Coordination and Organization Design:

Theory and Micro-evidence

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Abstract

We explore the relationship between a firm's organizational structure, the instability of its local environment, and the need for coordination among sub-units. Using micro-level data on a large retailer, we empirically test and provide support for our hypothesis that a more unpredictable local environment results in more decentralization only when coordination needs are small or moderate. In contrast, more unpredictability is associated with more centralization of tasks when coordination needs are high. Our evidence is consistent with an organizational tradeoff between adaptation and coordination and theories that argue that centralized organizations may be better at coping with local shocks when coordinated adaptation is important.

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I. Introduction

The use of authority is a central feature of the way firms coordinate the production and provision of goods and services (Coase 1937; Simon 1951; Williamson 1975). While top managers are endowed with formal authority, they are unable to master all relevant information and can only attend to a fraction of the tasks and decisions of a firm. As a result, they delegate tasks and responsibilities down the hierarchy to divisional managers, department managers, and so on. What drives the allocation of tasks and responsibilities to lower-level managers? What functions do higher-level executives centralize? Despite being central to firms' operations, empirical evidence on the responsibilities and decision-making authority of managers is limited and has lagged our understanding of other organizational choices, such as firm boundaries and the provision of incentives in firms.[1]

In this paper, we empirically explore the relationship between a firm's organizational structure, the unpredictability of its local environment, and the need for coordination among organizational sub-units. Seminal economic theories on why firms delegate authority emphasize the need to adapt decisions to local information (Holmstrom 1979; Aghion and Tirole 1997; Dessein 2002). In the spirit of Hayek (1945), lower-level managers are assumed to have better information than top managers as they are closer to the firm's field operations.

However, as asserted by the organizational theorist Chester Barnard (1938), what matters for organizational performance is not just autonomous adaptation to local shocks and emergent events, but also the ability to engage in what Williamson (1996, 2002) calls "coordinated adaptation".[2] Centralized organizations may be better at such coordinated adaptation. Intuitively, despite having superior local knowledge, lower-level managers may only be able to act individually on this information. But doing so potentially results in large coordination losses for the organization (Dessein and Santos 2006, Alonso, Dessein and Matouschek 2015).[3] Similarly,

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[1] For empirical tests of incentive theories inside firms, see e.g. Lazear (2000), Bandiera, Barankay and Rasul (2007), Lo, Ghosh, and Lafontaine (2011), and Larkin (2014), and Prendergast (1999) for a survey. For empirical tests of vertical integration theories, see e.g. Hubbard (2001), Gil (2008), and Forbes and Lederman (2009), and Lafontaine and Slade (2007) for an overview.

[2] Barnard (1938), for example, defines a formal organization as "a system of consciously coordinated activities or forces of two or more persons."

[3] As argued by Alonso, Dessein and, Matouschek (2015), while lower-level managers may have better information about shocks affecting their own unit and therefore have an advantage in terms of depth of knowledge, central management may well know more about other units and therefore have an advantage in terms of breadth of knowledge. When coordinated adaptation is essential, breadth of knowledge is more valuable than depth of knowledge.

comparing centralized to decentralized decision-making structures, Aoki (1986) posits that the ability of sub-units to cope with emergent events and make use of their on-the-spot knowledge is "limited by their partial understanding of the whole mechanism operating within the firm" (p.973).[4] Incentive conflicts may also play a role: lower-level managers tend to care mainly about the performance of their particular department or unit. The need for coordination then creates an agency problem in adaptation and may result in centralization, even when local information is valuable (Alonso et al. 2008; Rantakari 2008).

Drawing on the above theories, we put forward, and empirically test, the hypothesis that a more unpredictable local environment results in more decentralization only when needs for coordination across sub-units are small or moderate. In contrast, we expect to see an association between more local uncertainty and more centralization when coordination needs are high.

To empirically examine the relationship between a firm's organizational structure, the unpredictability of its local environment, and the need for coordination of sub-units, we analyze a novel hand-collected data set that contains rich micro-level information on the job scope and authority of 189 managers employed by a larger retailer. Our usage of individual-level data sheds more light on the exact mechanisms which drive managerial authority, and distinguishes us from previous empirical work which has used establishment or firm-level data in a cross-section of industries (Colombo and Delmastro 2004; Acemoglu et al. 2007; Bloom, Sadun, Van Reenen 2012; Bloom et al. 2014; Lo et al. 2016). Our study is arguably also the first to provide direct evidence on the role of local uncertainty on the job scope and authority of middle-level managers. Our main contribution, however, is to show how the impact of local uncertainty crucially depends on the need for coordination, consistent with the literature on coordinated adaptation.

In our study, we equate local uncertainty with the unpredictability of local demand faced by an individual manager. While local uncertainty has, on average, a modest non-significant correlation with managerial authority, we find a large positive association when coordination needs are limited, but a negative association with managerial authority when coordination is very important. In all our regressions, this negative interaction effect between local uncertainty and

[4] Aoki (1986) argues that central management has "perfect a priori knowledge of technological possibilities" but has incomplete knowledge of "emergent events affecting these technologies". In contrast, sub-units have incomplete knowledge of technologies at the outset, but have better on-the-spot knowledge about emerging events (p. 971).

the need for coordination on managerial authority is highly significant. We interpret these results as supportive of our hypothesis and, more generally, of organizational theories that emphasize trade-offs in organization design between adaptation and coordination.

Institutional Context: The institutional context of our study is one of the largest retail operators in Japan and Asia. Our data pertains to twelve large general merchandise stores ("stores" hereafter) located within a metropolitan area of Tokyo.[5] Each of our 189 managers are uniquely responsible for one of 24 departments within one of these twelve stores. Examples of departments include kids apparel, lady's wear, home furnishing, cosmetics, grocery, deli, ecommerce, and customer service. Each store is managed by a general manager ("store manager"), to whom the department managers report. Performance evaluations of those managers are explicitly tied to the performance of the department assigned to them. In contrast, the store manager is responsible for the overall mall performance.

Our empirical context is appealing to test our theory for two major reasons. First, all the twelve stores are located within proximity (all contained in a 25-mile radius circle) and under the administration of the same regional headquarters in Tokyo. As such, the same unobserved heterogeneity in macroeconomic, technological, or cultural factors would affect, if at all, managerial task allocation and authority. Moreover, uniform policies on management, personnel, and compensation structure eliminate variations at the corporate level, which in turn increases the reliability of our analysis relative to a multi-corporation study. Second, each of the 24 departments covers a distinct product or service but may involve frequent coordination with other departments, for instance, on pricing, promotions, merchandise, or customer service. With a shared environment and rich micro-level data, our "insider econometrics" study (Ichniowski and Shaw 2013) provides an appealing context to examine managerial issues related to the way organizations coordinate sub-units, delegate tasks to managers, and cope with uncertainties.

For each of the department managers, we survey data regarding their responsibilities and authority with respect to fifteen tasks. Examples of tasks include sales, merchandise, ecommerce, pricing, training, and so on. As a proxy for the unpredictability of the local environment, we have survey data, for each department manager, on the volatility of local demand and its impact on sales, profits, and the daily routines of each manager. As a proxy for the need for coordination,

[5] We provide exact definition and detailed summary on these general merchandise stores in sub-section 4.1 on p,13.

we have survey data, for each department manager, on how important coordination between different departments and functional managers is to perform his/her job well.

To measure managerial authority, we collected data on the job scope of each department manager in terms of the number of tasks delegated to him/her. Concretely, the company provided us with 15 tasks which a manager's job may be involved in. The job scope of a manager, however, typically only includes a subset of the 15 possible tasks. On average, the task allocation of a given manager consists of just 11.3 tasks out of 15. For example, a manager may not have any responsibility for ecommerce or training. Importantly, there is a substantial variance in the job scope of a department manager: the standard deviation is just above four tasks. We view the job scope of a manager as a central measure of a manager's authority as it is both a relative objective measure and the clearest indication of a manager's authority. A task not being part of a manager's job is the ultimate sign of a lack of authority and responsibility. Other empirical papers which partially use job design and task allocation are Bloom, Sadun and Van Reenen (2012), who survey manufacturing managers to see if they have responsibilities for marketing and sales decisions.[6]

Additional analysis: While our main measure for managerial authority is the overall job scope of a manager – namely overall task delegation, we also glean insights in the mechanism behind our results by dissecting the fifteen tasks in two categories, based on how much coordination they require with other departments in the same store. Concretely, we identified five tasks – including marketing, customer service, and ecommerce – that required much more coordination than average, as reported by the department managers. We refer to those as functional tasks, and the remainder – for instance, sales, pricing, personnel management – as departmental tasks. We obtain two results. First, consistent with existing theories (Alonso et al. 2008; Dessein, Garicano, and Gertner 2010), these five functional tasks are, on average, more likely to be centralized than the ten departmental tasks Second, if one excludes these 5 coordination-intensive tasks from the data, then local uncertainty always has a positive – albeit mild – impact on delegation. In other words, we only find a negative effect of local uncertainty on delegation for the subset of tasks that are coordination intensive. Intuitively, it is only for those tasks that coordinated adaption is important.

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[6] Among theory papers, see Dessein, Garicano, and Gertner (2012) for a model that explicitly analyzes which functions should be centralized at headquarters, and which ones should be decentralized at the division level.

Our main analysis controls for store fixed effects, experience, education, age, and gender of managers, and competition. Not surprisingly, experience is an important driver of task delegation. Competition, on the other hand, tends to reduce task delegation, which is consistent with the theory in Alonso et al. (2015), but different from cross-industry studies at the establishment-level such as Bloom et al. (2010), Meagher and Wait (2013), and Lo et al. (2016) which generally find a positive impact of competition on delegation. As argued by Alonso et al. (2015) more intense competition may make coordination between sub-units more important. This, in turn, may result in more centralization.

We also perform a number of robustness checks. First, we find similar qualitative results when we use department fixed effects, even though some departments (e.g. deli, groceries, fish, processed meats) receive significantly more task delegation than others (e.g. pharmacy). Second, we find qualitatively similar results when we exclude departments (e.g., customer service) that do not directly face customers and, hence, generate sales revenues. Third, to control for endogenous sorting of workers into jobs, we include personality traits in our regressions (Ackerberg and Botticini 2002), such as "agreeableness", "risk loving", and "career aspiration." Again, our results are robust though managers with a high "agreeableness" tend to sort into jobs that are more coordination intensive, whereas "`risk-loving" managers tend to match with jobs facing more local uncertainty. Managers with a higher score for "career aspiration" tend to be delegated more tasks, but this variable is not correlated with our other independent variables. Finally, we obtain similar qualitative results (reported in an online appendix), when we use, as an alternative measure of local information, the instability of a worker's routines and daily job, rather than the unpredictability of profits and sales revenues.

To conclude our analysis, we test a final prediction of our theory. Keeping local uncertainty fixed, a decrease in the center's quality of information or an increase in the center's cost of information acquisition should always result in more delegation, even when the need for coordination is high. To test this hypothesis, we follow Acemoglu et al. (2007) who argue that firms who operate in more heterogeneous environments and, hence, are more idiosyncratic, are more likely to be decentralized, because the greater heterogeneity makes learning from others more difficult (p.1760). As Acemoglu et al., we view idiosyncrasy (department-specific heterogeneity) as a proxy for the information acquisition costs and information noise of central management. As our data is on a retail firm, however, we use dispersion in the sales growth rate rather than dispersion in productivity growth to create a proxy for such heterogeneity. Concretely, we posit that the more a department's sales growth rate deviates from that of the store it belongs to, the more idiosyncratic a department is. In our data, there is only a weak correlation between demand idiosyncrasy and our local uncertainty variable. This suggests that demand idiosyncrasy does not capture the magnitude or frequency of local shocks, but simply information asymmetries about such shocks. Consistent with the prediction of our theory – and similar to related findings in Acemoglu et al., we find a significant positive effect of demand idiosyncrasy on task delegation, and only a weak negative interaction effect with the need for coordination. Even when the need for coordination is large, demand idiosyncrasy still has a positive marginal effect on delegation. In contrast, for the same set of departments, local uncertainty only has a significant positive effect on delegation when the need for coordination is small (and a negative marginal effect when coordination needs are high).

II. Literature Review

2.1. Determinants of delegation

While we are not the first paper to study the impact of local information on delegation, empirical studies on the determinants of delegation have been relatively scant. In one early study, Baiman (1995) shows that managers whose business unit is in a different 2-digit SEC code as their parent are delegated more authority. Acemoglu et al. (2007) find that firms closer to the productivity frontier or firms who are operating in more heterogeneous industries (as measured by heterogeneity in productivity growth) are more likely to be decentralized. Recently, Huang et al. (2017) shows how state-owned-enterprises in China are more likely to be decentralized when the distance to the government is farther. The proxies for local information used in the above studies mainly measure the information disadvantage of central management – that is how difficult it is for headquarters to be informed about local circumstances. In contrast, our measure of local uncertainty captures the unpredictability of the local environment itself. As our theoretical model shows, higher information costs or more information noise for central management always results in more decentralization. In contrast, the impact of an increase in local uncertainty has an ambiguous impact on decentralization and depends on the need for coordination.[7]

[7] In contrast, our measure of "demand idiosyncrasy" is similar in nature to the proxies for local information in the above paper: it mainly captures the information cost and information noise of central management.

A number of other studies provide indirect tests of the impact of local information, for example by examining the impact of product market competition (Bloom, Sadun, and Van Reenen 2010, Meagher and Wait 2013), information and communication technology (Colombo and Delmastro 2004; Guadalupe, Li and Wulf 2013; Bloom et al. 2014), firm and plant size (Colombo and Delmastro 2004, McElheran 2014), the experience of salespeople (Lo et al. 2016), and cultural aspects such as trust (Bloom, Sadun and Van Reenen 2012).

While the trade-off between adaptation and coordination plays a central role in the recent theories of organizational design, there are few papers that consider the impact of the need for coordination on organizational design. One exception is McElheran (2014) which studies the delegation of decision rights over IT investments across establishments and firms. Whereas she observes more delegation in establishments that contribute more to firm sales, she finds less delegation in establishments whose production is more integrated with the rest of the firm. Local information plays no role in this analysis.

