager operated within both a hierarchy (lower branch of Figure S1) and a flat polyarchical organization (upper branch of Figure S1), depending on whether a project fell under global or local responsibility. When a local-level manager passed ideas on to a global superior, her decisions would be reevaluated by an employee possessing greater authority (hierarchical setting). Yet, when further assessing locally relevant ideas (polyarchical setting), the local mid-level manager would only have to consult with colleagues at her level (potentially leading to a "polyarchical" scenario, in which similar or even identical ideas could be pursued by different local units at the same time).

Approximately half of the proposals received favorable evaluations (contingent on their being evaluated at all) by the middle manager. Of those relevant ideas, the middle managers deemed about 56 percent to be globally relevant, 35 percent locally relevant, and 9 percent both locally and globally relevant.

In terms of the awareness of identities, one can consider the system to be a form of single-blind review when it comes to the relationship between managers and submitters. Evaluators could see who submitted an idea in the information available to them on the online system. But evaluators remained anonymous to the submitters, so they did not need to worry about future interpersonal interactions and potential frictions with those who submitted the ideas they assessed.

Data selection

The company provided data on 22,958 anonymous valid idea proposals,[8] which were further narrowed in a number of ways: First, to facilitate a linguistic analysis of the ideas, we only considered German or English proposals (the two principal languages of the idea-submission system), reducing the number of observations to 17,718. Second, because the company does not maintain centralized personnel databases for its worldwide employees, some of the biographic information on lower-level managers is incomplete. We thus dropped those observations for which we could not unambiguously determine that the mid-level manager (first idea evaluator) belonged to one of the three main business units, which left us with a sample of 12,519 observations. Third, we excluded another 1,351 (right-censored) cases in which the idea had not been evaluated by the discontinuation of the initiative in May 2008, which left 11,168 cases. Eventually, because of incomplete biographic data, required to compute similarity measures between submitters and evaluators, we were left with a sample of 9,765 observations for the analysis.

As the description above shows, the data might in theory be subject to selection biases. In the absence of feasible ways to address the problem econometrically,[9] we therefore address the potential consequences carefully in the Discussion section.

Dependent variable(s)

The main dependent variable to test our proposition is the *business-wide relevance* (0/1) of an idea,

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[7] Note that, in an earlier paper drawing on this same raw data source (Reitzig and Sorenson, 2013) and for a different type of analysis, we lump sum these two relevance decisions at the global and local level together.

[8] For an entry to be considered valid, the online form had to be filled out in full. Incomplete entries, those submitted anonymously, or those submitted using invalid e-mail addresses thus do not appear in our records.

[9] It would not be clear which instruments the data would provide to carry out Heckman (1979) selection corrections. Also, propensity-score approaches appear to be theoretical rather than practical options, given the lack of important variables for larger parts of the subsamples.

which takes a value of 1 if the idea was declared globally relevant by the (local) middle manager, and 0 otherwise. It includes those cases in which she deemed the idea both locally and globally relevant.[10] In these instances, the mid-level manager would kick the idea proposal up to her superior, who would judge the proposal's relevance for a corporate-wide application. This variable therefore captures the local (mid-level) manager's decision to pass information on to her superior in a typical hierarchy (lower branch of Figure S1).

To corroborate our main findings, we also analyze how the same middle manager passes information on in a "polyarchical" environment (upper branch of Figure S1). The dependent variable for this additional test is called *local relevance*.

Independent variables

The key independent variable is the *degree of hierarchy of the business unit*, and it is computed at the level of the business unit in which the mid-level manager works.[11] Following the most recent work by Zhou (2009), which combines earlier approaches by Rothwell (1996) and Rajan and Wulf (2006), we count the number of subdivisions and subsidiaries in each hierarchical layer in a given business unit, and multiply this number by the rank of the layer in the business unit's overall hierarchy. Our total hierarchy measure for the business unit is the sum of these (layerwise) products. The following numerical example serves as an illustration. Assume a business unit has two layers (excluding the head office). In the upper layer there are two subdivisions, A and B. Subdivision A has five sub-subdivisions (e.g., subsidiaries); subdivision B has three. The total value for the hierarchy of the business unit is calculated as follows: Hierarchy $= 2 \times (1+1) + 1 \times (5+3) = 12$. Two aspects of this central variable appear noteworthy. First, this measure captures not only the number of hierarchical layers in an organization but also its top heaviness. This top heaviness is in line with the classic writings on the subject (Selznick, 1957) and is a welcome feature, as it increases with the number of

people who have authority in the organization. Second, the variable is computed at the level of the business unit in which the middle manager works. We do this computation because it appears more likely that the biases of interest to this paper are being induced by the permanent organizational environment in which an agent operates (i.e., his/her business unit), and not by the temporary structure of the idea funnel (see also Discussion).

In addition, we use a series of controls to strip off variance that is unrelated to the organizational environment in which the middle manager operates, but which may codetermine whether an idea is deemed relevant at the business level. Most of these enter as control variables in Stage 1 (the idea level) of our estimations, and only two enter in Stage 2 (the local manager level; see Methods for details on the different steps in the estimation procedure).

In order to strip off the variance in our dependent variable that is attributable to the idea's misfit with corporate-wide business (as opposed to local business) we include *idea categories* (e.g., body care or packaging adhesives) and *idea subcategories* (e.g., R&D and marketing) in the model.[12]

Idea proposals may also differ in quality, and quality can affect a manager's assessment of whether an idea is considered irrelevant at the business level. To capture quality differences in Stage 1 of the estimation, we first include (content-coded) word-count variables (*number of words*, *squared term of the number of words*, *word counts of positive* and *negative words*) as additional controls that should capture at least some of the proposal's quality (Blumenstock, 2008).

