

# Performance Measure Diversity and the Delegation of Authority in Organizations

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## Abstract

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We investigate the non-linear relation between the number of performance measures used in a firm and delegated authority to local managers. We use a model suggested by Aghion and Tirole (*Journal of Political Economy*, 1997) that allows us to underpin theoretically our empirical investigation and to control for several other determinants of delegated authority including information asymmetry, externalities between units within the firm, the span of control of the superior, the number of superiors of a subordinate manager, the urgency of a decision, and the reputation of the superior for moderate interventionism. We find strong evidence of a non-linear relation between delegated authority and the number of performance measures used. We also conclude that information asymmetry, externalities between units, the reputation of the superior, and the superior's span of control affect delegated authority in the hypothesized manner. These results continue to hold after addressing potential endogeneity problems.

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## 1. Introduction<sup>1</sup>

We investigate the effect of using multiple performance measures (such as in a ‘balanced scorecard’) on the decentralization of decision rights within firms. We find that the relation between the amount of measures used and decentralization is non-linear. While the relation remains flat when few measures are used, we document a strong negative association when many measures are used.

The non-linearity in the relation between the use of multi-measure systems and decentralization arises because using more measures has two opposing effects: (1) top management is better able to assess the effort of agents and hence is more willing to decentralize and (2) agents have a greater opportunity to game the performance measurement system to their advantage prompting management to centralize decision making. We expect the first effect to dominate when only few measures are being used, while the latter effect dominates in cases where many measures are employed to assess the performance of agents.

One implication of this study is that recommendations in practice-oriented journals in which ‘balanced scorecards’ or multiple-measure systems are advocated for large decentralized firms (Kaplan and Norton, 1996) should be treated with caution. We provide evidence that the relation between using multiple performance measures and decentralization is more complex.

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The design of this study includes a number of distinguishing features. First, despite considerable theoretical work (Nault, 1998, Melumad, Mookherjee and Reichelstein, 1992, Baiman, Larcker and Rajan, 1995, Brickley, Smith and Zimmerman, 1997, Hayek, 1945), little attention has been paid empirically to the determinants of decentralization choices made by top management (Ittner and Larcker, 2001). Our study investigates the effect of using multiple performance measures together with other determinants of decentralization identified in earlier theoretical work. Specifically, we base our tests on Aghion and Tirole (1997). The use of Aghion and Tirole's (AT) model is helpful to our work for two reasons. First, AT is one of few models which admit a role for performance measurement systems in the decisions surrounding organization design. Second, recent reviews of the management accounting literature have lamented the atheoretical approach taken in many empirical inquiries (Zimmerman, 2001, Ittner and Larcker, 2001, Luft and Shields, 2003). The AT model provides a consistent theoretical framework and allows for substantial guidance on the specification of the empirical tests.

A second feature of our research design is that we consider potential endogeneity problems explicitly in our econometric approach (see, Ittner and Larcker, 2001).

Finally, our theory predicts non-linearities in the relation between delegated authority and performance measure diversity. While some research has attempted to model and test non-linear relations in management accounting, much of the empirical research does not even question the form of the relations (Luft and Shields, 2003). We explicitly model the non-linear relations predicted by theory in our regression specifications and find strong evidence supporting the existence of non-linearities. We test our model using survey data from a sample of 78 local managers (unit managers within divisionalized firms) from a representative set of firms listed on the Amsterdam Stock Exchange.

The remainder of this paper proceeds as follows. Section 2 contains the development of our empirical model. We describe sample and research method in Section 3. In Section 4 we report our empirical results and we provide a discussion of these results in Section 5. In Section 6, we discuss potential caveats and we offer some concluding remarks.

## **2. Hypothesis development**

### *2.1 Determinants of local authority*

We use a model of decentralization choice based on theoretical work by Aghion and Tirole (1997). These authors discuss both *formal* and *real* authority vested in local managers. Hence, we define decentralization as the assignment of authority to managers in the firm. Real authority pertains to the effective control over decisions. This may or may not coincide with formal authority in which an explicit or implicit contract allocates the right to decide on specific matters to a manager (Aghion and Tirole, 1997, 1995). If a superior is in the habit of ‘rubberstamping’ the decisions of his subordinate, the latter may not have formal authority, but it is he who effectively decides. We define local authority as the combined formal and real authority vested in a local manager. Despite considerable fundamental work on the concept of authority (Simon, 1951; Grossman and Hart, 1986; Hart and Moore, 1990, Aghion and Tirole, 1997), little is known empirically about its determinants (Ittner and Larcker, 2001). The following is a summary of the relations examined here.