As noted above, all of the above research uses firm-level or establishment-level data in a cross-section of industries, typically manufacturing firms. This stands in contrast with many influential studies on the provision of incentives in firms, which often focus on data from one establishment.[8] Similarly, recent empirical work on vertical integration decisions has tended to focus on a single industry (e.g., Hubbard 2001;, Gil 2008; Forbes and Lederman 2009).

2.2 Japanese employment features

While not its main contribution, our paper also adds to the understanding of Japanese employment practices. Close coordination among same rank peers is a distinct characteristic of Japanese companies. Aoki's (1986) pioneering study formalizes the comparison between American-style and Japanese-style firms as one of vertical control versus horizontal coordination respectively. He observes that American firms are apt to stipulate clear job descriptions, rules and operation manuals for employees to follow, and focus on specialization and hierarchical control to attain efficiency. In contrast, Japanese firms tend not to be specific about descriptions of daily tasks, but emphasize the capability of employees to cope with uncertainties through

[8] See, for example, Baker, Gibbs, Holmstrom (1994), Lazear (2000), Bandiera, Barankay and Rasul (2007). For more recent “within-firm" studies, see Larkin (2014), Friebel et al. (2017) and Frederiksen, Kahn, and Lange (2018).

learning by doing. Their focus is on the use of on-the-spot knowledge and horizontal coordination by sub-units (p. 973).

Similarly, Nonaka (1994) also identifies learning on the spot as a key feature of Japanese management. He conceptualizes that lower-level employees first acquire information and knowledge through their daily activities and coordination and then the acquired knowledge is codified and formalized at the organizational level. As such, Japanese firms are more likely to accord a higher degree of task authority to lower level employees. Morita (2005) also notes that, unlike American firms, Japanese firms frequently use job rotations and on-the-job training to enrich employees' experiences and expand their skill set. These practices generate "multi-skilled" employees who work efficiently with one another to cope with emergent events (p.70).

III. Theory

In this section, we put forward and theoretically motivate our main hypotheses. While we propose a new model with novel empirical predictions, the main mechanisms underpinning our hypotheses are borrowed from a rich literature in organizational economics. This literature views the production process within a firm as consisting of a number of tasks which must be adaptive to local shocks, but also coordinated with each other.[9] In other words, firms must achieve `coordinated adaptation' to a changing external environment. To fit our empirical exercise, one should think of a firm as one particular store.

In section 3.1, we provide an overview of the main ingredients of our model, state its main implications and discuss the underlying intuitions. We also discuss connections with related models in the literature. Section 3.2 provides a detailed exposition and derivation of our results and can be skipped by a reader who is mainly interested in the empirical analysis.

[9] See, for example, Cremer (1980), Aoki (1986), Dessein and Santos (2006), Alonso, Dessein and Matouschek (2008, 2015) and Rantakari (2008, 2011).

3.1 Overview

Formally, consider an organization which consists of n departments $i \in \mathcal{I} = \{1, ..., n\}$. Each department is operated by a (different) department manager. In addition, there is also one general manager. Each department i must carry out a set of tasks $(t_{i,k})_{k \in \mathcal{K}}$. Following Dessein and Santos (2006), Alonso, Dessein and Matouschek (2008, 2015), and Rantakari (2008), each task $t_{i,k}$ must be responsive to a department specific shock θ_i but also coordinated with the tasks $t_{j,k}$ of other departments, with $j \in \mathcal{I}_{-i}$.[2] The shock θ_i is normally distributed with variance σ_i^2 and is uncorrelated across departments. Both coordination and mal-adaptation costs take the form of a quadratic loss function, as is common in the literature, with β_{ij} the weight on the coordination loss. Thus β_{ij} characterizes the need for coordination between department i and j, and $\beta_i = \sum_j \beta_{ij}$ the overall need for coordination of department i.

The main organizational choice is whether to keep task $t_{i,k}$ in headquarters, or to delegate task $t_{i,k}$ to the department manager m_i.[3] In the context of our empirical analysis, the company which we study, has identified a set of 15 tasks that a department manager may get involved in such as marketing, customer service, merchandise, sales, pricing, personnel... On average, however, the job of a department manager is only involved in 11 of those 15 tasks, with substantial variation among managers.[4]

A key feature of our model is that while a department manager has an informational advantage in observing the local shock θ_i the general manager is better at coordinating tasks across departments. Intuitively, the general manager has better organization-wide knowledge and, hence, is able to achieve better coordination on this task (Aoki 1986, Alonso et al. 2015). The flipside of this is that the general manager has worse local (departmental) knowledge: acquiring information

[2] We follow Dessein and Santos (2006) in modeling the coordination and adaptation losses. We follow Alonso et al. (2008) and Rantakari (2008) in modeling the incentive conflict between the general manager and the department manager.

[3] As pointed out by Dessein, Garicano, and Gertner (2010), while large organizations are generally organized into business units or departments, there are almost always some functions that are centralized at the corporate level. This raises a question of task allocation: which tasks to centralize, which tasks to delegate to the division or department managers?

[4] Empirically, the allocation of tasks from headquarters to business units or departments tends to be more observable than the real authority a manager has in carrying out a task. Baiman, Larcker, and Rajan (1995), for example, study what determines whether a business unit has direct control over all core functions such as manufacturing, operations, R&D, engineering, marketing, sales. Similarly, Aghion et al. (2007) use as a measure of decentralization the relative use of profit centers as opposed to cost or revenue centers. The argument, again, is that profit centers are delegated a broad range of tasks, whereas cost and revenue centers either control costs or revenues, but not both.

about θ_i is costly and her local knowledge will be less precise (Aoki 1986, Aghion and Tirole 1997, Dessein 2002).

Concretely, we assume that the department manager perfectly and freely observes θ_i. Instead, the general manager must incur a cost $R_i > 0$ to become informed, but even when doing so, her signal is noisy. She then observes $s_i = \theta_i + \varepsilon_i$, where ε_i is a normally distributed noise term with variance $\sigma_\varepsilon^2 = \rho\sigma_i^2$.

Finally, following Alonso et al. 2008, there is an incentive conflict between the department manager and the general manager in that the department manager does not fully internalizes coordination externalities with other departments. As a result, the department manager may be to eager to adapt to local shocks.

Based on these assumptions, our model derives the following results

Proposition 1 *(i) An increase in local uncertainty (σ_i^2) makes task delegation more likely when the need for coordination among sub-units (β_i) is small.*
(ii) An increase in local uncertainty (σ_i^2) makes task delegation less likely when the need for coordination among sub-units (β_i) is large.
(iii) An increase in the information acquisition cost of the general manager R_i and/or an increase in the noisiness of the general manager's signal (ρ) , always makes decentralization more attractive.

The mechanism underpinning the above results draws upon at least two papers:

First, in a classic paper, Aoki (1986) argues that while sub-units may have better on-the-spot knowledge, "their ability to coordinate their decisions between themselves [is] limited by their partial understanding of the whole mechanism operating within the firm" (p 973). Instead, Aoki contends that "[central] management possesses a perfect a priori knowledge of technological possibilities of shops" but has incomplete knowledge of emergent events affecting these technologies (p. 971). While Aoki does compare the efficiency of hierarchical and decentralized decision-making structures in coping with emerging events, his focus is on the collective learning-by-doing by sub-units, a central feature of Japanese manufacturing firms. As such, his model does not yield testable predictions for our setting.[5]

[5] Proposition 2 in Aoki (1986) does provide a condition which depends on the technological matrix which characterizes interdependencies between shops,.and which is necessary and sufficient for hierarchical decision-making to be optimal. Unfortunately, this condition does not provide an easily testable prediction (loosely speaking, matrices which.are more strongly dominant-diagonal favor decentralization).

Second, and related to the argument by Aoki (1986), Alonso et al. show that for sufficiently interdependent decisions, a central manager who is partially informed about each sub-unit is better at adapting production to local shocks than sub-unit managers who know a lot about their own unit but very little about others. Intuitively, lower-level managers may only be able to act individually on their information. When coordination is important, doing so results in large losses for the organization. Lower-level managers are then forced to largely ignore their local knowledge, an insight first put forward by Dessein and Santos (2006). Put differently, centralization is optimal when coordinated adaptation to local shocks is essential. In contrast, decentralization is optimal when autonomous adaptation suffices.

While our paper can broadly be construed as supportive of the theories in Aoki (1986) and Alonso et al. (2015), neither model lends itself to be directly tested in our data:

(i) Whether a centralized organization is better at adapting to local shocks in Alonso et al. only depends on the need for coordination, not on the amount of local uncertainty (σ_i^2). The key interest of our paper, instead, is the interaction between local uncertainty and the need for coordination.

(ii) In both papers, all organizational decisions are either centralized or decentralized. Thus, both papers compare a horizontal information structure with a vertical information structure. This does not fit our empirical context, where we observe a hybrid form of centralization and decentralization: some tasks are centralized for one department, but delegated in another department.

To resolve the above issues, our model differs from Alonso et al. along the following two key dimensions:

(1) As in Aghion and Tirole (1997), we introduce an information acquisition cost for the general manager R_i. The general manager needs to incur this cost to learn about local shocks.

(2) We use the coordination technology proposed by Dessein and Santos (2006), which allows for flexible delegation decisions (resolving (ii) above).

In the next section, we provide a detailed exposition of our model and as well as a derivation of our main comparative statics.

3.2 A model of coordinated adaptation

Consider an organization which consists of n departments $i \in \mathcal{I} = \{1, ..., n\}$. Each department is operated by a department manager, m_i, with $i \in \mathcal{I}$. In addition, there is also one general manager m_g. Each department i must carry out a set of tasks $(t_{i,k})_{k \in \mathcal{K}}$. The main organizational choice is whether to keep task $t_{i,k}$ in headquarters, or to delegate task $t_{i,k}$ to the department manager m_i. To simplify notation, we will drop the subscript k, and present the model as if there was only one task per department. The extension to $K > 1$ tasks is immediate.

3.2.1 Pay-offs and information

Formally, each task t_i with $i \in \mathcal{I}$, requires taking a *primary action* a_i. This action must be adapted to a local shock θ_i, which is normally distributed with mean μ_i and variance σ_i^2. Department manager i perfectly observe θ_i. Whenever there is imperfect adaptation, that is $a_i \neq \theta_i$, department i suffers adaptation losses $-(a_i - \theta_i)^2$. In addition, each task t_j with $j \in \mathcal{I}_{-i}$ must take a *coordinating action* c_{ji}. Whenever $c_{ji} \neq a_i$, the organization incurs a coordination loss $-\beta_{ji}(a_i - c_{ji})$. Given the above discussion, profits of the organization are given by

$$\pi_g = \sum_{i \in \mathcal{I}} \left\{ h(\theta_i) - (a_i - \theta_i)^2 - \sum_{j \in \mathcal{I}_{-i}} \beta_{ji}(a_i - c_{ji})^2 \right\}$$

3.2.2 Managerial Preferences

We follow Alonso et al. (2008, 2015) and Rantakari (2008) in assuming an incentive conflict between department managers and the general manager. In particular, we posit that manager i only cares about the performance of his own department, given by

$$\pi_i = h(\theta_i) - (a_i - \theta_i)^2 \tag{1}$$

$$-\lambda \sum_{j \in \mathcal{I}_{-i}} \beta_{ji}(a_i - c_{ji})^2 \tag{2}$$

$$-(1 - \lambda) \sum_{j \in \mathcal{I}_{-i}} \beta_{ij}(a_j - c_{ij})^2 \tag{3}$$

In contrast, the general manager cares about the performance of all divisions, $\pi_g = \sum_{i \in \mathcal{I}} \pi_i$. In expression 1, the term $\lambda > 0$ is the fraction of coordination losses caused by action a_i which are internalized by department manager i. It follows that whenever $\lambda < 1$, the department manager is too eager to adapt to the local shock θ_i. Departmental preferences are consistent with the institutional settings of our empirical analysis, where performance evaluations of department manager are directly tied to the peformance of their department.[6]

[6] Departmental preferences can be endogenized along the lines of Athey and Roberts (2001), Dessein, Garicano, Gertner (2010), Friebel and Raith (2010) or still Rantakari (2013), at the expense of a more complex and cumbersome model.

Note that our model does allow for the special case where $\lambda = 1$ and department managers simply maximize firm profits (e.g. their interests are fully aligned with the general manager). .

3.2.3 Organization Design

The main organizational design decision is whether or not to centralize task t_i at headquarters, or delegate task t_i to the agent. Task centralization improves the information of headquarters and allows for better coordination, but requires costly information acquisition.

Information and Organization Design Under *task delegation*, only the department manager observes θ_i. The assumption that the department manager has an informational advantage in observing local information is standard in the literature (see, e.g., Jensen and Mackling 1995, Aghion and Tirole 1997, Dessein 2002).

Under *task centralization*, at a cost R_i, the general manager learns a noisy signal about θ_i. This is similar in spirit to Aghion and Tirole (1997), where the principal is assumed to have a higher cost of information acquistion than the agent. In particular, we assume that by incurring R_i, the general manager observes a noisy signal

$$s_i = \theta_i + \varepsilon_i$$

where ε_i is normally distributed with variance $\sigma_\varepsilon^2 \equiv \rho\sigma_i^2$. This is similar in spirit to Aghion and Tirole (1997), where the principal is assumed to have a higher cost of information acquistion than the agent.

An alternative interpretation of R_i is that it represents the higher (opportunity) cost of the headquarter manager to carry out task t_i. Note that this interpretation allows R_i to be negative, in which case it is 'cheaper' for a task to be carried out at headquarters than at the departemental level. In order to derive comparative statics on the *probability of delegation*, we assume that the headquarter cost R_i is a uniformily distributed random variable with cdf $G(.)$, whose value is realized prior to the organization design decision.

Coordination and Organization Design Task i and $j \neq i$ must be coordinated, which requires that department manager j chooses an action $c_{ji} = a_i$ where a_i is chosen by the department manager i (task delegation) or by the general manager (task centralization). There are two ways to achieve such coordination

Ex ante coordination: As long as $E(\theta_i) = \mu_i$ is common knowlegde across the organization, the department or general manager can always avoid coordination losses by setting $a_i = \mu_i$. No communication is then needed to achieve coordination. Indeed, in the absence of any communication, department manager j then optimally chooses $c_{ji} = \mu_i$. Dessein and Santos (2006) refer to this as "ex ante" coordination. The vector $(\mu_i)_{i\in\mathcal{I}}$ can be interpreted as the standard operating procedures of the firm.