At the level of the individual manager, we control for *age of the middle manager* at the time of the idea evaluation as well as her *firm tenure* at the end of the innovation campaign (both measured in years). The first variable enters Stage 1 of the estimation; the second, Stage 2.[13] Moreover, we control for the middle manager's propensity to be (overly)

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[10] We explain why we pool these two cases in the Methods section.

[11] Over the observation period, the number of middle managers who changed business units was negligible (below 10%). In those instances, we stuck with the middle manager's first business unit affiliation, on the assumption that this would have the strongest imprinting on the manager.

[12] In order not to lose too many degrees of freedom, we separately include dummies for (sub)categories accounting for 5 percent or more of the entire sample. We pool the remaining categories as the reference category.

[13] In theory, we could compute both control variables for the time at which the evaluation takes place, so that they could both enter the first stage of our estimations. In practice, however, the correlation between these two variables is too high, and one of them does get dropped from the estimation. So, in order to provide maximum control and use both controls, we fix firm tenure at the time of the end of the evaluation campaign and introduce it in Stage 2 of the estimation.

optimistic (*optimism*) by calculating the difference between the number of ideas s/he deemed globally relevant and the actual number of ideas her/his global superiors confirmed to be globally relevant eventually, and then divide this difference by the number of ideas deemed globally relevant to normalize the variable between 0 and 1 (teasing out scale effects).[14] To control for the perceived geographical and cultural distance between the middle manager and her/his superiors, we introduce a dummy variable that captures whether the middle manager was stationed in the *headquarter country* (or not), using other cases as the reference category.[15] Moreover, we control for the *relative size* of the business unit in which the middle manager operates by computing the percentage share of corporate employees working in the lower-level manager's business unit. The last three variables (*optimism, headquarter country,* and *relative size*), like the *middle manager's gender*, do not vary for a given middle manager, and both variables therefore enter as controls in Stage 2 of our regressions.

Finally, at the level of the idea we also control for submitter characteristics and resulting similarities between submitter and middle manager, as these may affect the middle manager's propensity to promote or suppress suggestions (Szulanski, 1996). *Submitter age* and *submitter firm tenure* provide controls for potential differences in idea proposals that are related to prior experiences of the individual, assuming that prior business exposure may prove useful in suggesting more feasible ideas. Also, the demographics of submitters and their evaluators may matter in relative terms in that similarities between the two persons bias evaluations in a positive direction (Cox, 1993). We therefore include six similarity measures that capture such dyadic relationships (*same country of operation, same unit, same nationality, same gender, negative age difference, difference in firm tenure*). *Same unit* takes on the value of 1 (0 otherwise) if both the submitter and evaluator of an idea belonged to the same division of the firm and worked at the same site (Reitzig and Sorenson, 2013).

Methods

To tease out the relevant effect of hierarchy on business-wide relevance without discarding valuable information in the data, we pursue a two-stage estimation technique as described by other authors previously (Reitzig and Puranam, 2009).

In Stage 1, we model business-wide relevance at the level of the individual idea as a function of fit- and quality-related variables (*idea categories, idea subcategories, word counts*), local manager characteristics that change over the observational period and thus with each new idea evaluation (*age*), submitter characteristics (*age* and *tenure*), and time-variant biographic similarities between submitters and middle managers (*same country of operation, same unit, same nationality, same gender, negative age difference, difference in firm tenure*) according to the following specification:

Stage 1 ：

$$bus\_wide\ relevance_{i,j} = \beta_1 \times quality_{i,j} + \beta_2$$
$$\times fit_{i,j} + \beta_3 \times middle\ manager_j$$
$$+ \beta_4 \times submitter_{i,j} + \beta_5 \times similarity_{i,j}$$
$$+ \alpha_{i,j} + \mu_j \qquad (1)$$

here, *i* represents variation at the idea level, and *j* represents variation at the local manager level, which also varies over time[16] (i.e., is not time invariant, such as the *middle manager's age* at the date of submission/evaluation of the idea). Estimating Model 1 as a fixed effects model allows for computing the predicted residual $\hat{\mu}_j$ that characterizes the middle manager's preference for deeming an idea globally relevant after controlling for all other effects except organizational environment and other time-invariant characteristics of the middle manager.

In Stage 2, we can thus estimate the pure effect of hierarchy on the residual propensity of the middle manager to deem an idea relevant business-wide, γ_1 controlling for the size of the organization (i.e., business unit) in which the mid-level manager operates, as well as some (not all) characteristics of the middle manager that stayed constant over time

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[14] Corner solutions are set to zero for cases in which the middle manager did not pass on any idea of potential corporate-wide importance. The measure is conservatively biased as it counts a missing evaluation by a corporate manager as a negative evaluation.

[15] Virtually all senior (global) managers were situated in the corporation's headquarters, which is why the dummies provide effective ordinal distance measures.

[16] Note that, for the sake of readability, we excluded suffixes related to the time of the evaluation process. The different evaluations do take place over a period of two years, however, so certain evaluator features change over time.