#### **Equation 1:**

Local Authority (LOCAUT) =  $f$ (performance measure diversity, information asymmetry, externalities of local decisions, span of control, number of principals, urgency of decisions, reputation of superior for moderate interventionism)

### *2.2 Performance measure diversity*

AT demonstrate that the availability of new, informative performance measures enables top management to delegate more authority to local managers (see also, Nault, 1998). We define

*performance measure diversity* as the number of performance measure categories a firm uses to evaluate its managers. The benefits associated with top management's improved ability to delegate more authority when they can assess the performance of local managers better are labeled IB (Information Benefits).

As noted before, adding measures is costly and include the costs of producing information, as well as the costs associated with the complexity of multi-performance measure systems and the integrity of the measures (Bushman and Smith, 2001). This is a likely explanation why (in practice) compensation contracts are not written on all measures that are correlated with performance. Managers may react dysfunctionally to (imperfect) performance measures. The costs associated with this dysfunctional behavior can outweigh the information benefits from using an additional measure. We emphasize three kind of costs associated with performance measure diversity: (1) measurement costs (MC), (2) effort reduction costs (ERC), and (3) ratcheting costs (RC). If the marginal costs of increasing performance measure diversity outweigh its marginal benefits (which we expect when many measures are used), then top management will change the allocation of tasks to reduce the possibility of managers misdirecting effort. Thus, the firm's response is to mute incentives and to reduce the delegation of authority to local managers (Prendergast, 1999, Holmstrom and Milgrom, 1991). We expect a non-linear relation between local authority and performance measure diversity. At low levels of performance measure diversity, adding a measure will lead to increased opportunities for further delegation of authority to local managers, but at higher levels of diversity, local authority will be less in view of possibilities of agents' dysfunctional responses to the many measures.<sup>2</sup>

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<sup>2</sup> Firms may also reduce the number of measures or rely on more aggregate measures and keep delegated authority constant. For the purpose of the discussion in this section, we

In sum, we expect the relation between local authority and performance measure diversity to be as follows:

**Equation 2:**

$$\text{Local Authority} = f [\text{IB}(\text{measure diversity}), \text{MC}(\text{measure diversity}), \text{ERC}(\text{measure diversity}), \text{RC}(\text{measure diversity}), \text{other determinants}]$$

IB, MC, ERC and RC are all increasing functions of performance measure diversity. The partial relation between LA and IB is expected to be positive, while a negative partial relation is expected between LA and MC, ERC, and RC respectively.<sup>3</sup> Below we discuss the nature of performance measure diversity costs. The relations of the other determinants with local authority will be discussed in subsequent sections.

*Measurement costs.* Holmstrom and Milgrom (1991, 1994) show that the costs of measuring an agent's performance affect the delegation of authority to local managers negatively. These

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(temporarily) assume the number of measures to be exogenously determined to maintain a given level of decentralization. The firm may need many measures to direct attention to certain tasks or to communicate its strategy. It is also possible that aggregate measures of performance are simply unavailable given the complexity of the job. Prendergast (1999) suggests that the unavailability of aggregate measures is a motive for using additional (subjective) measures. Given the (exogenously determined) number of measures, the firm's response to the costs of these measures is to reduce delegated authority. Note, however, that our empirical work treats performance measure diversity as endogenous.

<sup>3</sup> It is easy to see by taking the total derivative of Equation 2 with respect to performance measure diversity that the sign of the relation between local authority and performance measure diversity depends on the size of the change in authority due to information benefits and the size of the change in authority caused by measure diversity costs.

authors find that rigid rules and limits on activities (more centralized decision-making) are an optimal response to difficulties in measuring and rewarding performance. Measurement costs are likely to be increasing in performance measure diversity. Not only will a firm incur direct costs of gathering, analyzing and verifying information on each performance measure, but also indirect costs of performance measure diversity exist. Indirect costs may arise because employees start shifting their attention from poorly measured to the better measured and well-compensated activities, even if this allocation of effort is not optimal to the firm (Holmstrom and Milgrom, 1991; Holmstrom, 1989). These costs can cause top management to refrain from using (additional) measures and to put restrictions on the allocation of effort over tasks of an agent (in effect, reducing his authority).

The same phenomenon may also occur if the aggregation (weighting) of the individual performance measures to an overall evaluation of the agent is incorrect (Baker, 1992). Performance measure diversity requires superiors to aggregate the scores on the individual measures. Often this aggregation (weighting of each measure) will be implicit and judgmental and will leave substantial room for discretionary decision-making. The more discretion a superior has in determining the performance evaluation of a subordinate, the stronger will be the agent's incentives to influence her (Prendergast and Topel, 1993). Even when the weights are announced explicitly, subordinates may have an incentive to lobby for shifting weights to the measures on which they scored best. These costs will decrease the benefits of adding a new measure and at the same time increase the costs of further delegation of authority. Thus, local authority is reduced in response to the influence costs associated with higher performance measure diversity.