Ex post coordination: The general manager or the department manager i, however, may want to adapt a_i to the local shock θ_i in which case effective communication about a_i is required in order to achieve coordination. Dessein and Santos (2006) refer to this as "ex post" coordination. When $a_i \neq \mu_i$ is chosen by deparment manager i, we assume that such ex post coordination is successful with probability $p_D < 1$ and fails with complimentary probability $1 - p_D$.[7] In contrast, when $a_i \neq \mu_i$ is chosen by the general manager, we assume that ex post coordination is successful with probability $p_C = 1$.

The assumption of perfect coordination under centralization is made for simplicity. What matters for our results is that vertical coordination is more effective than horizontal coordination, that is $p_C > p_D$.[8] Intuitively, while the general manager lacks local knowledge, she has general firm-wide knowledge and a better understanding of how to coordinate departments. As such, she understands better – or can communicate better – what action c_{ji} department j must undertake to achieve coordination with department i. For our purposes, it is not important whether the general manager centralizes c_{ji} or can perfectly communicate to department j the desired choice of c_{ji}.

3.2.4 Timing

We summarize our the timing of model and action choices as follows:

1. Headquarter cost R_i is realized.

2. **Organization Design**: The general manager (GM) decides whether to centralize task t_i and or whether to delegate task t_i to the department manager i (DM)

[7] One possble interpretation is that p_i is a measure of communication quality – that is the ability of agent i to communicate effectively his non-standard action to agent j. In Alonso et al. (2008), the quality of coordination also depends on the ability to communicate, but communication breakdowns stem from communication being strategic and noisy, as in Crawford and Sobel (1982).

[8] This assumption is similar to that in Alonso et al. (2008, 2015). In the latter models, however, a task is either centralized across all divisions, or decentralized to all division. Under centralization, there is then no need for communication to achieve coordination. Consistent with our data, our model allows for a task to be centralized for some departments and decentralized for others.

3. Local Information θ_i is realized and observed by manager m_i. If task t_i is centralized, GM can observe $s_i = \theta_i + \varepsilon_i$ at cost R_i.

4. **Action Choice** a_i and realization of adaptation losses $-(a_i - \theta_i)^2$.

5. Coordination

   (a) If $a_i = \mu_i$ there is never mis-coordination.

   (b) If $a_i \neq \mu_i$ there is mis-coordination with department $j \neq i$ (that is $c_{ji} \neq a_i$) with probability $1 - p_D$ if t_i is delegated to the department manager. There is never mis-coordination under centralization.

3.3 Optimal Task Allocation

3.3.1 Task Delegation

For a given realization of θ_i and action a_i, expected pay-offs to department manager i equal

$$E(\pi_i|a_i,\theta_i) = h(\theta_i) - (a_i - \theta_i)^2 - \lambda \sum\nolimits_j \beta_{ji} E((a_i - c_{ji})^2) - (1-\lambda)T$$

where T is a term which is independent of a_i and where $c_{ji} = a_i$ with probability p_D (ex post coordination is successful) and $c_{ji} = \mu_i$ with probability $1 - p_D$ (ex post coordination fails, and manager j coordinates with the ex ante optimal action μ_i)

It follows that

$$\begin{aligned} E(\pi_i|a_i,\theta_i) &= h(\theta_i) - (a_i - \theta_i)^2 - \lambda \sum\nolimits_j (1-p_D)\beta_{ji}(a_i - \mu_i)^2 - (1-\lambda)T \\ &= h(\theta_i) - (a_i - \theta_i)^2 - \lambda(1-p_D)\beta_i(a_i - \mu_i)^2 - (1-\lambda)T \end{aligned}$$

where $\beta_i \equiv \sum_j \beta_{ji}$. Hence, maximizing her pay-offs, division manager i chooses

$$a_i = a_i^D \equiv \mu_i + \left(\frac{1}{1+\lambda\beta(1-p_D)}\right)(\theta_i - \mu_i).$$

It follows that under delegation, expected coordination losses are given by

$$\begin{aligned} CL_D &= E((1-p_D)\beta_{ji}(a_i^D - \mu_i)^2) \\ &= (1-p_D)\beta_{ji}\left(\frac{1}{1+\lambda\beta(1-p_D)}\right)^2 \sigma_\theta^2 \end{aligned}$$

and expected adaptation losses are given by

$$\begin{aligned} AL_D &= E((a_i^D - \theta_i)^2) \\ &= \left(\frac{\lambda\beta(1-p_D)}{1+\lambda\beta(1-p_D)}\right)^2 \sigma_\theta^2 \end{aligned}$$

from which

$$AL_D + CL_D = \sigma_\theta^2 - \frac{1+(2\lambda-1)\beta(1-p_D)}{(1+\lambda\beta(1-p_D))^2}\sigma_\theta^2$$

3.3.2 Task Centralization

Under task centralization, there are no coordination losses as the general manager can perfectly communicate a_i to manager j. Hence, if the General Manager incurs the cost R_i to learn s_i, firm profits are maximized by setting

$$a_i = E(\theta_i|s_i) = \mu_i + \frac{1}{1+\rho}(s_i - \mu_i)$$

where, recall, $\rho \equiv \sigma_\varepsilon^2/\sigma_\theta^2$ is a measure of the informational disadvantage of the general manager.

It follows that adaptation losses under task centralization (with information acquisition) equal

$$AL_C \equiv E(\theta_i - E(\theta_i|s_i))^2 = \frac{\rho}{1+\rho}\sigma_\theta^2$$

If the general manager does not incur R_i, she simply sets $a_i = \mu$ and adapation losses equal $AL_C^{NI} = \sigma_\theta^2$

3.3.3 Organization choice

Note first that the GM will never delegate, regardless of the realization of R_i, whenever

$$AL_C^{NI} < AL_D + CL_D$$

or still, whenever

$$1+(2\lambda-1)\beta(1-p_D) < 0$$

Indeed, the GM is then strictly better off centralizing task i and take an uninformed decision rather than delegating task i to manager i.

Assume therefore that

$$1+(2\lambda-1)\beta(1-p_D) > 0 \tag{4}$$

so that it is never optimal for the GM to centralize and not acquire information. The GM then optimally chooses to centralize a task if and only if the cost of centralization (the information acquistion cost R_i) is smaller than

$$R_i \leq AL_D + CL_D - AL_C$$

that is, if and only if

$$R_i \leq \bar{R} \equiv \frac{1}{1+\rho}\sigma_\theta^2 - \frac{1+(2\lambda-1)\beta(1-p_D)}{(1+\lambda\beta(1-p_D))^2}\sigma_\theta^2$$

Hence, the probability of delegation is given by

$$P = 1 - G(\bar{R})$$

where $G(.)$ is the cdf of R_i, assumed to uniformily distributed.

It follows that whenever $P \in (0,1)$,

$$\frac{\partial P}{\partial \sigma_\theta^2} = g(\bar{R})\left[\frac{1+\beta(2\lambda-1)(1-p_D)}{(1+\lambda\beta(1-p_D))^2} - \frac{1}{1+\rho}\right]$$

Note

$$\frac{\partial P}{\partial \beta \partial \sigma_\theta^2} = -g(\bar{R})(1-p_D)\frac{[1+\lambda\beta\,(2\lambda-1)\,(1-p_D)]}{(1+\lambda\beta(1-p_D))^3}$$

which is negative given (4). Moreover in the limit, as β goes to infinity

$$\lim_{\beta\to\infty}\frac{\partial P}{\partial \sigma_\theta^2} = -\frac{1}{1+\rho}g(\bar{R}) < 0$$

whereas $\frac{\partial P}{\partial \sigma_\theta^2} = g(\bar{R})(\frac{\rho}{1+\rho}) > 0$ for $\beta = 0$. We obtain the following result

Proposition 2 *We have that*

$$\frac{\partial P}{\partial \beta \partial \sigma_\theta^2} \leq 0$$

and there exists a $\bar{\beta}$ *such that*

$$\begin{aligned} \frac{\partial P}{\partial \sigma_\theta^2} &\geq 0 \text{ if } \beta < \bar{\beta} \\ \frac{\partial P}{\partial \sigma_\theta^2} &\leq 0 \text{ if } \beta > \bar{\beta} \end{aligned}$$

where the inequalities are strict whenever $P \in (0,1)$. *In contrast, we have that*

$$\frac{\partial P}{\partial \beta} \leq 0; \frac{\partial P}{\partial \rho} \geq 0 \text{ and } \frac{\partial P}{\partial \lambda} \geq 0$$

where the inequalities are strict whenever $P \in (0,1)$..

IV. Data and Measurement

4.1 The company and the stores under our study

Japan's retail market generated over US$1.3 trillion in sales in 2017 and is among the largest in the world. The focal company that provided access to data is a major retailer that operates a large portfolio of various retail formats such as shopping malls and convenience stores throughout the country. Our sample covers 12 general merchandise stores ("stores") in a company designated sales region in the metropolitan area of Tokyo. North American Industry Classification System (NAICS: code number 452) defines general merchandise stores as "establishments in this subsector are unique in that they have the equipment and staff capable of retailing a large variety of goods from a single location." Outside of Japan, Target, Wal-Mart, Marks and Spencer, and Tesco are examples of companies that operate similar stores. Two of our sampled stores are located in large shopping malls while the remainder are standalones. The average floor space of the 12 stores we sampled is over 20,000m^2, with a store employing about 480 employees and catering to over 11,000 daily shoppers on average. Sales per square footage in 2017 is US$340, which is slightly higher than the average for United States retailers (US$325).

4.2 Store managers and department managers.

A store manager who directly reports to the regional headquarters is the head of a store. A given store may operate all or a subset of the following 24 departments (or functions): kids apparel, lady's wear, clothing and accessories, underwear, men's wear, home furnishing, cosmetics, grocery, liquor, daily food, deli, produce, processed meat and poultry, fish, home appliances, fast moving consumer goods (FMCG), pharmacy, online business, sales operation, cashier, customer service, information technology (IT), partners, and shop-in-shop. Each department has one, and only one, manager ("department manager") who reports to the store manager, and who manages the department's staff and daily business. Figure 1 shows the organizational structure of the sampled region and its stores.[10] Our study includes 189 department managers, who are of the same rank, working in one of the 12 stores. A department manager is then the focal *unit of analysis* in our study. Consistent with common management practice in Japan, many managers have gone through job or site rotations and on-the-job training (Morita 2005).

[10] Figure 1 also includes the list of 15 managerial tasks. We describe the tasks in the next sub-section on variables and measurement.

<Insert Figure 1 and Table 1 about here>

4.2.1 Coordination

To manage a store's business, each month the store manager and all department managers hold several meetings together to come up with a monthly master sales plan. The master plan defines targets and activities in terms of major store operations such as targeted customers, sales and marketing, merchandise, and inter-departmental coordination. Managers also participate in weekly (e.g., Sunday evening) and daily meetings in the morning in which the store manager and/or department managers review progress with respect to goals set in the monthly master plan. In those meetings, one of the main topics is how to allocate tasks and coordinate daily operations. For instance, managers across departments have to synchronize contents and/or timing on merchandise, price, staffing, and marketing materials for sales promotions or weekend events. They may also work on standards and variation on services, training, and hygiene, and resolve conflicts and customer complaints. Besides formal meetings, we observed department managers and/or the store manager exchange ideas and information and make small decisions in the office, hallways, or on the shop floors. These managerial practices are consistent with emphasis on both rank-hierarchy and peer coordination in the literature of Japanese corporate governance (e.g., Jackson and Miyajima 2007, pp.5-6).

4.2.2 Performance evaluation and compensation

Similar to employment practices of most large Japanese corporations, the company's compensation scheme is based on qualification, ability, and performance as its major components (Jackson 2007, p.293). On the one hand, the majority of the compensation received by department managers is a fixed salary that is commensurate with their industry and company work experience, qualifications, and positions. Performance pay, on the other hand, is made up of three components: (i) a summer bonus, (ii) a winter bonus, and (iii) an achievement bonus. The first two seasonal bonuses sum up to a maximum of four months of the base salary while the achievement bonus can equal one month's worth of base salary. The amount of performance pay is partly based on the achievement of "numerical" targets (i.e., sales revenue and gross profit) and partly based on "behavioral" aspects that relate to corporate and store missions (e.g., merchandise development) and special priority areas (e.g., cross-merchandise selling, food waste rate, price discount depth). In conjunction with a senior manager in the store or a panel of senior managers, and based on company evaluation guidelines, the store manager formally evaluates and decides on the performance pay for each department manager. Importantly, the level of fixed salary and the evaluation and structure of performance pay are *identical* across departments and across stores. Hence, this uniform compensation structure at the department and store levels provides an ex ante incentive scheme that is not variant among department managers (Lo et al. 2011).

4.3 Selection of survey participants and data collection procedure

To shed light on issues of managerial authority and coordination among peer managers, secondary data are unlikely to come by. Instead, we chose to use a survey to collect primary data. To design our questionnaire, we conducted two rounds of meetings with company executives and managers. The first round of meetings involved executives working in the strategic planning function of the company president's office. These face-to-face meetings, accompanied by email exchanges, provided an overview of the mission and strategy, geographic coverage, market competition, organizational issues, types of retail formats, financial performance, major challenges, and store operations. The company eventually designated all of the twelve stores belonging to a regional Tokyo metropolitan sales district for our study. After gathering more specific information on internal organization, compensation scheme, and performance metrics of managers in the stores, we designed a list of pilot questions and conducted full-day visits to two stores. At the two stores, we met the store managers, senior managers (e.g., deputy store manager), and several department managers. These onsite pilot interviews provided detailed information on types of tasks, coordination issues, and challenges from local shocks, which in turn was helpful in our questionnaire design. We conducted the survey in January 2018 by distributing hardcopies of the questionnaire to 189 department managers across the twelve stores. Managers returned their completed questionnaires in a sealed envelope (printed with one of our universities name and logo) and then put this envelope into a box designated for our survey usage. In the process, we ensured that the content of each questionnaire remained confidential to company executives who only received selected store-level overview later on. All 189 managers filled out the questionnaire; however, some had missing data in various questions so the actual sample size in our regressions varies and is slightly smaller.