(i.e., *optimism, headquarter country, gender*) or that were computed for a given point in time (i.e., *middle manager tenure*).

$$Stage\ 2:$$
$$\widehat{\mu}_j = \gamma_1 \times hierarchy_j + \gamma_2 \times size_j + \gamma_3$$
$$\times middle\ manager_j + \varepsilon_j \qquad (2)$$

Results

Few if any observations appear noteworthy in terms of descriptive statistics, and interested readers are referred to Table S1 in the online supporting information; variable means are of the expected order of magnitude, and correlations are mostly low to moderate. The somewhat higher correlation between hierarchy and size of the business unit is not problematic per se; however, it deserves attention when analyzing the multivariate results (see below). Table 1 reports the main test results. Column 1 shows the first-stage estimate deploying a standard multilevel logit model, the most efficient and unbiased estimator given the dichotomous nature of the dependent variable. Column 2 replicates the results using a linear probability (LP) model (ordinary least squares, OLS), which may suffer from inefficiency despite being consistent. Encouragingly, both the limited dependent variable (LDV) model and the LP model show convergent results in terms of coefficient significance, enabling us to draw on the OLS fixed effect regressions (column 2) to predict the residual unobserved heterogeneity at the level of the local managers—our dependent variable in the Stage 2 regressions (column 3).[17]

As expected, the likelihood of an idea being deemed globally relevant increases with its perceived relevance at the local level. The relevant marginal effect of the LP model points to an increase of almost one third in business-wide relevance for a locally relevant idea. The number of words dedicated to an idea description, a rough proxy for the underlying quality of the proposal, has an inverse U-shaped effect on business-wide relevance, with an inflexion point at about 220 words

(lying within data range). As local manager age increases, the likelihood of an idea being deemed relevant business-wide decreases rather substantially. Finally, whereas ideas could be submitted across business units in the corporation, middle managers seemed to prefer ideas that came from employees in their own unit.

The core result of the paper is presented in Column 3 of Table 1 (displayed in bold and italic). Controlling for local manager gender, firm tenure, optimism, distance to the global managers' headquarters, and size of the business unit,[18] we find the predicted negative effect of hierarchy on the likelihood to pass an idea on for further global (i.e., corporate-wide) evaluation.[19]

Finally, Table S2 in the supporting information presents the mirror image of the results when using *local relevance* as the dependent variable, controlling otherwise similar covariates as presented in Table 1. As such, it does not present tests directly related to this paper's proposition, but it sheds light on the effects of hierarchy on the lower level manager's decision-making behavior when she operates in her polyarchical environment. We will selectively refer to these latter results further below. Most important, and as predicted, there is no hierarchy effect visible in Model A2 (column 3).

Discussion of field results and exclusion of alternative explanations

The results presented in Table 1 are plausible as far as Stage 1 is concerned, and they are also robust to alternative specifications not presented in this paper.[20] The core findings in Stage 2 suggest—per our proposition—that the information economics perspective, as a parsimonious explanation for intraorganizational information flow, does not sufficiently depict managerial decision making in the field. Quite to the contrary, the direction of the effect suggests that invoking behaviorally richer

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[17] Note that predicting the fixed effect residual is not feasible when estimating the first stage as a multilevel LDV model. An alternative one-stage estimation approach using so-called Mundlak instruments within a random effects logit model (Mundlak, 1978; for a recent application to the field of strategy, see Reitzig and Puranam, 2009) yields consistent, albeit less significant results for the core hierarchy variable.

[18] Note that results are robust to logging the size of the business unit variable. This means that the hierarchy measure does not capture nonlinear effects of business unit size, as one might otherwise fear given the correlation between the two variables.

[19] Importantly, size and hierarchy are jointly and individually significant. We can thus exclude that effects of multicollinearity create an estimation artifact. Also, variance inflation factors are well below 3.

[20] For example, results do not qualitatively change when introducing time variables that capture the period between submission and evaluation (on average taking about 78 days). More information is available from the authors upon request.

Table 1.   Field data: modeling business-wide relevance

	Stage 1 (idea level): logit, conditional fixed effects	Stage 1 (idea level): OLS, fixed effects	Stage 2 (local manager level): OLS
Idea characteristics			
Number of positive words (/10)	0.612**	0.129**	
	(0.279)	(0.054)	
Number of negative words (/10)	−0.322	−0.041	
	(0.557)	(0.109)	
Number of total words (/100)	1.138***	0.217***	
	(0.111)	(0.020)	
Number of total words (/100) squared	−0.251***	−0.047***	
	(0.043)	(0.007)	
Idea sub/categories	YES	YES	
Middle manager characteristics			
Age of middle manager (at date of idea submission)	−0.959***	−0.174***	
	(0.072)	(0.013)	
Middle manager is male			0.721***
			(0.193)
Firm tenure of middle manager (at end of innovation campaign)			0.116***
			(0.010)
Optimism of middle manager			0.748**
			(0.297)
Middle manager is based in headquarter country			0.303*
			(0.177)
Submitter characteristics			
Age of submitter (at date of idea submission)	0.006	0.001*	
	(0.004)	(0.001)	
Firm tenure of submitter (at date of idea submission)	−0.009**	−0.002**	
	(0.004)	(0.001)	
Similarities between middle manager and submitter			
Age difference (absolute) $\times (-1)$	0.000	−0.000	
	(0.004)	(0.001)	
Same unit	0.401***	0.080***	
	(0.075)	(0.015)	
Same gender	−0.005	−0.001	
	(0.048)	(0.009)	
Same nationality	−0.006	−0.000	
	(0.115)	(0.022)	
Same country	−0.044	−0.003	
	(0.159)	(0.031)	
Firm tenure difference (absolute)	−0.006	−0.001	
	(0.004)	(0.001)	
Organizational environment			
Hierarchy of business unit of middle manager			***−0.015****
			(0.006)
Size of business unit of middle manager			0.028***
			(0.010)
Constant		7.487***	−0.490
		(0.542)	(1.182)
Observations	9,628	9,765	110
R^2		0.078	0.672
Log-likelihood	−5,218.8481		

Standard errors appear in parentheses. *significant at 10 percent; **significant at 5 percent; ***significant at 1 percent.

mechanisms, like evaluation apprehension and lack of control, may be needed to adequately capture agents' propensities to pass information upward within hierarchical firms.

As with every field study, controlling for all contingencies is notoriously difficult, and mechanistic identification has its inevitable limits. Thus, we eventually provide complementary evidence for the interplay and, more important, the relative magnitude, of the three mechanisms (information economics, evaluation apprehension, lack of control) in the form of a simulation study and a companion laboratory experiment in the next section of this paper.