*Effort reduction costs.* Multitask problems may also arise in the absence of explicit incentives. Some recent models show that when the market tries to infer an agent's talent from his measured performance, incentives to expend effort on one task may depend on the set of tasks

one is assigned to (Holmstrom, 1999). Dewatripont, Jewitt and Tirole (1999a, b) show that a reduction in the number of tasks an agent has to perform (i.e., reduce delegated authority) may increase his total effort. When reducing the number of tasks an agent has to perform strengthens the link between measured performance and an agent's perceived talent, agents will increase effort. Agents are, in such case, less uncertain about whether their talent will be picked up by a (imperfect) performance measure. Whereas in standard multitask problems, agents may substitute effort between tasks, in this model effort may actually be lowered due to the introduction of an additional measured task. To maintain the link between talent and measured performance top management reduces the number of tasks. While this decreases decision authority because related tasks are separated, it enables principals to assign more precise and clearer objectives consistent with the agent's talent (Dewatripont et al., 1999b), which in turn increases total effort.

*Ratcheting costs.* The "ratchet effect" describes the tendency of performance standards to be adjusted upwards after a particularly good performance, which penalizes good current performance by making it harder to exceed the new target in future (Milgrom and Roberts, 1992). Employees may respond to this tendency by reducing earlier efforts to avoid the setting of higher targets. Murphy (1999) and Leone and Rock (2002) demonstrate empirically that managers engage more in gaming the system when standards are subject to the ratchet effect. Indjejikian and Nanda (1999) argue that less performance measure diversity may be preferred because it can alleviate some of the inefficiencies of the ratchet effect. These authors assume that commitment by employers not to use past performance as a guide to evaluate an employee's current performance may not be credible. Indeed, efficiency gains might be earned ex post using the information. Their reasoning is that the use of a single performance measure system acts as a commitment device to ratchet less. "Aggregate" performance measures are subject to less ratcheting, since they are less informative than more detailed,

disaggregate components. If the negative effects of ratcheting are sufficiently large, delegating authority to a lower level agent and evaluating him on a consolidated (single) performance measure is called for.

In conclusion, firms make conscious decentralization choices. We expect that using more performance measures affects the extent to which an organization *can* decentralize. However, adding measures is costly and may exceed benefits especially when more measures are used already. In such case, organizations respond by lowering decentralization. Since we cannot observe costs and benefits of more performance measures directly, we estimate a reduced form. In the reduced form, the relation between local authority and performance measure diversity will be non-linear, where the sign depends on whether costs or benefits of diversity dominate.

### *2.3 Information asymmetry*

In AT's model the allocation of formal authority to local managers stimulates these managers to acquire information. In turn, more information impacted at the local level increases the real authority of local managers. Thus, information asymmetries have a positive effect on the level of local authority. However, assigning authority to managers who have an information advantage may lead to goal incongruity (i.e. moral hazard problems). In any case, the loss of control associated with vesting authority in local managers increases the expected cost of subordinates pursuing their own, instead of the firm's objectives. A tradeoff exists between the costs of control loss and the informational benefits associated with delegation of authority. We therefore have no prediction about the sign of the association between information asymmetry and local authority. Our agnosticism is supported by Baiman et al. (1995) who analyze three models of organizational design. These authors investigated the relation between delegation of decisions and relative expertise of local management versus top management. The prediction of their three models on the sign of the association between

these two variables depends on whether they emphasize the incentive costs or decision benefits of delegation. Nevertheless, their empirical work is most consistent with a model in which low levels of information asymmetry are matched with low levels of decentralization. Since the principal is informed, she chooses her preferred action and there is little benefit associated with delegating authority to local managers. Similar findings are reported by Christie et al. (2003), Melumad et al. (1992) and Nault (1998).

#### *2.4 Externalities of local decisions*

AT recognize two potential externalities of local managers' decisions. These externalities may prevent top management from delegating authority to subordinates because the harmful effects of local decisions on other managers or on the firm may outweigh the benefits associated with exploiting the information advantage of local managers. Externalities are expected to be negatively associated with the delegation of authority to local managers. If externalities occur between units, then the decisions of one local manager affect the performance of other local managers. Bushman et al. (1995) and Keating (1997) show that in these circumstances it becomes increasingly difficult to ascertain a local manager's performance. This, in turn, may convince top management not to delegate certain decisions (i.e., those most vulnerable to lateral influences) to the local level. Externalities may also be caused by dependent demand functions of business units or by joint supply or cost functions (Milgrom and Roberts, 1992). These dependencies imply that there may be benefits to be gained by coordinating the activities of the business units. A local manager's preferred decision is likely to be very suboptimal if there are substantial externalities on the firm. Top management will minimize the opportunity for suboptimal decision-making by centralizing (Bushman et al., 1995; Christie et al. 2003).