4.4 Variables and measurement

We begin by briefly describing the variables we used in our analysis. While some of our measures are cardinal (e.g., task delegation, competition, age), other variables are ordinal and were rated by managers on a 1-7 scale (e.g., local uncertainty, need for coordination). See Table 2 for detailed descriptions and their summary statistics.

<Insert Table 2 about here>

Need for coordination: we use a seven-point item to measure how important smooth coordination among departments and peer managers is for the manager to perform her/his job well. We created this measure *de novo* for our context. Local uncertainty: to capture exogenous shocks that matter to managers at the individual level, we asked them to rate the unpredictability of local demand and its impact on sales and profits. We also included an alternative measure that reflects the impact of the unpredictability of local demand on the focal manager's daily routines and decisions. We posit that a department manager is better informed about local demand than the store manager is.

Task delegation: To measure the tasks allocated to a department manager and hence the extent of delegation, the company provided us a list of fifteen tasks in which a manager may be involved in his job. These fifteen tasks are: sales, marketing, customer service, property management, IT management, e-commerce, merchandise, product, personal selling, pricing, personnel, training, shop floor, ordering, and checkout. We asked managers to indicate which of the fifteen tasks are part of their job. A higher number of tasks bundled into a manager's job implies a larger extent of delegation from his superiors. We also created this measure *de novo*.

Functional versus Departmental task delegation: In addition to treating overall *Task delegation* as the dependent variable, we also examine how local uncertainty and need for coordination affect the extent of delegation for two sub-group of tasks: Functional and Departmental tasks. Concretely, for each of the fifteen tasks, managers rated on a seven-point item the extent of discretion and flexibility they have when they coordinate with peer managers. A score of zero was recorded if a task is not part of a manager's job. We then noted the average score on each task and categorized all the tasks into five coordination-intensive tasks – referred to as *Functional tasks* - and ten less coordination-intensive tasks – referred to as *Departmental tasks*. The five functional tasks, with their scores in parentheses, are: marketing (1.88), customer service (1.97), property management (1.48), IT management (1.96), and e-commerce (2.02). The ten departmental tasks are: merchandise (3.35), product (3.59), sales (3.46), personal selling (2.99), pricing (3.19), personnel management (3.27), training (2.93), shop floor (3.48), ordering

(4.23), and checkout (3.66). See Figure 1 for a schematic representation of these tasks and the organizational structure of our sampled stores.

Aside from the main variables mentioned above, we include *Competition*, a measure that is rated by department managers on the intensity of price competition in the area where their stores are located. We also obtained information on individual characteristics. Managers reported the number of years – including work and training – she/he has had in each of the fifteen tasks; the average value is called *Experience*. Moreover, the human resources department at the company headquarters provided us archival data on each manager's education level, age, and gender. These four variables are included in all regressions.

To minimize omitted-variable bias potentially caused by matching individual and job characteristics (Ackerberg and Botticini 2002), we further asked managers to self-report a number of important personality traits and control for these traits in additional analysis.

V. Empirical Analysis and Results

5.1 Preliminary analysis: sources of variations

Before our main analysis on how local uncertainty and need for coordination affect organization design, we examine the sources of variations by sorting stores and departments in our three key variables: *Need for coordination*, *Local uncertainty*, and *Task delegation*. First notice that while there is a mild correlation between local uncertainty and (i) need for coordination (ρ=-0.095) and (ii) task delegation (ρ=0.078), the correlation between need for coordination and task delegation is more significant (ρ=-0.152). On *Need for coordination*, we summarize its means and standard deviations by department in Table 3 and by stores in Table 4.

<Insert Tables 3 and 4 about here>

Table 3 shows that, on the one hand, the mean values of coordination need (column 1) are quite different across departments: scores range from 4.00 to 6.00 and the standard deviation of the *mean values* is 0.56. Moreover, it is sensible that Fish department and Pharmacy need the least coordination with others whereas Shop-in-shop and Partners departments intensively coordinate with other departments. On the other hand, Table 4 shows that differences in the mean values of coordination need (column 1) across stores are much smaller, with a range of 4.80 to 5.83 and the standard deviation of the *mean values* being 0.28. When we look at the standard deviations for a given department across stores (Table 3, column 2) and those for a given store across departments (Table 4, column 2), the *mean* value of the former is larger than that of the latter: 0.93 versus 1.17. As such, we infer that the need for coordination varies significantly across departments – thus, products and services offered to customers and internally – but varies much less across stores – thus, specific locations. We use box plots in Figure 2 to visualize such differences, where the middle boxes represent *Need for coordination* sorted by store and by department in panels A and B respectively.

<Insert Figure 2 about here>

We replicate the same exercise on *Local uncertainty* and find (i) the standard deviation of the mean value sorted by department (Table 5, column 1) is almost identical to that sorted by stores (Table 6, column 1): 0.55 versus 0.56; and (ii) the *mean* values of the standard deviations (column 2's) exhibit much smaller differences: 0.95 (by department) versus 1.07 (by store). These results imply that (i) the overall variation in average local uncertainty is similar across departments and stores; and (ii) variations shown by different departments within a given store are slightly larger than those shown by different stores for a given department. The bottom boxes in Figure 2 visually show these results.

<Insert Tables 5 and 6 about here>

Lastly Tables 7 and 8 show the extent of *Task delegation* sorted by departments and by stores respectively. The mean values across departments in Table 7 range from 5.00 to 15.00, with Pharmacy and Information Technology having least task discretion and Fast Moving Consumer Goods and Deli having the highest number of tasks. The mean values across stores, however, show a much tighter range. Indeed, the standard deviation of the *mean values* of task delegation sorted by department is larger than that sorted by stores: 1.12 versus 0.98. The variation within a given department across stores, however, is much smaller than that within a given store across departments: the *mean* of the standard deviations (columns 2, both tables) is 2.92 (by department) versus 4.08 (by store). This suggests that the main source of variation in task delegation in our data comes from departments, as shown clearly also from the top boxes in Figure 2.

<Insert Tables 7 and 8 about here>

In sum, our preliminary analysis shows that departments exhibit larger variation in terms of both need for coordination and task delegation than stores. Yet in terms of local uncertainty, different departments and stores appear to have a similar level of variation.

5.2 Econometric specifications

Our regression analysis proceeds as follows. We first use overall *Task delegation* as the dependent variable. This variable indicates how many tasks are delegated to a department manager out of a total of 15 possible tasks. Then based on the intensity of inter-departmental coordination, we compare the extent of delegation of *Functional tasks* (the five tasks which are most coordination intensive) and *Departmental tasks* (the ten tasks which are least coordination intensive) by treating them as separate dependent variables. Finally, we conduct four robustness checks by restricting our analysis to sales-generating departments and by including (i) alternative fixed effects, (i) personality traits, and (iii) an alternative measures of local uncertainty. Most of our regressions use ordinary least squares (OLS) in the following specification:

$$Y_i = a + \alpha_1 \cdot Local\ uncertainty_i + \alpha_2 \cdot Need\ for\ coordination + \alpha_3 \cdot Local\ uncertainty_i \times Need\ for\ coordination + X_i' \cdot b + \varepsilon_i$$

where *i* denotes the department manager, Y_i is one of the aforementioned dependent variables, a is the intercept (or constant), and X_i is a vector of control variables, including *Competition*, selected personal characteristics, and store fixed effects. Notice that $\alpha_3 < 0$ is necessary to satisfy our two hypotheses. In some regressions, we omit the interaction term between local uncertainty and need for coordination, i.e., suppress the value of α_3 as zero, for comparison purposes. Robustness checks use different control variables or use department fixed effects instead of store fixed effects.

5.3 Results on Task Delegation

Table 9 shows the results on *Task delegation*. In column 1, we include the two main variables of interest, *Local uncertainty* and *Need for coordination*, and five control variables, *Competition*, *Experience*, *Education*, *Age*, *Gender*, and constant. We add the interaction term of *Local uncertainty* and *Need for coordination* in column 2. To control for unobserved demographic, market, and the store-manager's characteristics, we add store fixed effects in column 3. While the first three columns use robust standard errors, column 4 uses standard errors clustered by 24 departments.[11] Notice that using clustered standard errors only changes inference (i.e., p-values) but not the estimated values of coefficients.

<Insert Table 9 about here>

Results are consistent across the four specifications in the table. Column 1 shows that, as expected, task delegation is decreasing in need for coordination (α_2 = -0.40) but increasing in local uncertainty (α_1= 0.32), although the latter coefficient is not statistically significant. When the interaction term of *Local uncertainty* and *Need for coordination* is added to columns 2 to 4, the positive coefficient of *Local uncertainty* increases tremendously in magnitude (α_1 = 2.15, or 1.87) and turns to be statistical significant whereas the standard errors of *Need for coordination* becomes larger which renders it no longer significant. Most important of all, their interaction term is negative (α_3= -0.34, or -0.28). This moderation effect means the impact of local uncertainty on task delegation depends on the need for inter-departmental coordination. Specifically, we find that the marginal effects of *Local uncertainty* on task delegation in column 2 at the low value (=1), the mean value (=5.44), and the high value (=7) of *Need for coordination* are 1.81, 0.32, and -0.21 respectively.[12] For columns 3 and 4, the marginal effects of *Local uncertainty* at the low, mean, and high values of need for coordination are 1.58, 0.33, and -0.12 respectively. In other words, as coordination importance goes from low to high, the marginal effect of local volatility decreases and eventually turns to be negative. To graphically illustrate this key result, we compare the extent of task delegation using results obtained in column 2 in Figure 3. We assume the values of control variables at their means and set low and high levels of the main variables at the 10th and 90th percentile values respectively. The downward sloping black line depicts the case when the *Need for coordination* is high (=7): an increase in *Local uncertainty* from low (=1) to high (=6) <u>decreases</u> *Task delegation* by approximately 10%. On the other hand, the upward sloping grey line shows that when *Need for coordination* is low (=4), an increase of *Local uncertainty* from low to high <u>increases</u> *Task delegation* by around 40%.

<Insert Figure 3 about here>

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[11] Since our unit of analysis is a department manager located in a store, controlling for *both* store and department fixed effects generates an insufficient degree of freedom to estimate the model. Further, we opt for standard errors clustered by departments instead of stores because the former has a relatively larger number. See Angrist and Pischke (2009, ch.8) for discussions.

[12] As an example, under high value of *Need for coordination* in column 2, ∂*Task delegation*/∂*Local uncertainty* = $\alpha_1 - \alpha_3 \cdot 7 = -0.21$.

Therefore, these results are consistent with our hypotheses that task delegation is increasing in local uncertainty when the need for coordination is low but decreasing in local uncertainty when need for coordination is important. Intuitively, in the former case, autonomous (decentralized) adaptation to local shocks or emergent events is optimal, whereas in the latter case coordinated (centralized) adaptation to local shocks is called for. This novel finding amends what we know from conventional wisdom and previous studies that local information in general positively correlates with how much authority is delegated to the agent (e.g., Aghion and Tirole 1997; Dessein 2002, Nagar 2002; Acemoglu et al. 2007; Lo et al. 2016; Huang et al. 2017).

On control variables, we find that *Competition* negatively correlates with *Task delegation*, which is in contrast with existing empirical evidence (e.g., Acemoglu et al. 2007; Guadalupe and Wulf 2009; Bloom et al. 2010; Meagher and Wait 2013; Lo et al. 2016). Although competition may generate "yardstick competition" and facilitate learning (Aghion et al. 2014), it can also necessitate a more coordinated response through hierarchy (Williamson 1986, Alonso et al. 2015) which in turn leads to more centralization. Our result on competition is consistent with the latter argument. As one would expect, task delegation increases in both *Experience* and *Education*, as proxies of agent ability. When ability is kept constant by controlling for experience and education level, *Age* may measure *in*ability and thus correlates with less delegation. Lastly, females are accorded with less task flexibility but the standard errors are too large to yield a precise coefficient. It is also worthwhile to notice that controlling for store fixed effects (columns 3 and 4) does not qualitatively change our main results (in column 2). While none of the store fixed effects is statistically significant, standard errors clustered by departments tremendously increase the overall fit.

5.4 Results on Functional Tasks *versus* Departmental Tasks

To further investigate the impact of local uncertainty on task delegation, we categorize the fifteen tasks into two groups, *Functional tasks* and *Departmental tasks*, based on how coordination intensive they are as reported by department managers (see subsection on variables and measurement above for definitions). *Functional tasks* such as customer service, marketing and IT management are more coordination intensive and, empirically, more likely to be centralized. Departmental tasks such as sales, product, and merchandise are less coordination intensive and, empirically, more likely to be "entrusted" to a specific department. Table 10 shows the regression results. We follow the same regression specifications as we did for overall task delegation. As in the previous table, we report four regressions, but using functional task delegation (columns 1-4) or departmental task delegation (columns 1'-4') as the dependent variable. The results show two major differences between functional and departmental tasks.

<Insert Table 10 about here>

First, we compare column 1 and 1'. In both models, like the previous result on overall task delegation, *Need for coordination* reduces the extent of delegation and *Local uncertainty* has a positive but not statistically significant effect. However, the intercept of the departmental task regression (a = 11.63) is more than three times larger than that of the functional task regression (a = 3.66), while there are only twice as many departmental as functional tasks (10 vs. 5). The same qualitative pattern holds after we include the interaction term in the remainder of the three columns (columns 2-4 and 2'-4'). In particular, all of the intercepts for *Functional tasks* are very small and not statistically significant a = 0.24, or -0.54) whereas those for *Departmental tasks* are large (a = 10.35, or 11.32). This means that the baseline task delegation for coordination-intensive tasks is much smaller than that for tasks that are more independent, which is intuitive. Second, all the coefficients of the main variables – *Local uncertainty*, *Need for coordination*, and their interaction term – in columns 2'-4' are not statistically significant for *Departmental tasks*. For *Functional tasks*, however, the interaction term is negative (α_3 = -0.22) and highly significant (p-values <0.002) across columns 2-4.