We also rejected a series of alternative explanations pertaining to the field data itself, however. Notably, we ruled out (1) that our findings are likely spuriously driven by the imperfection of our quality controls, (2) that mid-level managers learned about their superiors' preferences and thus adjusted their propensity to pass up information over time, (3) that middle managers behaved overly optimistically, (4) that business units would differentially sanction or reward their mid-level managers within this initiative, (5) that hierarchy was correlated with competence allocation, (6) that between-manager variance in preferences for certain ideas would account for our findings, and (7) that managers had major incentives to behave opportunistically in this campaign. An in-depth detailed dismissal of these alternative explanations is available in the supporting information.

FORMALIZING MANAGERIAL BEHAVIOR: EVALUATION APPREHENSION AND LACK OF CONTROL

Whereas the above findings show the need to refine our understanding of how hierarchies influence mid-level managers' propensity to pass up information, the field study stops short of identifying behavioral mechanisms and quantifying their differential effects on agents' decision making. To facilitate a conclusive experimental test that is suited to shedding light on these open questions, we next derive model-based predictions that will guide our laboratory study. To that end, we formalize the effects of evaluation apprehension and lack of control in a hierarchical organizational environment in which agents, all else being equal, demonstrate decision-making behavior that is consistent with

the key tenets of information economics. Within the confines of this model, we then delineate the parameter spaces under which different types of managerial behaviors should become observable, if they exist.

Task environment

Agents are tasked with assessing idea submissions of heterogeneous quality. In each evaluation (simulation) round, they face a distribution of 10 ideas that are normally distributed around a threshold value T; however, agents are unaware of the distribution. Each idea has a quality signal q, which is noisy. Noise is modeled as a confidence interval C within which q resides. C can be reduced to 0 (i.e., to a point estimate) by agents in exchange for an investment i, which corresponds to their real-world opportunity costs of spending time on a different activity (work-related or other) rather than determining the quality of an idea. Agents receive an endowment e_A, which allows them to determine q for fewer than 10 ideas.

Idea submissions that are not implemented despite the fact that $q \geq T$ creates an omission error E_O for the firm. Idea submissions that are implemented despite the fact that $q < T$ creates a commission error E_C for the firm.

Agent goals and behaviors

Up to three different agents operate in a line of sequential decision making: the mid-level manager, her direct superior (in the case of a two-layer hierarchy), and her top manager (in the case of a three-layer hierarchy). Mid-level managers assess a set of 10 ideas in each simulation round, and they can pass up n_1 ideas (maximum 10) of these ideas to their direct superior. Direct superiors always reassess those ideas that are being passed on to them from scratch, and they decide on the implementation in the case of two-layer hierarchies, whereas they pass on up to n_1 ideas to top managers in three-layer hierarchies. Top managers reassess those ideas that are being passed on to them from scratch and decide on their implementation in the case of a three-layer hierarchy. Whenever the quality of a single idea cannot be determined with precision by the most senior decision maker in the hierarchy, she must guess whether to implement the idea or not. By design, she will make the correct decision in 50 percent of all cases.

Payoffs for all agents strictly and equally increase with the number of ultimate errors (Σ over all E_O and E_C) *avoided* at the level of the organization—that is, across the hierarchy. To avoid unnecessary complications, we attribute equal payoffs to the avoidance of commission and omission errors.[21] Agents share the same screening function; in other words, they agree on what constitutes an omission and what constitutes a commission error. Superiors (i.e., simulated agents) randomly over- and underestimate idea quality. Finally, payoffs are diminished individually for agents depending on the type of decision-making scenario that is being formalized (see below).

Information economics

In the base case, the individuals' payoffs consist of an equal split of the overall corporate profits minus their cumulative individual investments in detecting idea quality, I_A. Agents thus face a tradeoff between reducing their individual investments (i.e., opportunity costs) for screening ideas and increasing overall corporate profits, of which they retain a share. Agents' incentives to cooperate on the avoidance of errors are maximally aligned, allowing mid-level managers (and direct superiors in three-layer hierarchies) to behave opportunistically as regards the investment of their individual endowments only.

Information economics and evaluation apprehension

In this case, agents' individual payoffs consist of an equal split of the overall corporate profits minus (1) the evaluation apprehension costs, c_{EA}, which they incur for making an objective commission error in their assessment,[22] and (2) their cumulative individual investments in detecting idea quality, I_A. Thus, lower-level agents still face a tradeoff between reducing their individual investments (i.e., opportunity costs) for screening ideas

and increasing overall corporate profits, of which they retain a share, albeit evaluation apprehension costs for themselves and their superiors may change the optimal allocation pattern of their investments. Also, agents' incentives to cooperate on the avoidance of errors are still aligned; however, not only can mid-level managers (and direct superiors in three-layer hierarchies) behave opportunistically as regards the investment of their individual endowments, but they may also seek to avoid commission errors individually.

Information economics and lack of control

Agents' individual payoffs still consist of an equal split of the overall corporate profits minus (1) the administrative costs, c_{LC}, which they incur when passing on a (good or bad) idea; and (2) their cumulative individual investments in detecting idea quality, I_A. Agents' incentives to cooperate on the avoidance of errors are still aligned to some extent. However, mid-level managers (and direct superiors in three-layer hierarchies) will trade off their share in corporate profits and the costs of passing on ideas, and subordinates have incentives to behave opportunistically as regards the investment of their individual endowments.