### *2.5 Span of control*

AT show that an increasing span of control may lead to information overload and may as such necessitate the delegation of authority to lower level managers (see also, Aghion and Tirole, 1995). The argument of these authors is closely related to observations often made in empirical work in which managers of larger business units are seen to have more decision making power (Williamson, 1975; Chandler, 1977). We therefore expect a positive association between the size of the local manager's unit and the local authority vested in him.

### *2.6 Number of principals*

If a local manager is responsible to more than one principal, he will have more authority to make decisions. Intervention in the decisions of local managers requires the approval of all principals, since the intervention can potentially affect all of them. The need to get (ex ante) approval to intervene in the subordinate's decisions effectively increases the costs of doing so (Aghion and Tirole, 1997). As a result, the local manager will have less decisions reversed by his principal(s). Hence, local authority and the number of principals are positively related.

### *2.7 Urgency of decision*

If management needs to react quickly to changes in environmental conditions then this may force firms to decentralize. To be successful in a highly competitive environment requires a decision making structure that is flexible, dynamic and adaptable (Khandwalla, 1972). This implies a decentralized structure where local managers have the authority to respond quickly to changes in competitive conditions. A substantial amount of contingency theory-based research has documented the relation between (perceived) environmental uncertainty and local decision-making power (Ittner and Larcker, 2001). From an economic perspective, the need to decentralize may arise if delaying local decisions (to get approval

from higher-up in the hierarchy) is overly costly. Local decision making then becomes *urgent*. Local authority is then positively related with the urgency of decisions.

### *2.8 Reputation of the principal*

Depending on the principal's reputation to intervene in the local managers decision, the latter's local authority is greater (reputation of non-intervention) or smaller (reputation of frequent intervention) (Aghion and Tirole, 1997). Hence, we expect a positive association between the reputation of non-intervention and local authority. AT suggest that it may be optimal to a superior to use her authority to overrule the subordinate in "important" matters, but to relinquish this authority voluntary in matters that are less important to her.

## **3. Sample, measures and econometric issues**

### *3.1 Sample*

We obtained data from a cross section of Dutch listed firms. Only listed firms participated in our study since these firms represent the largest and most important firms in the Dutch economy. Size is of particular concern here. Larger firms are more likely to experience nontrivial problems of delegating authority to local managers. To investigate the role of externalities in the delegation of authority to local managers, we needed firms with multiple, dependent units. Therefore, we required firms to have at least two operating divisions. We defined division as units that report directly to the Chief Executive Officer (CEO) or Chief Operating Officer (COO) of the firm. Qualifying firms were asked to cooperate in the study by one of the researchers. We addressed the CFO to act as a sponsor of the project within the firm and to introduce the researchers to unit managers. Once we got the CFO's support, the response rate within the firm was 100%. In most cases, one of the researchers visited the unit manager on site to administer the survey. Alternatively, in a few cases we used a telephone call to talk to respondents. Respondents are division managers or unit managers who report directly to division managers. The respondents had a median age

between 45-49 and typically had a college or university education. They had been working on average for 6.4 years in the firm (median = 3 years) and for 3.9 years in their current position (median = 2 years). The final sample consists of 78 division managers from 15 industries.

### 3.2 Measures

In this section, we discuss the measurement of each variable. Descriptive statistics are presented in Table 1. Pearson and Spearman correlations among all variables are shown in Table 2.<sup>4</sup>

#### 3.2.1 Dependent variable

*Local authority.* Similar to an approach taken by Gordon and Narayanan (1984), we ask unit managers to indicate their influence over a range of key decisions (i.e., strategy, personnel, operations, investments and marketing). However, in contrast to these authors we asked managers to indicate the differences in influence over a certain decision between them and their superior to capture both formal and real authority. We obtained the measure by summing the responses to five survey questions. Factor analysis, maximum likelihood tests<sup>5</sup> and reliability assessment (Cronbach's alpha = 0.73) supported this approach.

#### 3.2.2 Independent variables

*Performance measure diversity.* We measured diversity by identifying the range of performance measures used by a superior to assess the performance of a local unit. For this purpose we asked managers to assign weights to each of 6 categories of performance measures (stock price, profitability measures, cost measures, revenue measures, non-financial measures on strategy, marketing and investments and non-financial measures on internal

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<sup>4</sup> A copy of the survey instruments is available from the authors upon request.

<sup>5</sup> Details about the factor analyses, Bartlett tests and reliability assessment of our instruments are available from the authors upon request.

processes and human resources). Performance measure diversity indicates the number of categories used to measure performance of the local unit (i.e., assigned weights > 0). The theoretical range of performance measure diversity is 1 to 6. We standardized (mean = 0, std.=1) this variable to reduce the potential effects of arbitrary differences in scale on the correlations among variables.