These results together in Table 10 provide a more nuanced evidence of the interaction between local uncertainty and the need for coordination. . While the less coordination-intensive departmental tasks are more likely to be delegated on average, the impact of local uncertainty on delegation appears to be independent of the need for coordination. In contrast, while coordination-intensive functional tasks are less likely to be delegated on average, the impact of local uncertainty on the delegation of such tasks is highly dependent on the on the importance of coordination. In particular, for units with low coordination needs, local uncertainty has a very large positive (and significant) impact on delegation of functional tasks. In contrast, for units with high coordination needs, more local uncertainty reduces the extent of delegation of functional tasks. Concretely, the marginal effect of *Local uncertainty* on *Functional tasks* delegation in column 4 is 1.20 when *Need for coordination* is low (=1) but becomes -0.12 when *Need for coordination* is high (=7). This is consistent with our theory. For tasks with a low coordination-intensity (departmental tasks), autonomous adaptation to local shocks is always preferred over centralized coordinated adaptation. In contrast, for tasks with a high coordination-intensity (functional tasks), autonomous adaptation is optimal only for units who require limited or moderate coordination with other departments in the same store.

5.5 Robustness checks

We run three checks to ensure our results presented above are robust to alternative specifications.

5.5.1 Department fixed effects

We used store fixed effects in the previous sets of regressions to control for unobserved heterogeneity at the store level. We can instead include department fixed effects to control for unobserved departmental characteristics.[13] For instance, becoming a manager in a department such as Cashier, Web Business, or Pharmacy, may require special skills or a license that might correlate with our main variables.

We divide our analysis of task delegation in two regressions, one with and one without the interaction term between local uncertainty and coordination need. As in our main specification we report results for overall task delegation, functional task delegation, and departmental task delegation. Table 11 shows these results in six columns. Compared to the results in Table 9, we find that the coefficients of *Local uncertainty* and *Need for coordination* in column 1 are weaker here when their interaction term is excluded; but the coefficients of the three main regressions when the interaction term is included in column 2 are almost the same. For other variables, the results on *Experience* and *Age* are no longer statistical significant while those on *Competition* and *Education* remain qualitatively the same. At the bottom of columns 1 and 2 in Table 11, we see that Deli department has a higher level of overall task delegation but that tasks at the departments of cashier, ecommerce, IT, partners, and pharmacy are more likely to be centralized.

<Insert Table 11 about here>

The results of the three main variables (local uncertainty, coordination need, and their interaction) for functional task delegation in columns 1’ and 2’ and departmental task delegation in columns 1’’ and 2’’ are qualitatively similar to those in Table 10. Of the other independent

[13] See footnote 14 for explanations on not enough of degrees of freedom in regressions when controlling for both store and department fixed effects in a single regression. For the same reason on economizing degrees of freedom, we cannot use robust and clustered (by store) standard errors here.

variables, the strong, positive effect of experience, obtained in our main specification, largely disappears for both types of tasks. In addition, for departmental tasks, the negative effect of age and gender go away as well. Finally, functional task delegation has a higher baseline at Deli and Sales Operation departments, whereas departmental task delegation has a lower baseline at the departments of cashier, ecommerce, IT, partners, and pharmacy.

5.5.2 Sales-generating departments only

One may suspect that departments that do not directly generate sales and profits are different from departments that do face customer directly, and wonder whether this might be driving some of our results on task delegation. For this purpose, we exclude department managers whose units do not directly generate sales revenue from our analysis in Table 12. The excluded departments are Sales Operations, Cashier, Customer Service, Partners, and IT. The results on our main variables (first three rows) and control variables – except *Age* is not statically significant throughout – are qualitatively similar to those in Tables 9 and 10.

<Insert Table 12 about here>

5.5.3 Inclusion of personality traits

Agents and jobs may match up along certain characteristics. For example, Ackerberg and Botticini (2002) argue and show that risk averse farmers are more likely to cultivate less risky crops. Therefore, controlling for personality traits that endogenously sort into job profiles based on local uncertainty and need for coordination would alleviate concerns for omitted-variable bias. For this purpose, we asked managers to self-report the following three important personality traits on 7-point scales.

Agreeableness measures how much a manager is cooperative versus going alone, which may match to tasks or jobs that need a great deal of peer coordination. This is adopted from the Big Five traits in the management literature (Oliver John 1990, book chapter; as cited in Benet-Martinez and John 1998, JPSP). Extracted from one of the items in the DOSPERT scale from the management and organization literature (Blais and Weber 2006, Judgment and Decision Making), we use *Risk loving* to measure how likely an individual would invest 5% of his annual income in a very speculative stock. A risk loving manager may be more likely to match to jobs that exhibit more local uncertainty (Ackerberg and Botticini 2002). Lastly, managers reported their *Career aspiration*, that is, how consciously they were intent to pursue a career in the company as an executive.

Conceptually, we posit that subjects with a high rating for *Agreeableness* may endogenously match to departments that have a high need for coordination and subjects with a high score for *Risk loving* to departments exhibiting higher local uncertainty. In addition, one might speculate that subjects with a high score for *Career aspiration* will match to jobs that are more challenging (in terms of volatility) and/or coordinative in nature. In our data, although the coefficients of correlation between *Career aspiration* and the two main task characteristics are close to zero, that between *Agreeableness* and *Need for coordination* is quite significant (ρ =0.297) and that between *Risk seeking* and *Local uncertainty* is mildly positive (ρ =0.051).

Table 13 shows the results of those regressions. The main results here on *Local uncertainty*, *Need for coordination*, and their interaction term (first three rows) are qualitatively the same across overall task delegation, functional task delegation, and departmental task delegation as those in Tables 9 and 10. On control variables that are previously included, we find similar results, except that the precision of the coefficients of *Education* is somewhat reduced. For the three newly added variables, being agreeable and thus cooperative has little to no effect on all of the three delegation variables. However, having a more long term, career-aspiring mentality and being more risk loving positively correlate with the three kinds of task delegations, albeit they are not statistically significant on functional task delegation. In sum, the results on personality traits apparently shows that store managers are willing to delegate more tasks to those who are more "ambitious" in general.

5.5.4 Alternative measure of Local uncertainty

Finally, using an alternative measure of local uncertainty that rates on a 1-7 item the impact of unpredictability of those customers on the focal manager's daily routines and decisions, we obtain qualitatively results on the effect of local uncertainty, coordination, and their interaction term on task delegation. We provide those results upon requests.

5.6. Results on department idiosyncrasy as a proxy for the center's information cost and noise

So far, we have tested the main prediction of our theory: whether an increase in local uncertainty makes delegation more likely, depends on the need for coordination among sub-units. In our data, we used the unpredictability of local demand as a proxy for local uncertainty. However, our theory also has an additional, unambiguous comparative static: a decrease in the general manager's ability to observe local shocks always makes task delegation more likely.

In our model, local uncertainty corresponds to the variance σ_θ^2 of local shocks θ_i. In turn, the center's ability to observe local shocks depends on the noise in the center's signal, $s_i = \theta_i + \varepsilon_i$, as captured by the variance σ_ε^2, and on the cost of acquiring this signal. Since the department manager perfectly observes θ_i, both local uncertainty σ_θ^2 and information noise σ_ε^2 are valid proxies for the information asymmetry between the general manager and the department manager.[14] A key insight of our theoretical analysis, however, is that more information noise or a larger information costs always favor decentralization, whereas more local uncertainty has an ambiguous effect.

In this section, we test this important difference by constructing a proxy for how difficult it is for the center to learn about local shocks affecting a particular department. We follow Acemoglu et al. (2007) who posit that firms who operate in more heterogeneous environments and, hence, are more idiosyncratic, are more likely to be decentralized, because the greater heterogeneity makes learning from others more difficult (p.1760). As a measure of firm-specific heterogeneity, they create an index that captures how different the productivity growth rate of the firm is compared to other firms in the same industry sector.[15]

Following Acemoglu et al., we create a variable which measures how different or "idiosyncratic" a department is, when compared to other departments in the same store, though we use sales growth rather than productivity growth as our data is on a retail firm. To do so, we obtained data from the company on the year-on-year growth rate of the sales revenues of each department and that of each store in the fourth quarter of 2017. [16] We posit that the more a department's sales growth rate deviates from that of the store it belongs to, the more idiosyncratic a department is. We construct the variable *Idiosyncratic demand* by taking the absolute value of the difference between two growth rates as follows:[17]

$$\textit{Idiosyncratic demand}_i = |\textit{department growth rate}_i - \textit{store growth rate}_{i \in store}| \,.$$

[14] Indeed, this information asymmetry vanishes when either local uncertainty disappears or when the center can learn about local shocks freely and perfectly.

[15] Similarly, Huang et al. (2017) use firm-performance heterogeneity as a proxy for poor centralized information.

[16] Summary statistics of the raw values of the two variables are as follows. Department sales growth rate: mean=3.71%, standard deviation=10.74%, range=(-28.6%, 55.5%). Store growth rate: mean=2.43%, standard deviation=6.16%, range=(-1.9%, 20.1%).

[17] The timing of the realization of the growth rates precedes that of our survey. This makes our idiosyncrasy demand measure predetermined and thus a valid independent variable in our analysis.

As Acemoglu et al., we view idiosyncrasy (i.e., department-specific heterogeneity) as a proxy for the information cost or information noise of central management. While the correlation between local uncertainty and our new measure for department idiosyncrasy is positive in our data, it is very weak (ρ=0.062). This suggests that local uncertainty, which captures the instability of or unpredictability of local demand, and demand idiosyncrasy, which captures how different that demand is from that of other departments, are indeed two different theoretical constructs.

Table 14 uses the same format as our previous regressions but replaces *Local uncertainty* by the newly constructed variable. Note that, by design, these regressions exclude department managers whose units do not directly generate sales revenues. To compare the impact of *Idiosyncratic demand* on *Task Delegation* with that of *Local uncertainty,* one should therefore refer to Table 12 in our robustness analysis, which also excludes non-sales generating departments.

Comparing Tables 14 and 12, the key differences between the effect of idiosyncratic demand and local uncertainty on task delegation are as follows:
First, comparing columns 1' and 2' across the two tables, idiosyncratic demand has a much weaker interaction term with the need for coordination, especially when functional tasks are concerned. Moreover, one can verify that the marginal effect of demand idiosyncrasy on task delegation is always positive, even when the need for coordination is at its highest value. This is consistent with our theory that information noise or costs always make delegation more likely. Second, comparing columns 1 and 3 across Tables 12 and 14, idiosyncratic demand has a stronger and more significant average effect on task delegation. Indeed, in Table 12, the impact local uncertainty on task delegation is not significant in the absence of an interaction term. Again, this is consistent with our theory that demand idiosyncrasy increases delegation even when coordination needs are high. It is also quite intuitive that the impact of idiosyncratic demand on delegation is largest for department-specific tasks. Arguably, department-specific expertise and the associated real authority is more relevant for departmental tasks such as merchandizing, pricing and sales, rather than for functional tasks such as IT, customer service, and ecommerce.

Overall, the results in Table 14 are supportive of our theory and help reconcile our findings with those in previous studies, such as Baiman et al. (1995), Acemoglu et al. (2007), and Huang (2017). The proxies for local information used in the above studies mainly measure the information disadvantage of central management-- that is how difficult it is for headquarters to be informed about local circumstances. In contrast, our measure of local uncertainty captures the unpredictability of the local environment itself. As Table 14 shows – and theory predicts, more noise or higher information acquisition costs for central management always results in more decentralization. In contrast, as shown by Table 12 for the same set of departments, the impact of an increase in local uncertainty has an ambiguous impact on decentralization and depends on the need for coordination.

VI. Conclusions

This paper has presented one of the first micro-level studies of managerial authority and task allocation inside firms. Our data concerns just under 200 individual department managers, employed by the same retail firm, subject to the same incentive scheme, and working at the same mid-level managerial rank. Working closely with firm management, we obtained detailed data on personal characteristics, job descriptions, department-level sales, and so on. As far as we are aware, previous studies on organizational design have instead used firm-level or establishment-level data in a cross-section of industries and/or countries.[18]

Our findings confirm some of the previous insights in this literature, but also provide a number of important qualifications and new insights. These new findings relate to the nature of local information, and how the need to maintain coordination among sub-units affects the way organizations respond to such local information.

First, using a measure for heterogeneity similar to the one used in Acemoglu et al. (2007), we confirm the finding that departments that are more idiosyncratic, are delegated more tasks.[19] As Acemoglu et al., we view idiosyncrasy as a measure for how difficult it is for the center to learn about local circumstances of a particular department. Intuitively, for a given local environment, the worse the center's information about local circumstances, the more attractive is delegation (Hayek 1945; Aghion and Tirole 1997; Dessein 2002). This is also consistent with previous findings in Baiman et al. (1995), Nayar (2002) and Huang et al. (2017).

The main contribution of our paper, however, was to show that the relationship between local information and organizational design is much more complex, and depends on how organizations coordinate their responses to such information. In particular, we show that an increase in the unpredictability of local circumstances may result in more centralization when coordination between sub-units is important. As lower-level managers are closer to field operations, it is natural to assume that they are better informed about local circumstances (Hayek 1945). As such, a more unpredictable local environment is a proxy for the local information of lower-level managers. Yet, a recent literature in organizational economics has suggested that an increase in such local uncertainty may result in more centralization as the center is better at

[18] This stands in contrast with many influential studies on the provision of incentives in firms, which often focus on data from one establishment. Also many studies on vertical integration decision focus on one industry.

[19] In our context, departments are more idiosyncratic when there demand growth differs more from overall growth in the same store.

“coordinated adaptation.” Indeed, when coordination between sub-units is important, autonomous adaptation to local information by lower-level managers is likely to result in large coordination losses for the organization (Dessein and Santos 2006). While the center may have worse information about local circumstances, it is likely better informed about the firm as whole (Aoki 1986, Alonso et al. 2015). As a result, a centralized organization may be better at adapting to emergent events and local shocks in a coordinated way. Our paper extends this theory, and shows, both theoretically and empirically, that the impact of local uncertainty on task delegation depends on the need for coordination among sub-units. While there is only a non-significant impact of local uncertainty on task delegation *on average*, we find a very strong positive impact when coordination needs are small, and a negative marginal impact when coordination needs are large. In sum, while we find support for the prediction that reducing the center’s information about local circumstances favors decentralization, a more unstable local environment favors centralization when coordination is critical.