Model implementation and predictions

With an eye on the need to implement our optimization routines across a number of participants in the laboratory experiment (see next section), we elected to implement our simulation model on a widely available commercial platform (MS Excel). Using Excel's standard evolutionary solver algorithm, we ran a series of simulations that would, for a given quality distribution of ideas across T as well as for given values of E_O and E_C, compare the payoffs to a mid-level manager in the case of a two-layer and a three-layer hierarchy, depending on (1) the endowments that agents would receive to screen idea quality, (2) the costs of evaluation apprehension (if applicable), (3) the costs of passing ideas up the hierarchy under lack of control (if applicable), and (4) the chosen pattern of ideas being passed on by the mid-level manager to her direct boss. To compute these mid-level manager payoffs, we always optimize the payoffs that would accrue to the direct superior (irrespective of whether we simulate a two- or a three-layer hierarchy), so as to account for the fact

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[21] This simplification, while uncritical in a model by definition, also appears unproblematic in our experiment despite subjects' well-known omission bias (Baron and Ritov, 1994; Spranca, Minsk, and Baron, 1991) for two reasons. First, we experimentally condition subjects to appreciate the avoidance of commission and omission errors equally. Second, any remaining bias in our results should conservatively distort our findings for the base case treatment (see also Results and discussion in the Experimental section).

[22] These costs do not apply to the highest decision maker, solely to her subordinates.

that behavioral effects, if they exist, should affect both mid-level managers and their direct superiors.[23] Figure 1(a–c) illustrate parameter combinations for E_O, E_C, $e_{Midlevel}$, $e_{Direct\ Superior}$, $Top\ Manager$, $I_{Midlevel}$, $I_{Direct\ Superior}$, $I_{Top\ Manager}$, c_{EA}, and c_{LC} under which rational mid-level managers should prefer to pass more ideas up the steeper the hierarchy that surrounds them (as information economics would predict), and vice versa (as organizational psychologists would predict), all else being equal. Note that, to keep the illustrations tractable, we assume that endowments are equal for all superiors, and that evaluation apprehension costs and costs associated with lack of control are identical for mid-level managers and direct superiors in the case of two-layer hierarchies. Also note that, for the particular parameter space we have chosen, it is the direct superior's unwillingness to pass any idea up to her top-level manager that drives the main differences in profits for two-layer as opposed to three-layer organizations in Figure 1(b, c).

We would eventually draw on these parameter combinations to design experimental stimuli that should allow for the identification of the individual mechanisms of information economics, evaluation apprehension, and lack of control in the laboratory, should these mechanisms determine subjects' decision-making behavior at all. Put differently, we resorted to our formalizations to create an experiment that should be conservatively biased, allowing us to be confident in denying the existence of either mechanism if we did not manage to validate it in the laboratory under the given settings. They translate into three testable predictions:

Prediction 1: Mid-level managers pass more ideas on to their superiors the steeper the hierarchy that surrounds them (as information economists would predict), as long as mid-level managers and their superiors work towards the same goal and share the same screening function, and as long as mid-level managers' costs of passing ideas up are confined to their opportunity costs of saving their endowment.

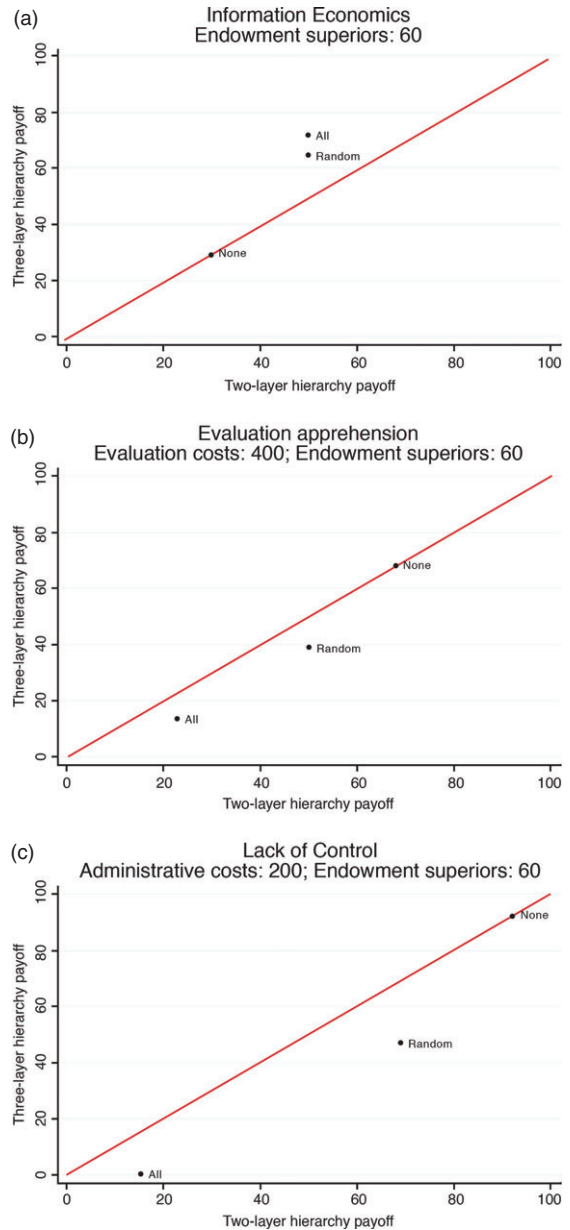An instance in which these conditions will be fulfilled is when mid-level managers must assess

Figure 1. (a–c) Simulation results. Simulation results comparing mid-level managers' normalized payoffs (across hierarchy levels within treatment) in the case of information economics (a), information economics and evaluation apprehension (b), and information economics and lack of control (c) for three-layer hierarchies and two-layer hierarchies. *All* refers to the case in which all 10 ideas are passed on by the mid-level manager, *Random* refers to the case in which the mid-level manager passes on some ideas at random, and *None* refers to the case in which the mid-level manager does not pass on any ideas

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a set of 10 ideas—distributed normally around a threshold level T—with noisy quality signals, a maximum of six of which they can assess with precision ($e_{Midlevel} \leq 180$), four of which they cannot assess with precision, and when $E_O = -1,000$, $E_C = -1,000$, $e_{Midlevel} \leq 180$, $e_{Direct\ Superior} \leq 60$, $e_{Top\ Manager} \leq 60$.