*Information asymmetry.* We relied on Dunk's (1993) six-item scale to measure the local manager's information relative to their superior's in their area of responsibility. Factor analysis and reliability assessment (Cronbach's alpha = 0.86) support the use of one common factor. Accordingly, we standardized the items and summed the responses to the six items to obtain a measure of information asymmetry. We checked the convergent validity (Brownell, 1995) of this measure by computing Pearson correlations with alternative proxies of information asymmetry. Details are reported in Section 3.3.2.

*Externalities.* We attempted to capture the influence of externalities on local authority by measuring the exchange of goods and services between business units within the firm. The questionnaire items were purpose-developed to capture operating interdependencies between units caused by joint cost and supply functions or dependent demand functions. The reasoning is that business units that transact with each other are more likely to be affected by decisions made in one of the units than organization units that have no sourcing relation. Thus, we expect external effects to be an increasing function of operating interdependencies. We asked BU managers two questions: (1) the percentage of total incoming supply of goods or services sourced from other BUs, and (2) the percentage of total outgoing goods provided to other subunits. The variable *Operating interdependencies* is the sum of these two percentages. One advantage of measuring externalities in this manner is that we do not rely on managerial perception about potential external effects but ask instead for 'hard data' on sourced goods or services (a recommended method, see Ittner and Larcker, 2001). We validated our measure by

constructing an alternative measure based on survey items suggested by Keating (1997). Keating asked respondents to identify the extent to which their activities impacted other units (IMPACTONTHEM). External effects received by the respondents are measured by having the respondent identify the extent to which their performance was affected by activities carried out in other units (IMPACTONYOU). Finally, we asked (in addition to Keating's items), the extent to which a unit would be able to operate independently (i.e., outside the parent company) on the market (INDEP). Factor analysis and reliability assessment indicated that these three items captured one underlying construct. We standardized and summed the three items to obtain IMPACT. The correlation between IMPACT and Operating interdependencies is 0.57 (p-value<1%). We interpret this significant correlation as evidence of convergent validity. Thus, we conclude that our measure of externalities captures the effects of managerial actions on other units.

*Span of control.* We proxy the superior's span of control by the size of the local manager's unit. Our reasoning is that without delegation of authority larger units (measured in terms of people employed) imply a wide span of control to the superior. This is not a direct measure of a superior's span of control. Ideally, we would need to know how many local managers a superior supervises. Since we administered our questionnaire at the level of local managers, we do not have this information. We standardized this variable as well.

*Number of principals.* Respondents have either one (division managers) or two principals (unit managers). Division managers report directly to the CEO or COO of the company. Unit managers report directly to a division manager and indirectly to the firm's CEO. We use an indicator variable, which takes the value of one if the respondent is division manager and of zero otherwise.

*Urgency of decisions.* The urgency of a decision is proxied by the degree of competition in an industry. We measured the degree of competition a unit faces using questionnaire items

introduced by Khandwalla (1972). His instrument surveys four elements of competition (1) price, (2) promotion and distribution (3) product quality and (4) product variety. Factor analysis and reliability assessment (Cronbach's alpha=0.65) supported that the construct "urgency of decisions" was unidimensional. We standardized and added the individual items to form our variable *Urgency of decisions*.

*Reputation of principal for moderate interventionism.* We argue that a principal's reputation (for intervening in his subordinate's decisions only when necessarily) is a function of the number of interactions that took place between superior and local manager. In turn the number of interactions depends on the duration of the relation between superior and local manager. In other words, the longer a superior and local manager have been working together, the higher the likelihood that a reputation of moderate interventionism has been established. We define the variable *Principal's reputation* as the number of years a superior and local manager have been working together. If this information is not available, we assign to the Principal's reputation the value zero. This variable was standardized to prevent scale differences to confound the analysis.

*Industry effects.* To preserve degrees of freedom, we included four indicator variables to control for potentially confounding influences of a firm's industry. This procedure implies that we re-grouped the original 15 industries into four relatively homogenous industries.

### *3.3 Econometric issues*

#### *3.3.1 Non-linearity of the relation between performance measure diversity and local authority*

We hypothesized that the relation between performance measure diversity and local authority exhibits non-linearity. We attempt to capture the potential non-linear relation by 1) including the variable PMDIV2, which is performance measure diversity squared and 2) estimating a spline regression. Since we expect that local authority will first increase and then decrease in performance measure diversity, we predict the sign on PMDIV2 to be negative.

As an alternative to a quadratic function, we estimate a spline regression (Greene, 1990). In absence of firm theoretical guidance as to the position of the knot in this regression, we decided that firms that use four or more measure categories (out of six possible categories) are likely to differ from firms that use three or fewer. Therefore, we specified a spline dummy that takes the value of the performance measure diversity variable minus four if performance measure diversity is greater than or equal to four and zero otherwise. In the spline regression we expect that the sign on performance measure diversity will be positive and on the spline dummy negative, which would capture the hypothesized increasing and then decreasing relation between local authority and performance measure diversity. Since the specification of a spline regression involves an arbitrary choice of knots, a quadratic function might be more appropriate to capture non-linearity or unknown functional form.