Throughout our paper, we merely offer descriptive overviews on incentives (e.g., pay and promotion prospects) and organizational practices (e.g., multi-skilling and job rotation) but keep them as the backdrop of our analyses. As mentioned in the literature, incentive schemes and managerial practices are also important organizational design issues (e.g., Aoki 1986; Gibbons and Henderson 2012). High incentive intensity or promotion prospects that are only based on measurable metrics may interfere with coordination among sub-units. While job rotation generates multi-skilled managers (Carmichael and MacLeod 1993), it may reduce specialized expertise and thus the ability to respond to local uncertainty. We believe tackling these issues will improve our understanding of organizational design, but leave those to future research.

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Figure 1: Organizational Structure: Stores, Departments, and Tasks

REGIONAL HEADQUARTERS

A Tokyo metro area

↓

12 STORES

Each store is headed by a Store Manager

↓

24 DEPARTMENTS or FUNCTIONS

Each store has all or a subset of 24 departments/functions. Each is headed by a department manager

1.Kids Apparel, 2.Lady's Wear, 3.Clothing Accessories, 4.Underwear, 5.Men's Wear, 6.Home Furnishing, 7.Cosmetics, 8.Grocery, 9.Liquor, 10.Daily Food, 11.Deli, 12.Produce, 13.Processed Meat and Poultry, 14.Fish, 15.Sales Operation, 16.Cashier, 17.eCommerce, 18. Customer Service, 19. Information Technology (IT), 20. Partners, 21.Home Appliances, 22. Fast Moving Consumer Goods (FMCG) 23. Pharmacy, and 24.Shop-In-Shop

↓

15 MANAGERIAL TASKS

Each department manager is delegated with all or a subset of 15 tasks

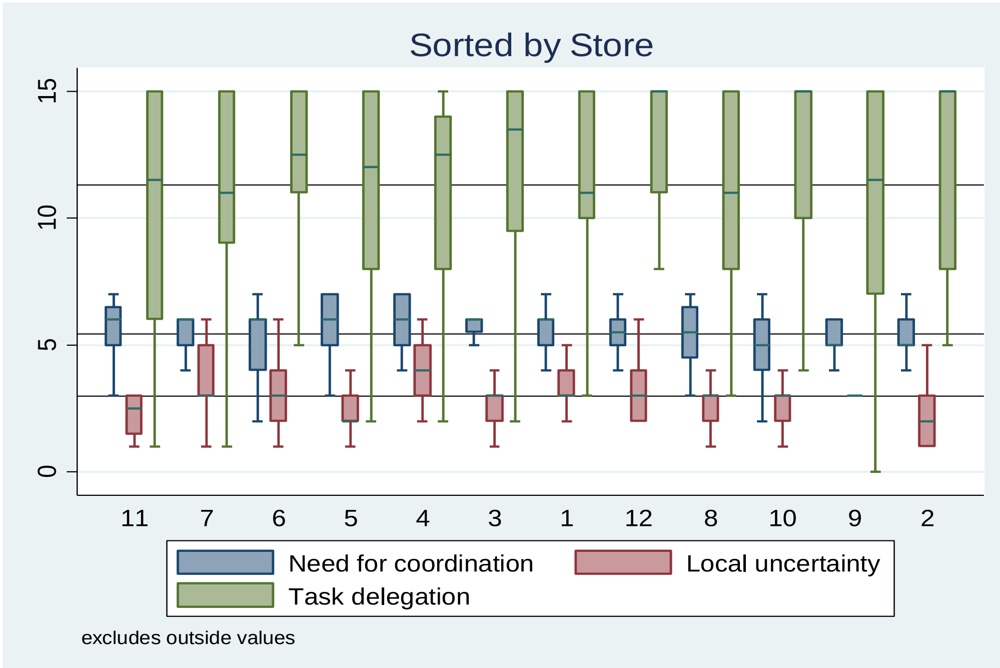
Five Functional Tasks:
Marketing, Customer Service, Property Management, IT Management, and eCommerce

Ten Departmental Tasks:
Merchandise, Product, Sales, Personal Selling, Pricing, Personnel Management, Training, Shop Floor, Ordering, and Checkout

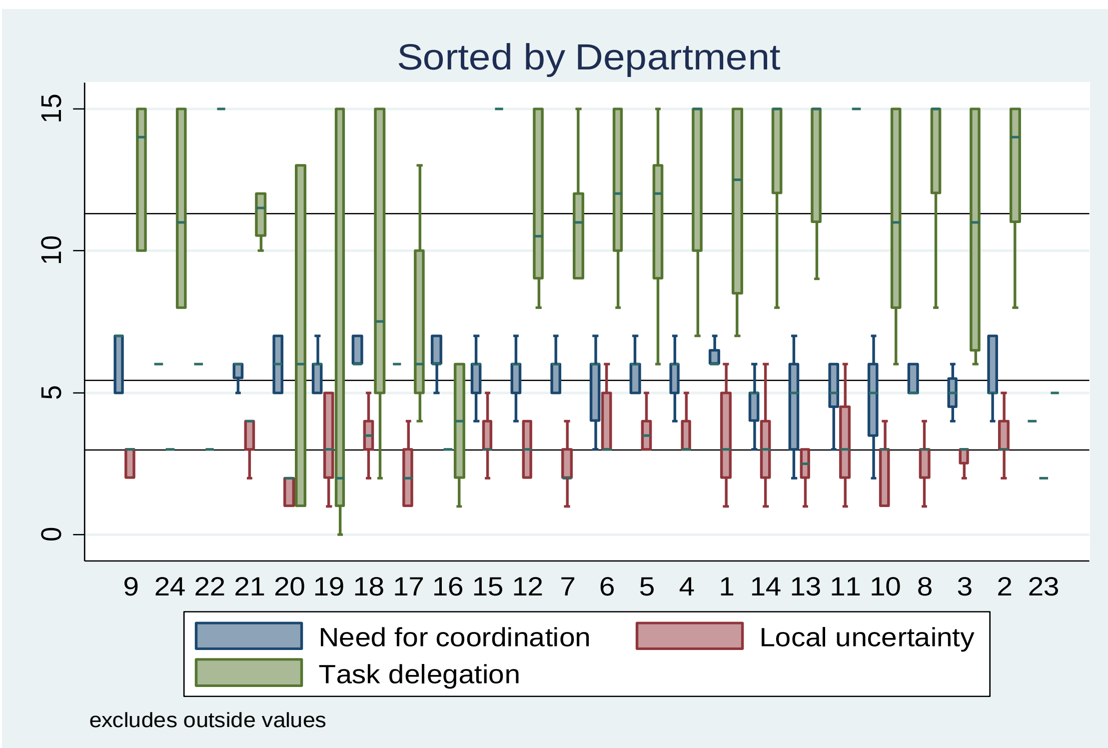
Figure 2 Box Plot of Sources of Variation

(Top: *Task delegation* Middle: *Need for coordination* Bottom: *Local uncertainty*)

Panel A

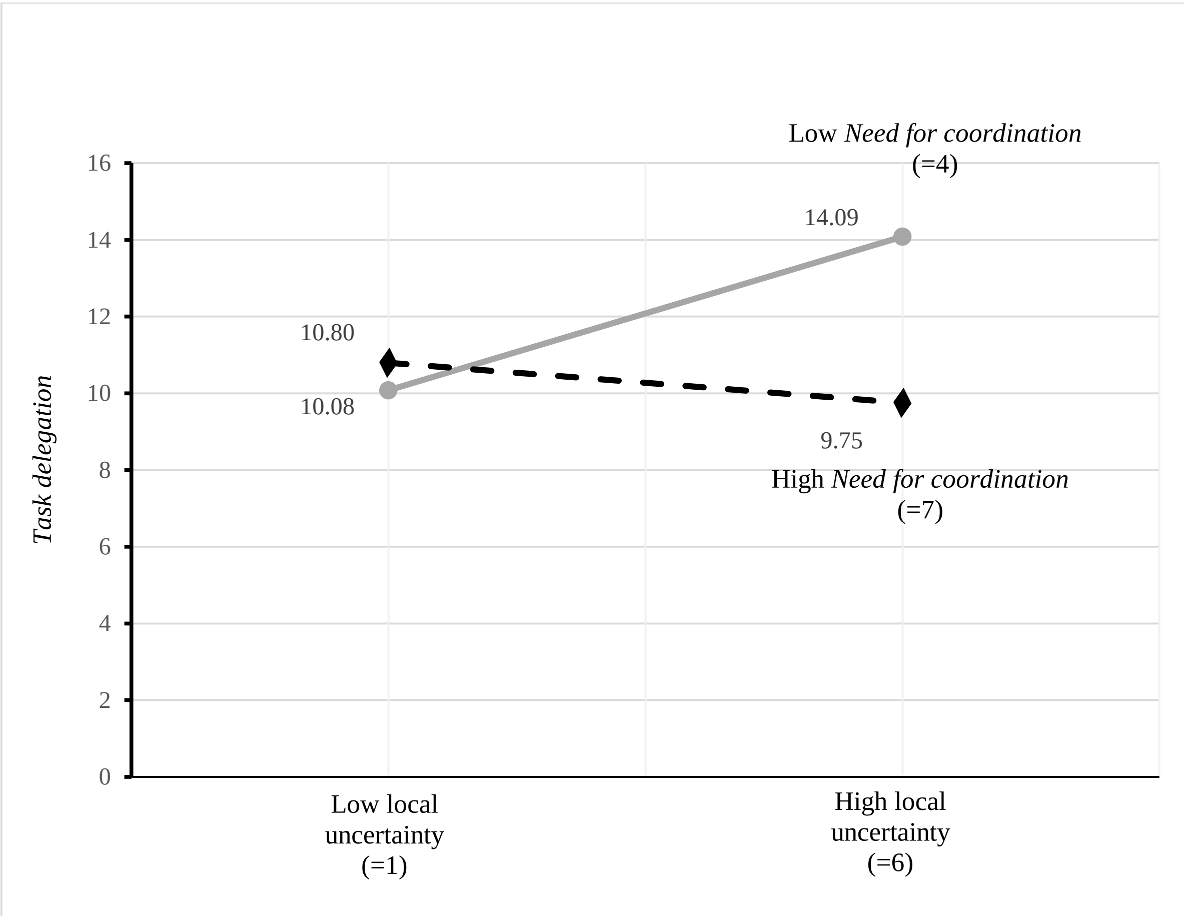


Panel B



Note: (1) Long horizontal lines are corresponding mean values. (2) Stores and Departments in their respective panels are ordered by median value of *Need for coordination* in descending order from left to right.

Figure 3 Interaction Effect of *Local uncertainty* and *Need for coordination*



Note: Low and High levels correspond to the 10th and 90th percentile values respectively. The values associated with the four end points are the level of *Task delegation* under their respective conditions of *Local uncertainty* and *Need for coordination*, plus the sum of the mean values of the control variables and the constant. For instance, *Task delegation* at (Low *Local uncertainty*, High *Need for coordination*) = 10.80 = $\hat{a}+\hat{\alpha}_1 \cdot 1+\hat{\alpha}_2 \cdot 7+ \hat{\alpha}_3 \cdot 1 \cdot 7+ \bar{X}_i^{'}\hat{b}$ where the estimated coefficients are obtained from column 2 in Table 9. Coefficients that are not statistically significant at $p<0.10$ (e.g., $\hat{\alpha}_2$ and that of *Gender*) are assumed a zero value in the calculation.

Table 1 Overview of Stores in Our Sample

Item	Value	Remarks
No. of stores	12	All stores under the same company subsidiary headquarters
No. of department managers	189	All managers were sampled, but some had missing answers
Average no. of managers per store	15.75	
Average floor space under direct management of store	Approx. 20,000 m^2	From approx. 10,000 to 35000 m^2
Average no. of employees	483	From 253 to 753
Average no. of daily shoppers	11,208	From 5,200 to 18,500

Table 2 Main Variables and Summary Statistics

Variable	No. of obs.	Description	Mean	Std. Dev.	Min	Max
Local uncertainty	176	Local, proximate customers' sales and profit to our store (1 very stable<–>very volatile 7)	2.97	1.21	1	6
Need for coordination	175	To perform well in my job, smooth coordination among different departments and functional managers is critical (1 completely disagree<–>completely agree 7)	5.44	1.16	2	7
Task delegation	176	Number of tasks the manager performs for her/his job that she/he has to involve superior manager(s)	11.30	4.11	0	15
Delegation – functional tasks	189	Number of coordination-intensive, functional tasks the manager performs for her/his job that she/he has to involve superior manager(s)	2.77	2.12	0	5
Delegation – departmental tasks	189	Number of less coordination-intensive, departmental tasks the manager performs for his/her job that she/he has to involve superior manager(s)	8.31	2.75	0	10
Competition	175	There is little price competition in the area where our store is located [reverse coded] (1 completely disagree<–>completely agree 7)	4.83	1.60	1	7
Experience	169	Number of years and months you have as experience – including training and work – in the following 15 areas. Note: please put a "0" in the cells if you don't have any experience or training in that item.	7.33	5.13	0	21.87
Education†	189	1 junior high, 2 high school, 3 technical school, 4 university, 5 master's	3.16	1.08	1	5
Age†	189	Years of age	43.63	9.22	22	65
Gender†	189	0 male, 1 female	0.29	0.45	0	1
Idiosyncratic demand†	143	Absolute value of the difference of sales growth rates between the department and the store	5.48	6.41	0	35.4
Career aspiration	175	How consciously are you intended to pursue a career inside the company as an executive? (1 not much <–> very much 7)	2.96	1.52	1	7
Agreeableness	175	The following item relates to your personality: agreeable, organized (i.e., sympathetic, cooperative, but not aggressive or going alone) (1 completely disagree<–>completely agree 7)	175	4.58	1	7
Risk seeking	170	Investing 5% of your annual income in a very speculative stock (1 extremely unlikely<–>extremely likely 7)	170	2.44	1	7

† Original data provided by the headquarters. See footnote 19 for raw data on growth rates. Others are self-reported in questionnaire.