> *Prediction 2: Mid-level managers pass fewer ideas on to their superiors the steeper the hierarchy that surrounds them (due to evaluation apprehension), as long as mid-level managers and their superiors work towards the same goal and share the same screening function, and as long as mid-level managers' costs of passing information up consist of their opportunity costs of saving their endowment and the costs they incur in receiving negative feedback when they overestimate quality.*

An instance in which these conditions will be fulfilled is when mid-level managers have to assess a set of 10 ideas—distributed normally around a threshold level T—with noisy quality signals, a maximum of six of which they can assess with precision ($e_{Midlevel} \leq 180$), four of which they cannot assess with precision, and when $E_O = -1,000$, $E_C = -1,000$, $e_{Midlevel} \leq 180$, $e_{Direct\ Superior} \leq 60$, $e_{Top\ Manager} \leq 60$, $c_{EA} = 400$.

> *Prediction 3: Mid-level managers pass fewer ideas on to their superiors the steeper the hierarchy that surrounds them (due to perceived lack of control), as long as mid-level managers and their superiors work towards the same goal and share the same screening function, and as long as mid-level managers' costs of passing information up consist of their opportunity costs of saving their endowment and administrative costs.*

An instance in which these conditions will be fulfilled is when mid-level managers have to assess a set of 10 ideas—distributed normally around a threshold level T—with noisy quality signals, a maximum of six of which they can assess with precision ($e_{Midlevel} \leq 180$), four of which they cannot assess with precision, and when $E_O = -1,000$, $E_C = -1,000$, $e_{Midlevel} \leq 180$, $e_{Direct\ Superior} \leq 60$, $e_{Top\ Manager} \leq 60$, $c_{LC} = 200$.

CONTRASTING INFORMATION ECONOMICS, EVALUATION APPREHENSION, AND LACK OF CONTROL: EXPERIMENTAL EVIDENCE

Experimental design and procedure

Sixty students (28 females; $M_{age} = 26.42$, $SD_{age} = 4.93$) at a large European university were randomly assigned to the conditions of a mixed factorial design with the between-subjects factor *mechanism* (information economics, evaluation apprehension, lack of control) and the within-subjects factor *hierarchy* (two layers, three layers). The study was computerized, programmed in Python, and based on the same optimization algorithm that was used for the simulation results reported earlier (see the previous section for details).

In the experiment, participants were told that they would assume the role of an employee with one or two superiors in a study on organizational decision making. The experiment consisted of two blocks of 20 periods, with the following structure for each period:

1. *Idea screening*: Participants were given the lower and upper bounds of 10 ideas (see *A* and *B* of Figure S2 in the online supporting information) and were told that the true "quality" of an idea would fall somewhere between these bounds. Participants were informed that in general an idea would only be worth pursuing if the quality were equal to or greater than an absolute threshold value of 50 quality units (on a scale of $1-100$).

   In order to determine the quality of ideas more precisely, participants could invest parts, or all, of their per-period endowment of 180 experimental currency units (ECU).[24] By investing 10, 20, or 30 ECU and clicking "refresh" (see C and D of Figure S2 in the online supporting information), the quality noise interval would shrink by 20 units, respectively. More specifically, without investing, the difference between the bounds was 60 units; by investing 10 ECU, the difference would drop to 40 units; by investing 20 ECU, the difference was 20 units; and by investing 30 ECU, participants would receive a point

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[24] The exchange rate between ECU and Euros was set such that participants could make between €10 (US$13.7) and €25 ($34.25), including a €10 ($13.70) show-up fee, in the experiment.

estimate of the quality of an idea. Note that the true quality of an idea was not the midpoint between the bounds but fell somewhere between the bounds, so that participants had to invest the total sum of 30 ECU to ascertain that an idea exceeded/fell below the threshold. Given their endowment, participants could thus evaluate 6 of the 10 ideas precisely (6 × 30 ECU = 180 ECU) in each period. Residual endowments, that is, endowments that were not invested, were added to a participant's take-home payment.

2. *Decision to pass ideas up*: For each idea, participants could decide whether to pass the idea on to their superior or not (see G of Figure S2 in the online supporting information). Participants were explicitly made aware of the two types of errors that could occur when making their decisions: errors of commission (passing up ideas whose values were below the threshold) and errors of omission (not forwarding ideas whose quality exceeded the threshold). They were also informed that such errors were costly to the organization and reduced its overall profit, in turn reducing their own payment.

3. *Decision of superior(s)*: Participants were told the number of direct superiors in each period (see H of Figure S2 in the online supporting information). In the case where there was one superior, this superior had 60 ECU to invest in the reevaluation of those idea(s) that were passed on (and *only* those) to her. Notably, the superior evaluated potential ideas from scratch; that means she did not see the participant's original assessment, but she implemented or dismissed those ideas she could determine with certainty, and she rolled the dice on the remaining ones to determine their implementation.

   In the case where there were two superiors, the direct superior did as above and decided which ideas to further pass along to her superior, who would reevaluate these forwarded ideas from scratch again. That second superior then evaluated potential ideas and determined implementation as above.