### *3.3.2 Endogeneity biases*

Earlier theoretical and empirical work has suggested that (1) information asymmetry and (2) performance measure diversity are choice variables to the firm. Aghion and Tirole (1997) show that delegating formal authority to a subordinate manager provides him with incentives to gather and process new information. Without formal authority, the local manager is vulnerable to opportunistic use of the information he has gathered by his superior. If a superior surrenders her formal authority to the local manager, she credibly commits to ignore new information to harm the subordinate. In sum, increasing the local authority of a manager *causes* an increase in information asymmetry. Chenhall and Morris (1986) show empirically that the use of performance measures depends on the level of decentralization. Specifically, these authors show that increasing levels of decision rights allocated to business unit managers imply higher use of aggregated and integrated information. Potentially, therefore, an endogeneity problem might exist in our model. It is well known in the econometric literature that ordinary least squares estimation of the parameters of a structural

model in case of endogenous variables may be inconsistent (Greene, 1990). We tested whether the endogeneity bias would render our OLS estimates inconsistent using a Durbin-Wu-Hausman test (Johnston and DiNardo, 1999).

We used three additional variables as instruments for information asymmetry and four additional variables as instruments for performance measure diversity.<sup>6</sup> Three characteristics of local managers are likely to be associated positively with the information asymmetry between superior and subordinate manager: (1) age, (2) experience in current position and (3) experience in the firm. The local manager's age and experience are likely to be correlated with his specialized knowledge. Demsetz (1997) and Jensen and Meckling (1992) argue that specialized knowledge is costly to communicate up in the hierarchy. Thus, information asymmetries between hierarchical levels increase with higher levels of specialized knowledge.

Prior research has shown that the design of performance measurement systems is dependent on the competitive environment of a firm (Khandwalla, 1972; Gordon and Narayanan, 1986). Growth opportunities are a dimension of the firm's competitive environment. The impact of growth opportunities on the use of performance measures has recently been investigated in the context of internet companies (Trueman et al. 2000, Demers and Lev, 2000). Together these studies suggest that earnings are a less important performance measure for these firms, instead non-financial indicators as well as revenues are used. Some authors (e.g., Ittner and Larcker, 2002) argue that below target performance makes management shift attention to financial measures only. Thus, we expect performance of a unit to be negatively related to performance measure diversity. The need to add additional performance measures likely depends on the perceived accurateness of the available

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<sup>6</sup> Details about the measurement of the instrument variables (including descriptive statistics) are available upon request.

aggregated financial measures. The better an aggregated financial measure captures managerial performance, the less need to introduce additional measures (Datar et al., 2001). Finally, the degree to which a unit functions independently from the firm, may be related with the number of performance measures used. More independent units presumably will be judged on broader, more aggregated measures. These measures will typically capture the overall performance of the unit – hence fewer measures might be expected. We therefore assume (1) growth opportunities (GROWTH), (2) perceived accurateness of aggregated measures (ACC), (3) independence of the unit (INDEP), and (4) performance of the unit (PERF) to be associated with performance measure diversity.

The results of the Durbin-Wu-Hausman test indicated that endogeneity bias does not affect the OLS estimates unduly (F-statistic=0.98, p-value=0.38). Although there is some reason<sup>7</sup> to treat these test results with some caution, we proceeded by estimating the model by OLS.

## **4. Results**

### *4.1 Quadratic regression*

Our model of the determinants of local authority has good explanatory power, the adjusted R-squared exceeds 49% (see Table 3). The F-statistic is 8.00 (Prob(F) < 1%) which supports that our model is able to capture many of the relevant determinants of local authority. Consistent with our hypothesis, performance measure diversity is strongly

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<sup>7</sup> The available instruments for performance measure diversity and information asymmetry are at the lower bound of what the literature accepts as reasonable (first-stage adj. R2 is 33.01% (Information asymmetry) and 15.98% (Performance measure diversity) respectively) (see also, Nelson and Startz, 1990 and Bound et al. 1995). Note furthermore that the Hausman test is an asymptotic test and within the current small sample context its results need to be construed with care.

negatively associated with the level of local authority (coefficient = -0.81, t-statistic = -2.46). We find weaker evidence of a non-linear relation between local authority and performance measure diversity. The coefficient estimate on PMDIV2 is -0.61 (t-statistic = -1.76, p-value=0.08). We find a strong positive relation between information asymmetry between subordinate and superior and local authority as predicted (coefficient = 0.45, t-statistic = 6.95). We find strong evidence of the expected negative relation between externalities and local authority. Specifically, operating interdependencies between business units are significantly negatively associated with levels of local authority (coefficient = -1.93, t-statistic = -2.39). The span of control is positively related to local authority as expected (coefficient = 0.86, t-statistic = 2.42). We also find evidence that the reputation of the principal for moderate interventionism affects local authority, but the relation is in a direction opposite to our expectations (coefficient = -0.60, t-statistic = - 1.91). The number of principals (coefficient = 0.97, t-statistic = 1.48), the urgency of decisions (coefficient = -0.01, t-statistic = -0.14) and the industry dummies were all insignificant at conventional levels. Note that the sign on Urgency of decisions is negative and on Number of principals positive, contrary to our expectations.