Table 3 *Need for coordination*: Sorted by Department

	Department	Mean	Std Dev	No. of observation
1	Kids	5.750	1.581	8
2	Ladies wear	5.667	1.118	9
3	Cloth accessories	5.000	0.816	4
4	Underwear	5.700	0.823	10
5	Menswear	5.833	0.753	6
6	Home furnishing	5.444	1.424	9
7	Cosmetics	5.636	1.120	11
8	Grocery	5.000	1.342	11
9	Liquor	6.333	1.155	3
10	Daily food	4.833	1.642	12
11	Deli	5.000	0.953	12
12	Produce	5.700	0.823	10
13	Processed meat	4.700	1.636	10
14	Fish	4.600	0.843	10
15	Sales operation	5.556	0.882	9
16	Cashier	6.000	0.943	10
17	eCommerce	5.833	0.983	6
18	Customer service	6.000	1.095	6
19	IT	5.714	0.756	7
20	Partners	6.000	1.000	3
21	Home appliances	5.750	0.500	4
22	FMCG	6.000	0.000	1
23	Pharmacy	4.000	0.000	1
24	Shop-in-shop	6.000	0.000	3
Total		5.440	1.162	175

Table 4 *Need for coordination*: Sorted by Store

Store	Mean	Std Dev	No. of observations
1	5.833	0.857	18
2	5.364	1.206	11
3	5.500	0.966	16
4	5.778	1.003	18
5	5.467	1.356	15
6	5.278	1.526	18
7	5.353	0.862	17
8	5.375	1.408	8
9	5.214	0.802	14
10	4.800	1.549	10
11	5.625	1.310	16
12	5.286	1.204	14
Total	5.440	1.162	175

Table 5 *Local uncertainty*: Sorted by Department

	Department	Mean	Std Dev	No. of observation
1	Kids	3.375	1.768	8
2	Ladies wear	3.333	1.500	9
3	Cloth accessories	2.750	0.500	4
4	Underwear	3.100	1.287	10
5	Menswear	3.667	0.816	6
6	Home furnishing	4.000	1.323	9
7	Cosmetics	2.364	0.809	11
8	Grocery	2.727	1.104	11
9	Liquor	2.667	0.577	3
10	Daily food	2.417	1.165	12
11	Deli	3.167	1.642	12
12	Produce	2.900	0.876	10
13	Processed meat	2.400	0.699	10
14	Fish	3.200	1.398	10
15	Sales operation	3.100	1.101	10
16	Cashier	3.000	1.054	10
17	eCommerce	2.167	1.169	6
18	Customer service	3.500	1.049	6
19	IT	3.143	1.464	7
20	Partners	1.667	0.577	3
21	Home appliances	3.500	1.000	4
22	FMCG	3.000	0.000	1
23	Pharmacy	2.000	0.000	1
24	Shop-in-shop	3.000	0.000	3
Total		2.972	1.212	176

Table 6 *Local uncertainty*: Sorted by Store

Store	Mean	Std Dev	No. of observations
1	3.278	1.074	18
2	2.091	1.300	11
3	2.813	1.047	16
4	4.000	1.029	18
5	2.400	0.986	15
6	3.056	1.474	18
7	3.529	1.375	17
8	2.625	0.916	8
9	2.929	0.475	14
10	2.636	0.924	11
11	2.250	0.856	16
12	3.286	1.383	14
Total	2.972	1.212	176

Table 7 *Task delegation*: Sorted by Department

	Department	Mean	Std Dev	No. of observation
1	Kids	11.750	3.327	8
2	Ladies wear	12.778	2.539	9
3	Cloth accessories	10.750	4.924	4
4	Underwear	12.900	2.961	10
5	Menswear	11.143	2.911	7
6	Home furnishing	12.222	2.863	9
7	Cosmetics	11.182	1.888	11
8	Grocery	13.091	2.587	11
9	Liquor	13.000	2.646	3
10	Daily food	11.250	3.696	12
11	Deli	14.333	2.015	12
12	Produce	11.300	2.830	10
13	Processed meat	13.300	2.312	10
14	Fish	13.100	2.726	10
15	Sales operation	13.556	3.127	9
16	Cashier	5.600	5.232	10
17	eCommerce	7.333	3.502	6
18	Customer service	8.667	5.391	6
19	IT	5.286	6.676	7
20	Partners	6.667	6.028	3
21	Home appliances	11.250	0.957	4
22	FMCG	15.000	0.000	1
23	Pharmacy	5.000	0.000	1
24	Shop-in-shop	11.333	3.512	3
Total		11.301	4.109	176

Table 8 *Task delegation*: Sorted by Store

Store	Mean	Std Dev	No. of observations
1	11.222	3.750	18
2	11.818	3.842	11
3	11.813	4.119	16
4	10.889	4.013	18
5	11.200	3.968	15
6	12.278	3.083	18
7	10.235	4.507	17
8	10.889	4.512	9
9	10.143	5.127	14
10	12.909	3.833	11
11	10.063	5.434	16
12	12.769	2.743	13
Total	11.301	4.109	176

Table 9 Task Delegation

	Task Delegation			
	1	2	3	4
Local uncertainty	0.32	2.15***	1.87**	1.87***
	(0.24)	(0.73)	(0.77)	(0.63)
Need for coordination	-0.40*	0.58	0.46	0.46
	(0.24)	(0.45)	(0.45)	(0.35)
Local uncertainty × Need for coordination		-0.34**	-0.28*	-0.28**
		(0.14)	(0.14)	(0.11)
Competition	-0.40**	-0.41**	-0.44**	-0.44***
	(0.19)	(0.19)	(0.21)	(0.15)
Experience	0.29***	0.30***	0.30***	0.30***
	(0.08)	(0.07)	(0.08)	(0.07)
Education	0.53*	0.53*	0.56*	0.56*
	(0.28)	(0.28)	(0.31)	(0.32)
Age	-0.08*	-0.08*	-0.08*	-0.08*
	(0.05)	(0.05)	(0.05)	(0.05)
Gender	-0.67	-0.57	-0.47	-0.47
	(0.69)	(0.69)	(0.73)	(0.90)
Constant	14.17***	8.82***	9.36***	9.36***
	(2.53)	(3.19)	(3.43)	(2.77)
12-store fixed effects[#]	No	No	Yes (0)	Yes (0)
Clustered standard errors (by 24 departments)	No	No	No	Yes
R^2	0.198	0.213	0.248	0.248
F-statistic	5.77***	6.59***	3.43***	62.51***
N	167	167	167	167

* p < 0.10; **p < 0.05; ***p < 0.01. Robust standard errors in parentheses in columns 1,2, and 3. [#] Number of statistically significant (p< 0.10) fixed effects in parentheses.

Table 10 Task Delegation – Functional Tasks vs. Departmental Tasks

	Delegation - Functional Tasks				Delegation - Departmental Tasks			
	1	2	3	4	1’	2’	3’	4’
Local uncertainty	0.14	1.31***	1.42***	1.42***	0.24	0.67	0.43	0.43
	(0.13)	(0.43)	(0.44)	(0.38)	(0.14)	(0.50)	(0.52)	(0.40)
Need for coordination	-0.26*	0.37	0.40	0.40*	-0.27*	-0.04	-0.16	-0.16
	(0.13)	(0.26)	(0.26)	(0.23)	(0.14)	(0.29)	(0.28)	(0.23)
Local uncertainty × Need for coordination		-0.22***	-0.22***	-0.22***		-0.08	-0.03	-0.03
		(0.08)	(0.08)	(0.07)		(0.10)	(0.10)	(0.08)
Competition	-0.21**	-0.21**	-0.22**	-0.22***	-0.15	-0.15	-0.15	-0.15
	(0.10)	(0.10)	(0.10)	(0.06)	(0.11)	(0.12)	(0.14)	(0.12)
Experience	0.09**	0.09***	0.10**	0.10***	0.25***	0.25***	0.25***	0.25***
	(0.03)	(0.03)	(0.04)	(0.03)	(0.05)	(0.05)	(0.05)	(0.06)
Education	0.16	0.16	0.21	0.21	0.39**	0.38**	0.39**	0.39**
	(0.16)	(0.15)	(0.17)	(0.18)	(0.17)	(0.17)	(0.19)	(0.19)
Age	-0.00	-0.00	-0.01	-0.01	-0.11***	-0.11***	-0.11***	-0.11***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Gender	-0.26	-0.20	-0.19	-0.19	-0.70*	-0.68*	-0.56	-0.56
	(0.37)	(0.37)	(0.40)	(0.46)	(0.40)	(0.40)	(0.42)	(0.66)
Constant	3.66***	0.24	-0.54	-0.54	11.63***	10.35***	11.32***	11.32***
	(1.33)	(1.89)	(1.95)	(1.53)	(1.49)	(1.79)	(2.06)	(2.10)
12-store fixed effects[#]	No	No	Yes (0)	Yes (0)	No	No	Yes (1)	Yes (1)
Clustered standard errors (by 24 departments)	No	No	No	Yes	No	No	No	Yes
R^2	0.124	0.147	0.190	0.190	0.299	0.301	0.339	0.339
F-statistic	4.26***	5.32***	2.71***	75.84***	9.00***	8.04***	3.94***	30.62***
N	167	167	167	167	167	167	167	167

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. Robust standard errors in parentheses in columns 1, 2, 3, 5, 6, and 7. Clustered standard errors in parentheses in columns 4 and 8. [#] Number of statistically significant ($p < 0.10$) fixed effects in parentheses.

Table 11 Task Delegations with Department Fixed Effects

	Task Delegation	Task Delegation	Delegation – Functional Tasks	Delegation – Functional Tasks	Delegation – Departmental Tasks	Delegation – Departmental Tasks
	1	2	1'	2'	1''	2''
Local uncertainty	0.16	2.06**	0.10	1.34**	0.05	0.59
	(0.24)	(1.04)	(0.13)	(0.57)	(0.13)	(0.56)
Need for coordination	-0.08	0.95	-0.16	0.51	-0.08	0.21
	(0.26)	(0.60)	(0.14)	(0.33)	(0.14)	(0.32)
Local uncertainty × Need for coordination		-0.35*		-0.23**		-0.10
		(0.19)		(0.10)		(0.10)
Competition	-0.35**	-0.35**	-0.23**	-0.23**	-0.13	-0.13
	(0.18)	(0.18)	(0.10)	(0.10)	(0.10)	(0.10)
Experience	0.04	0.05	0.04	0.05	0.03	0.03
	(0.07)	(0.07)	(0.04)	(0.04)	(0.04)	(0.04)
Education	0.55*	0.56**	0.18	0.19	0.33**	0.33**
	(0.28)	(0.28)	(0.15)	(0.15)	(0.15)	(0.15)
Age	0.05	0.05	0.02	0.02	-0.00	-0.00
	(0.04)	(0.04)	(0.02)	(0.02)	(0.02)	(0.02)
Gender	-0.35	-0.08	-0.15	0.02	-0.46	-0.39
	(0.82)	(0.83)	(0.45)	(0.46)	(0.44)	(0.44)
Constant	8.53***	2.39	2.04	-1.95	8.98***	7.23***
	(3.17)	(4.53)	(1.75)	(2.49)	(1.68)	(2.42)
12-store fixed effects	No	No	No	No	No	No
24-departments fixed effects[‡]	Yes (+: deli; -: cashier; -ecomm, IT, partners, pharmacy)	Yes (+: deli; -: cashier, ecomm, IT, partners)	Yes (+: deli, sales operation)	Yes (+: deli, sales operation)	Yes (-: cashier, ecomm, IT, partners, pharmacy)	Yes (-: cashier, ecomm, IT, partners, pharmacy)
R^2	0.447	0.461	0.332	0.355	0.632	0.635
F-statistic	3.81***	3.87***	2.35***	2.50***	8.11***	7.88***
N	167	167	167	167	167	167

* p < 0.10; **p < 0.05; ***p < 0.01. [†] p < 0.10 one-tail test. Standard errors in parentheses.. [‡] Base department = kid apparel: + means positive and negative coefficient at a minimum of p<0.10 level.

Table 12 Sales-Generating Departments Only – Task Delegations

Excludes: Sales Operations, Cashier, Customer Service, Partners, and Information Technology

	Task Delegation	Task Delegation	Delegation – Functional Tasks	Delegation – Functional Tasks	Delegation – Departmental Tasks	Delegation – Departmental Tasks
	1	2	1'	2'	3	3'
Local uncertainty	0.34	2.05***	0.18	1.83***	0.10	0.46
	(0.24)	(0.64)	(0.17)	(0.46)	(0.10)	(0.33)
Need for coordination	-0.28	0.64	-0.25	0.64**	-0.13	0.06
	(0.22)	(0.42)	(0.15)	(0.28)	(0.10)	(0.21)
Local uncertainty × Need for coordination		-0.33***		-0.32***		-0.07
		(0.12)		(0.09)		(0.07)
Competition	-0.37*	-0.38*	-0.26**	-0.26**	-0.06	-0.06
	(0.20)	(0.19)	(0.13)	(0.12)	(0.10)	(0.10)
Experience	0.13*	0.14*	0.06	0.07	0.09***	0.09***
	(0.08)	(0.08)	(0.05)	(0.05)	(0.03)	(0.03)
Education	0.41	0.42	0.25	0.26	0.20	0.20
	(0.29)	(0.29)	(0.20)	(0.19)	(0.14)	(0.14)
Age	-0.00	-0.00	0.01	0.01	-0.02	-0.02
	(0.04)	(0.04)	(0.03)	(0.03)	(0.02)	(0.02)
Gender	0.04	0.19	0.24	0.38	0.05	0.08
	(0.74)	(0.74)	(0.51)	(0.49)	(0.33)	(0.34)
Constant	11.26***	6.24**	2.48	-2.35	9.29***	8.22***
	(2.33)	(3.10)	(1.61)	(2.13)	(1.00)	(1.45)
12-store fixed effects[#]	Yes (0)	Yes (0)	Yes (0)	Yes (1)	Yes (0)	Yes (0)
R^2	0.134	0.159	0.165	0.218	0.098	0.103
F-statistic	1.81**	2.39***	1.95**	2.64***	1.14	1.28
N	133	133	133	133	133	133

* p < 0.10; **p < 0.05; ***p < 0.01. Robust standard errors in parentheses. [#] Number of statistically significant (p< 0.10) fixed effects in parentheses.