4. *Payoffs*: At the end of a period, a computer algorithm (identical to the one described in the previous section on our simulation results) maximized the overall profits of the first superior in the hierarchy, which were modeled as an equal share (with the subject, and potentially the second superior) of the overall organizational profits. The latter increased linearly with the number of total avoided errors (omission and commission), and it was reduced by the endowment invested by the first superior. Payoffs for the subjects were then determined for the parameter values resulting from this optimization procedure, and they were displayed to participants not only for the current period, but also for each of the last 10 periods (see I of Figure S2 in the online supporting information). Participants were also reminded about the number of hierarchy levels for each of the past 10 periods and the current period number (see J and E of Figure S2 in the online supporting information).

Specific design features and conditions

In each period, exactly 5 (of the 10) ideas proved worthy of investment (i.e., had a quality equal to or greater than 50 quality units); however, the exact values of the bounds and ideas were determined randomly before the experiment was run and then applied in the exact same order to every participant. We did this to make learning comparable across conditions.

There were two sets of 20 periods in the experiment. For every treatment, the first 20 periods were identical. These periods represent what we call the base case: the information economics setting, conditioning our subjects to appreciate the avoidance of both omission and commission errors. For the second set of 20 periods, we had three (between-subjects) conditions:

1. *Information economics*: In this condition, participants had another 20 periods of the same setting, but they were given different idea-quality distributions.

2. *Evaluation apprehension*: In this condition, participants were told that their superior(s) had the ability to determine whenever the participant made a commission error, in which case a participant's period earnings were reduced by 400 ECU. The rationale for capturing evaluation apprehension purely in terms of costs rather than in terms of actual behaviors (like shame, fear of speaking up, etc.) is that the latter are harder to capture in experiments and are subject to large interindividual differences (Tzieropolous *et al.*, 2010).

3. *Lack of control*: In this condition, participants were told that for each submitted idea they would face administrative costs of 200 ECU. The rationale for capturing lack of control by

administrative costs is that they reflect the time the participant has to spend to deal with further evaluation requests by her superior(s), regardless of whether she correctly sends up a good idea or mistakenly passes up a bad one.

The parameters for the three mechanisms were chosen to ensure that each mechanism allows for the predicted pattern to emerge; that is, for information economics, participants' expected earnings increase if they pass more ideas up in the three-layer hierarchy as compared to the two-layer hierarchy, all else being equal. For evaluation apprehension and lack of control, the opposite picture emerges: participants' expected earnings increase if they pass fewer ideas on in the steeper hierarchy relative to the less steep hierarchy, all else being equal. Thus, if participants exhibit the predicted sensitivity in terms of their idea-submission behavior as a function of hierarchy, this provides conclusive evidence about the existence of the mechanism in question. Furthermore, the chosen parameters allow us to make inferences about the relative strength of the various mechanisms.

Results and discussion

Given the experimental nature of our data, few observations appear noteworthy in terms of purely descriptive statistics. The average number of ideas passed up by a subject in the different treatments was 5.68 (information economics), 5.43 (evaluation apprehension), and 4.40 (lack of control). Individuals earned, on average, about US$31 per session, with the variable, performance-based component of their payoff amounting to 90 percent of their total revenue—thus indicating that subjects engaged in the experimental task and seemed to understand it well overall.

Table 2 presents the results pertaining to the core relationships we sought to unravel in the experiment. Model 3a provides experimental support for both Prediction 2 and Prediction 3, suggesting that participants—when being sanctioned for commission errors or when incurring administrative costs for forwarding ideas—pass along fewer ideas the steeper the hierarchy that surrounds them. The results remain robust in Model 3b, in which we also control for time-invariant subject-specific effects. Notably, while both treatments—evaluation apprehension and lack of control—interact negatively with the degree of hierarchy, the interaction effect for lack of control

Table 2. Experimental data: number of ideas submitted per period as a function of experimental treatment

	Model 3a	Model 3b
Prediction 1		
Hierarchy	0.135	0.135
	(0.099)	(0.189)
Prediction 2		
Evaluation apprehension	−0.385	
	(0.323)	
Evaluation apprehension × hierarchy	−0.235[*]	−0.235[*]
	(0.123)	(0.066)
Prediction 3		
Lack of control	0.790	
	(0.549)	
Lack of control × hierarchy	−2.150[**]	−2.150[**]
	(0.285)	(0.000)
Constant	5.480[**]	5.615[**]
	(0.267)	(0.000)
Observations	1,200	1,200
Groups		60
R^2 (total)	0.38	0.21
R^2 (between)		0.48

Model 3a: Cross-sectional data, standard errors clustered by subject.
Model 3b: Multilevel data, fixed effects for subjects, standard errors clustered by subject and adjusted for degrees of freedom.
*Significant at 10 percent; **significant at 1 percent.

and hierarchy exceeds the one for evaluation apprehension and hierarchy by almost an order of magnitude. Not surprisingly, subjects generally pass up significantly fewer ideas in both treatments than in the information economics base case (for Model 3a: Evaluation apprehension + Evaluation apprehension × Hierarchy = −0.62, $p = 0.00$; Lack of control + Lack of control × Hierarchy = −1.36, $p = 0.00$). Finally, we do not find support for Prediction 1; however, directionally our results are consistent with the predicted pattern. Participants passed on more ideas the steeper the hierarchy that surrounds them in the information economics treatment. In any case, even if our subjects suffered from an omission bias (Baron and Ritov, 1994) and over-appreciated the relative benefits from avoiding commission errors, this omission bias would be too weak to account for a negative net effect of hierarchy on agents' propensity to pass up information to their superiors.