#### *4.2 Spline regression*

Compared with the results of the quadratic regression, the spline regression has slightly more explanatory power (adj. R2 = 52%) (see, Table 3). Coefficient estimates on almost all variables are qualitatively similar to the estimates in the quadratic regression and our inferences do not change. However, we find that performance measure diversity is positively (but not significantly) associated with local authority (coefficient = 1.04, t-statistic = 1.39). Moreover, we find a strongly significant negative relation between the spline dummy and local authority, which indicates that high values of performance measure diversity (i.e., four or higher) cause local authority to *decrease*. Combined with the non-significant relation

on performance measure diversity, this finding would indicate that performance measure diversity has no effect on local authority at low levels of diversity and a negative effect at higher levels of diversity.

#### *4.3 Sensitivity analysis*

We conducted two sets of sensitivity checks (details are available on request). First, we addressed potential concerns about common method bias in our results. Second, we relaxed some of the assumptions about how indicator variables group into factors in our factor analyses. In particular, we factor analyze all variables in Equation 1 that are measured through Likert scale type items simultaneously. Our results are not driven by common method bias and are robust against weaker assumptions about indicator groupings (i.e., we obtained a ‘clean’ factor structure).

### **5. Discussion**

Theory suggests that the relation between performance measure diversity and local authority is non-linear. The benefits from adding a new performance measure follow directly from the informativeness principle: the effort of an agent can better be ascertained and therefore more authority can be delegated to lower level managers. This in turn reduces the information overload at top management level and allows specific knowledge to be used in decision-making. More recent agency models suggest however that greater performance measure diversity is costly and these costs are likely to dominate when a large number of measures is used. Hence, the relation between measure diversity and local authority is non-linear. Our evidence strongly suggests that the costs of performance measure diversity (i.e., adding a new measure) start to outweigh its benefits early. To see this, consider the partial derivative  $\partial(\text{Local authority})/\partial(\text{Performance measure diversity})$  in the quadratic regression. The significantly negative coefficient on Performance measure diversity brings forward (i.e., reduces) the optimal performance measurement diversity, *ceteris paribus*. Sign reversal on the

variable performance measure diversity would not affect our conclusion about the existence of a non-linear relation, but would suggest that firms can longer continue to add performance measures before the costs of doing so take the upper hand.

When comparing the results of the quadratic regression with the spline regression, it seems that the claiming that the quadratic regression shows evidence of an inverted U- shape is taking the results too far. The estimated quadratic function is mostly fitting data points in the region from  $-0.5$  to  $1$  (which is where most of the data points are given that the median value of performance measure diversity is  $0.43$ ). The slope of the relation is always negative here. The data from the left-hand tail (below  $-0.5$ ) does not come into play and it is therefore not clear that the left tail of the fitted regression curve represents the data. This concern is borne out by the spline regression results, which show a (positive, but) not-significant relation for low performance measure diversity and a significant negative slope for high performance measure diversity. In sum, the benefits of performance measure diversity do not outweigh its costs (or vice-versa) at low values of measure diversity, but costs of diversity clearly dominate its benefits when performance measure diversity is high.

In addition we find that local authority and information asymmetries are positively associated. Top management has an incentive to delegate authority to subordinates to benefit from their superior information. Empirically, this effect dominates the potential concerns about moral hazard – i.e., the local manager may want to use his superior information to pursue his private objectives. This adds to earlier empirical findings that also showed that information benefits tend to dominate moral hazard concerns (Baiman et al., 1995; Christie et al., 2003). We also find strong evidence that a wider span of control of the superior is related to higher levels of local authority. The benefits of vesting authority in local managers if they have better information may be mitigated by delegation costs. Such costs might be caused by allowing local managers to make decisions that are optimal for their unit but *not* for other

units within the firm. Empirically, these externalities of local decisions were shown to have a negative effect on the delegation of authority. If local decision-making is more likely to affect other managers in the firm, top management typically retains more decision making power. We also find that a superior's span of control is important in determining the decision-making authority of a local manager. Specifically, a wider span of control increases the chances of information overload of top management and thus increases the need for delegating more authority. Finally, we find that the reputation of the principal for moderate interventionism is *negatively* correlated with local authority. This finding contradicts our theory and we cannot explain it.