Table 13 Effect of Personality Traits on Task Delegations

	Task Delegation	Task Delegation	Delegation – Functional Tasks	Delegation – Functional Tasks	Delegation – Departmental Tasks	Delegation – Departmental Tasks
	1	2	1'	2'	3	3'
Local uncertainty	0.30	1.77**	0.24	1.56***	0.19	0.13
	(0.26)	(0.87)	(0.16)	(0.47)	(0.14)	(0.54)
Need for coordination	-0.29	0.49	-0.20	0.50*	-0.21	-0.25
	(0.25)	(0.52)	(0.15)	(0.28)	(0.14)	(0.31)
Local uncertainty × Need for coordination		-0.27*		-0.25***		0.01
		(0.16)		(0.09)		(0.10)
Competition	-0.41*	-0.41*	-0.19*	-0.19*	-0.14	-0.14
	(0.21)	(0.21)	(0.11)	(0.11)	(0.13)	(0.13)
Experience	0.28***	0.29***	0.09**	0.10**	0.24***	0.24***
	(0.08)	(0.08)	(0.04)	(0.04)	(0.05)	(0.05)
Education	0.35	0.36	0.16	0.16	0.23	0.23
	(0.30)	(0.30)	(0.17)	(0.17)	(0.18)	(0.18)
Age	-0.07	-0.07	-0.00	0.00	-0.10***	-0.10***
	(0.04)	(0.04)	(0.02)	(0.02)	(0.03)	(0.03)
Gender	-0.04	0.02	-0.09	-0.05	-0.23	-0.23
	(0.71)	(0.71)	(0.40)	(0.40)	(0.39)	(0.40)
Career aspiration	0.41*	0.39*	0.19	0.17	0.23*	0.23*
	(0.22)	(0.22)	(0.12)	(0.12)	(0.13)	(0.13)
Agreeableness	-0.01	-0.02	-0.07	-0.08	0.04	0.05
	(0.26)	(0.26)	(0.13)	(0.13)	(0.16)	(0.16)
Risk loving	0.35*	0.35*	0.12	0.12	0.29**	0.29**
	(0.20)	(0.20)	(0.11)	(0.10)	(0.13)	(0.13)
Constant	11.41***	7.13*	1.91	-1.94	10.29***	10.47***
	(2.73)	(3.65)	(1.56)	(2.07)	(1.57)	(2.12)
12-store fixed effects[#]	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (1)	Yes (1)
R^2	0.262	0.271	0.185	0.212	0.373	0.373
F-statistic	2.95***	3.13***	2.34***	2.82***	3.95***	3.75***
N	162	162	162	162	162	162

* p < 0.10; **p < 0.05; ***p < 0.01. Robust standard errors in parentheses. [#] Number of statistically significant (p< 0.10) fixed effects in parentheses.

Table 14 Effect of Idiosyncratic Demand

(Idiosyncratic demand is the absolute value of the difference between the growth rates of the department and its store)

	Task Delegation	Task Delegation	Delegation – Functional Tasks	Delegation – Functional Tasks	Delegation – Departmental Tasks	Delegation – Departmental Tasks
	1	2	1’	2’	3	3’
Idiosyncratic demand	0.08*	0.44**	0.04	0.24	0.06***	0.12
	(0.04)	(0.22)	(0.03)	(0.15)	(0.02)	(0.09)
Need for coordination	-0.28	0.00	-0.28*	-0.12	-0.11	-0.05
	(0.21)	(0.28)	(0.15)	(0.20)	(0.09)	(0.13)
Idiosyncratic demand × Need for coordination		-0.06*		-0.04		-0.01
		(0.04)		(0.03)		(0.02)
Competition	-0.29	-0.28	-0.26*	-0.26*	0.01	0.01
	(0.19)	(0.19)	(0.13)	(0.13)	(0.08)	(0.08)
Experience	0.11	0.13	0.05	0.06	0.07**	0.07**
	(0.07)	(0.08)	(0.06)	(0.06)	(0.03)	(0.03)
Education	0.44	0.46*	0.27	0.28	0.20*	0.20*
	(0.27)	(0.27)	(0.20)	(0.20)	(0.11)	(0.11)
Age	0.01	0.01	0.02	0.02	-0.01	-0.01
	(0.04)	(0.04)	(0.03)	(0.03)	(0.02)	(0.02)
Gender	-0.09	-0.04	0.22	0.25	-0.08	-0.07
	(0.70)	(0.71)	(0.50)	(0.50)	(0.27)	(0.27)
Constant	11.27***	9.35***	2.83*	1.77	8.80***	8.42***
	(2.31)	(2.51)	(1.65)	(1.83)	(0.90)	(0.96)
12-store fixed effects#	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)
R^2	0.145**	0.160	0.169	0.178	0.166	0.170
F-statistic	1.72	1.96**	2.00**	2.17***	1.43	1.45
N	127	127	127	127	127	127

* p < 0.10; **p < 0.05; ***p < 0.01. Robust standard errors in parentheses. # Number of statistically significant (p< 0.10) fixed effects in parentheses.

Table 15 Effect of Experience Difference

(Difference of experience between department manager and superior manager)

	Task Delegation	Task Delegation	Delegation – Functional Tasks	Delegation – Functional Tasks	Delegation – Departmental Tasks	Delegation – Departmental Tasks
	1	2	1’	2’	1’’	2’’
Experience difference	0.23***	0.17	0.06*	0.06	0.21***	0.13
	(0.07)	(0.17)	(0.03)	(0.09)	(0.04)	(0.11)
Need for coordination	-0.33	-0.33	-0.22	-0.22	-0.21*	-0.21*
	(0.24)	(0.23)	(0.15)	(0.14)	(0.13)	(0.13)
Experience difference × Need for coordination		0.01		-0.00		0.01
		(0.03)		(0.01)		(0.02)
Competition	-0.33	-0.33	-0.21*	-0.21*	-0.07	-0.07
	(0.22)	(0.23)	(0.11)	(0.11)	(0.14)	(0.14)
Education	0.42	0.41	0.18	0.19	0.30	0.28
	(0.32)	(0.32)	(0.18)	(0.18)	(0.19)	(0.19)
Age	-0.05	-0.04	0.01	0.01	-0.08***	-0.08***
	(0.04)	(0.04)	(0.02)	(0.02)	(0.03)	(0.03)
Gender	-0.66	-0.65	-0.22	-0.22	-0.59	-0.58
	(0.78)	(0.78)	(0.43)	(0.43)	(0.43)	(0.43)
Constant	14.78***	14.76***	3.31**	3.31**	12.31***	12.28***
	(2.77)	(2.77)	(1.40)	(1.41)	(1.62)	(1.62)
12-store fixed effects#	Yes (1)	Yes (1)	Yes (2)	Yes (2)	Yes (2)	Yes (2)
R^2	0.200	0.200	0.143	0.143	0.310	0.313
F-statistic	2.20***	2.11***	1.76**	1.70**	3.69***	3.72***
N	162	162	162	162	162	162

* p < 0.10; **p < 0.05; ***p < 0.01. Robust standard errors in parentheses. # Number of statistically significant (p< 0.10) fixed effects in parentheses.

Note 1: *Experience difference*: mean = -2.16, standard deviation = 7.21, range = (-20.13, 18.87). What this variable does is a proxy – rather than a direct measure – for the difficulty of a department manager’s superior to ascertain local uncertainty at the department. The more experience the department manager relative to the superior, the harder for the latter to access local uncertainty based on limited information.

Note 2: The immediate superior manager of a sales-generating department manager and the IT manager is the merchandise manager in a store. The immediate superior manager of sales operation, cashier, and online business departments is the sales manager. The immediate superior manager of customer service manager is the marketing manager. All superior managers work directly and closely their corresponding department managers and have higher formal ranks than the latter. These superiors are regarded as deputy store heads in a store.

Note 2: As seen in Note 1, our constructed variable *Experience difference* and the original *Experience* are not only conceptually difference but also “mechanically” different: the former variable involves the number of years in experience of higher ranking managers, which never occurs in our other regressions. Nevertheless, we find that the two variables incidentally have very high correlation (ρ=0.792). Therefore, we exclude *Experience* in the analysis here to avoid multi-collinearity.

Table 16 Departmental Sales Volatility (z-scored)

	Task Delegation	Task Delegation	Delegation – Functional Tasks	Delegation – Functional Tasks	Delegation – Departmental Tasks	Delegation – Departmental Tasks
	1	2	1’	2’	1’’	2’’
Departmental sales volatility	0.08	1.76***	-0.02	1.49***	0.06	-0.09
	(0.20)	(0.43)	(0.17)	(0.32)	(0.04)	(0.16)
Need for coordination	-0.30	-0.31	-0.29*	-0.30*	-0.12	-0.12
	(0.22)	(0.22)	(0.16)	(0.16)	(0.09)	(0.09)
Departmental sales volatility × Need for coordination		-0.31***		-0.28***		0.03
		(0.08)		(0.06)		(0.03)
Competition	-0.28	-0.26	-0.26*	-0.24*	0.03	0.02
	(0.20)	(0.20)	(0.14)	(0.14)	(0.09)	(0.09)
Experience	0.12	0.12	0.06	0.06	0.08**	0.07**
	(0.08)	(0.08)	(0.06)	(0.06)	(0.03)	(0.03)
Education	0.52*	0.54*	0.30	0.31	0.24**	0.24*
	(0.30)	(0.30)	(0.21)	(0.21)	(0.12)	(0.12)
Age	0.01	0.00	0.01	0.01	-0.01	-0.01
	(0.04)	(0.04)	(0.03)	(0.03)	(0.02)	(0.02)
Gender	0.04	0.13	0.31	0.39	-0.02	-0.03
	(0.72)	(0.73)	(0.51)	(0.51)	(0.29)	(0.29)
Constant	11.56***	11.51***	3.05*	3.00*	8.97***	8.98***
	(2.35)	(2.34)	(1.67)	(1.66)	(0.92)	(0.93)
12-store fixed effects#	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)	Yes (0)
R^2	0.125	0.139	0.154	0.176	0.119	0.120
F-statistic	1.45	21.29	1.70	22.82	1.15	15.19
N	125	125	125	125	125	125

* p < 0.10; **p < 0.05; ***p < 0.01. Robust standard errors in parentheses. # Number of statistically significant (p< 0.10) fixed effects in parentheses.

Note 1: *Departmental sales volatility* = (variance of *Departmental month-to-month sales changes*) / (variance of *Store’s month-to-month sales changes*). This variable measures department-specific sales volatility relative to that at the store level. We z-score the variable for the ease of coefficient interpretations.

Note 2: *Departmental sales volatility*: mean = 2693, standard deviation = 21890.41. The two original variables used to construct it are: *Store month-to-month sales changes*: mean = -0.03%, variance = 0.0124; and *Department month-to-month sales changes* mean = 30.93%, variance = 25.6807.

Note 3: Not shown in the paper, we also construct an alternative measure that borrows from the classic measure of a stock price’s relative volatility to that of the market, beta, where *Beta* = covariance(departmental month-to-month sales changes, store month-to-month sales change) / variance(store month-to-month sales change). This variable measures department-specific sales volatility relative to the direction, normalized by store-level month-to-month sales changes. *Beta*: mean = 2.548, standard deviation = 18.220. Results of using *Beta* and *Departmental sales uncertainty* are very similar, apparently because of their high correlation (ρ=0.955).

Table 17A Effect of Local Volatility under High versus Low Coordination Need (Extreme Values of H and L)

	Task Delegation	Task Delegation	Task Delegation	Task Delegation
Need for coordination	Low	High	Low	High
	1	2	1'	2'
Local uncertainty	0.91**	-0.56		
	(0.41)	(0.51)		
Departmental sales volatility			0.06	-133.09
			(0.16)	(462.89)
Competition	-0.72	-0.95**	-0.69	-0.62**
	(0.44)	(0.39)	(0.46)	(0.29)
Experience	0.09	0.40***	-0.04	0.05
	(0.11)	(0.14)	(0.11)	(0.31)
Education	-0.12	0.21	-0.32	2.09***
	(0.58)	(0.88)	(0.58)	(0.72)
Age	-0.02	-0.18	0.11	-0.04
	(0.09)	(0.11)	(0.08)	(0.18)
Gender	-2.74	0.00	-2.93	2.01
	(2.69)	(1.66)	(1.92)	(2.50)
Constant	13.15***	20.89***	12.46***	-8.43
	(3.87)	(6.38)	(4.38)	(59.98)
12-store fixed effects[#]	No	No	No	No
R^2	0.298	0.547	0.357	0.399
F-statistic	4.63***	6.48***	7.94***	3.99**
N	31	25	27	15

* p < 0.10; **p < 0.05; ***p < 0.01. Robust standard errors in parentheses. [#] No store fixed effects to economize on the degree of freedom; otherwise, it is impossible to calculate a meaningful F statistic.

Note 1: *Need for coordination*: Low = ratings are 2, 3, and 4; High = ratings are 7.

Note 2: *Lack of experience*, however, generates positive coefficients on both *Local uncertainty* and *Departmental sales volatility*. This is not shown in the paper.

Table 17B Effect of Local Volatility under High versus Low Coordination Need (Less Extreme H and L)

	Task Delegation	Task Delegation	Task Delegation	Task Delegation
Need for coordination	Low	High	Low	High
	1	2	1'	2'
Local uncertainty	1.25***	-0.27		
	(0.32)	(0.35)		
Departmental sales volatility			0.58**	-0.13
			(0.24)	(0.23)
Competition	-1.05***	-0.26	-0.57*	-0.13
	(0.30)	(0.28)	(0.30)	(0.30)
Experience	0.34***	0.34***	0.12	0.17
	(0.13)	(0.10)	(0.10)	(0.12)
Education	0.15	0.80*	0.79*	0.60
	(0.50)	(0.41)	(0.45)	(0.40)
Age	-0.08	-0.05	0.05	0.00
	(0.06)	(0.06)	(0.06)	(0.06)
Gender	1.22	-1.05	1.51	-0.64
	(1.42)	(0.86)	(1.14)	(0.91)
Constant	11.72***	10.37***	9.31***	8.12***
	(3.48)	(3.50)	(3.44)	(3.15)
12-store fixed effects#	Yes (1)	Yes (2)	Yes (0)	Yes (1)
R^2	0.422	0.339	0.297	0.279
F-statistic	3.39***	3.37***	3.32***	3.03***
N	72	95	60	65

* p < 0.10; **p < 0.05; ***p < 0.01. Robust standard errors in parentheses. # No store fixed effects to economize on the degree of freedom; otherwise, it is impossible to calculate a meaningful F statistic.

Note 1: *Need for coordination*: Low = ratings are 2, 3, 4, and 5; High = ratings are 6 and 7.

Note 2: Since more samples are included in the regressions, including store fixed effects are feasible.