CONCLUSIONS AND FURTHER RESEARCH

The current paper shows that ultra-parsimonious nonbehavioral models—as suggested by

information economists—insufficiently account for mid-level managers' information transmission behaviors in real-world organizations. Contrary to the model's predictions, mid-level managers in the field pass on fewer ideas the steeper the hierarchy, suggesting the existence of more complex underpinning behavioral mechanisms. In our specific case, introducing another manager at the second highest level within the business unit would lead to roughly 10 percent fewer ideas being passed up from below, all else being equal. Whereas this figure is likely context-specific, it provides an idea of the order of magnitude of effect sizes. Complementary experimental results indicate that agents pass up fewer ideas the steeper the hierarchy that surrounds them once they fear negative feedback for commission errors they make or once they incur administrative costs for passing on ideas irrespective of their quality. Of the two behavioral mechanisms, the latter seems to be the most powerful by far.

Our findings appear to be relevant to different communities of scholars in the field of strategic management and organizational studies more broadly. Both behavioral strategists more broadly and colleagues examining the evolution of strategies within firms more specifically may find it interesting that employees' unwillingness to transfer information within the firm need not necessarily originate from the relationship between the sender and receiver of such information (Hansen, 1999; Szulanski, 1996). A middle manager, irrespective of her liking of a subordinate, may decline to pass a proposal by the latter on to top-level management if the firm's hierarchy either leads to the manager's detachment from corporate goals or increases the likelihood of her receiving negative feedback. Put differently, motivational barriers to idea diffusion within the firm may well be exacerbated by structural organizational features such as hierarchy. This finding also adds to a more refined picture of the true role of middle managers within the strategy formation process—a picture that other scholars have recently begun drawing (Huy, 2011; Reitzig and Sorenson, 2013), and which takes account of the particular behaviors middle managers may display because of their position within the actual corporate line of command. Notably, these prior works as well as the findings we report here highlight the challenges of using middle managers to counterbalance the actions by visionary CEOs who pursue (overly) narrow strategic trajectories in their firms,

as scholars before us have suggested (Rotemberg and Saloner, 2000).

Organizational economists may find it insightful that hierarchies in which agents are connected by a line of command can alter agents' screening functions in such a way that endogenous screening produces even more omission errors than exogenous screening. With increasing psychological detachment from corporate omission errors, the relative benefits of having decisions rechecked by superiors—to the extent that they exist[25]—appear to pale in comparison to the costs of endorsing potentially bad proposals or spending time on initiatives that are of (perceived) little value to the agent. Arguably, the most interesting practical consequence is that managers who wish to "weed out" overoptimistic decisions by their subordinates by funneling these decisions through hierarchies (Christensen and Knudsen, 2010) may want to consider implementing fewer hierarchical layers than prior contributions would suggest. Colleagues from psychology may consider our (formal) theoretical integration of evaluation apprehension and lack of control with a rational model of information processing insightful. Also, we hope they see value in our empirical test that originally adds to the largely conceptual literature on employee voice. Finally, given the empirical context of our field data, our findings also speak to scholars of corporate innovation. In their literature, there has also long been debate about how organizational structure affects the type of innovation a firm can solicit (Teece, 1996); much less attention has so far been dedicated, however, to the effects of organizational structure on the actual number of employee ideas reaching corporate management.

As usual, many intriguing questions remain unanswered, and addressing them in future work would appear worthwhile. At this point, we conclude by touching briefly on three different categories of remaining questions, the first of which results from the imperfections of our current design.

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[25] In an earlier pilot study, which we ran with analytically trained engineering and science undergraduates from one of the finest engineering colleges worldwide, we do get traction on the information economics base case; i.e., these highly formally trained students do realize the value of using superiors as rechecking devices, and they pass up more ideas the steeper the hierarchy—as per the predictions of Sah and Stiglitz (1986). However, even these subjects are easily conditioned to succumb to the mechanisms of evaluation apprehension and lack of control. More information is available from the authors upon request.

Despite best efforts, we must not exclude the possibility that omitted variables in our field data may bias our existing findings. In an ideal world, we particularly would like to control even better for an idea's fit with global business in the first stage of our regressions. We take some comfort in the fact, however, that our specifications are largely robust to the inclusion of a variable that measures whether the idea was simultaneously exploited at the local level—serving as a crude control for an idea's potential lack of fit for global business. Also, instead of relying on word counts to capture idea quality, we would optimally like to draw on multi-respondent idea reevaluations. While these data could not be feasibly obtained in this research project, future researchers may find ways to generate field data that contain these controls. Finally, to rule out that omission biases in the field might cause a negative net effect of corporate hierarchy on mid-level managers' propensities to pass up information on their own, future researchers would ideally rerun our study and compare results across organizations that differ in their emphasis on pursuing opportunities as opposed to avoiding threats.

The second category of open questions speaks to the link between organizational structure and agent behavior. Apart from the results of this first paper gained in a particular setting, what do we know about how an employee's actions are affected by the structural organizational environment we expose her to? Could an omission bias in the field ever be strong enough to account for a negative net effect of hierarchy on agents' propensity to pass up information on its own? Are our operationalizations of evaluation apprehension and lack of control optimally suited to capture what is happening in real-world organizations? And if they are, are the costs for employees in organizations similar in magnitude to our experimental test? Can the effects of hierarchy on information transfer be counteracted through incentive schemes? Do different types of managers react differently to the same environment? These and other issues appear to be critical when seriously thinking about designing organizations that employ human actors. Their examination, however, necessitates a type of data that may be difficult to find in the field, in turn stressing the need to devise intelligent laboratory experiments of sufficient validity to be meaningful for scholars interested in real-world organizations. The second kind of remaining questions evolve around the discussion about agent behavior, organizational structure, and

organizational performance. Clearly, increasing or reducing vertical information flow by affecting agents' willingness to pass up data is not good or bad per se, but its optimal degree depends on its link to corporate performance. Extending prior works in this domain (Csaszar, 2012) by allowing for more complex behavior of managers in organizations appears to be an issue worth investigating.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix S1. Alternative explanations pertaining to field data results and screen-shot of the experimental computer interface.