## **6. Caveats and concluding comments**

While our empirical work is motivated by and inspired on Aghion and Tirole (1997), it cannot be considered a direct test of their model. First, Aghion and Tirole (1997) distinguish between the delegation of real and formal authority. Both forms have potentially their own set of unique determinants. We were unable to make this distinction given the data we collected and we combined the two forms of authority in the construct local authority. Second, some of the proxies we had to use are arguably not ideal. Specifically, we cannot ascertain the span of control of the superior directly, and neither do we have data on the reputation of the superior for moderate interventionism. Nevertheless, as argued above, we believe that our proxies are sufficiently associated with the constructs of interest to our study. Moreover, while care has been taken to address potential methodological pitfalls, at least two caveats remain. First, the potential endogeneity suggested in theory and in earlier empirical work was addressed by conducting a Hausman test for endogeneity bias. Although the test results admitted the use of OLS, concerns remain since the results of the Hausman test are sensitive to the choice (and predictive quality) of the instrument variables. Ideally the choice of instruments should be directed by theory. Unfortunately, Aghion and Tirole's model does not provide much

guidance with respect to the determinants of information asymmetry. In addition, theory about the number of performance measures to be used relies on applications of the informativeness principle and are hard to operationalize. We used instrument variables that were suggested by earlier (empirical) literature, but poor data availability and lack of theoretical guidance warrant caution in the interpretation of the Hausman test results. This is especially true for the test of potential endogeneity of our performance measure diversity variable, since the adjusted R2 from the first stage regression is moderate. Note also that recent work in econometrics suggests that the cure to endogeneity biases might be worse than the disease. (Generalized) instrumental variables (IV) estimation, for example, can perform worse than OLS estimation if the correlation between the instruments and the endogenous explanatory variable is low. Moreover, in finite samples, IV estimators are biased in the same direction as the OLS estimators (Bound et al., 1996). Second, we relied on questionnaires to gather our data. This implies that we only captured the perception of respondents, which may be subject to bias. This in turn introduces potential measurement error into our empirical testing.

Notwithstanding these caveats we believe this study adds to our knowledge about the relation between organizational choices and performance measurement system design. The empirical evidence is consistent with our theory that high levels of local authority can only be sustained if the required set of performance measures can be held relatively small. We show that increasing performance measure diversity is only helpful to allow more local decision-making if a firm uses only a few measures. Increasing the number of measures further soon causes performance measure diversity costs to outweigh its benefits. Organizations may then optimally respond by reducing the authority delegated to local managers.

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**Table 1**

Summary statistics for local authority, information asymmetries, operating interdependencies, span of control, number of principals, urgency of decisions, reputation of principal for moderate interventionism, performance measure diversity and performance measure diversity squared (PMDIV2). Sample consists of 78 local units. Data obtain from survey of local managers.

| <i>Variable</i>               | <i>Mean</i> | <i>Standard deviation</i> | <i>Median</i> | <i>Minimum</i> | <i>Maximum</i> |
|-------------------------------|-------------|---------------------------|---------------|----------------|----------------|
| Local authority               | 0.00        | 3.49                      | 0.49          | -9.58          | 5.82           |
| Information asymmetry         | 0.00        | 4.60                      | 0.71          | -10.60         | 7.26           |
| Operating interdependencies   | 0.33        | 0.39                      | 0.15          | 0              | 1.50           |
| Span of control               | 0.00        | 1.00                      | -0.01         | -1.78          | 1.32           |
| Urgency of decisions          | 0.00        | 2.78                      | 0.36          | -11.18         | 5.25           |
| Number of principals          | 0.33        | 0.47                      | 0.00          | 0.00           | 1.00           |
| Performance measure diversity | 0.00        | 1.00                      | 0.43          | -1.82          | 1.18           |
| Principal's reputation        | 0.00        | 1.00                      | -0.44         | -0.70          | 3.69           |
| PMDIV2                        | 0.99        | 0.91                      | 1.14          | 0.10           | 3.30           |

**Table 2**

Pearson (Spearman) correlations above (below) diagonal between local authority, information asymmetries, operating interdependencies, span of control, number of principals, urgency of decision-making, reputation of the principal for moderate interventionism, performance measure diversity. Sample consists of 78 local units. Data obtained from survey of local managers. *italics*, **bold typeface**, *italics and bold typeface* denotes significance at 10%, 5% and 1% respectively.

|                               | Local authority     | Information asymmetry | Operating interdependencies | Span of control    | Number of principals | Urgency of decisions | Principal's reputation | Performance measure diversity |
|-------------------------------|---------------------|-----------------------|-----------------------------|--------------------|----------------------|----------------------|------------------------|-------------------------------|
| Local authority               | 1                   | <i><b>0.59</b></i>    | <i>-0.21</i>                | <i><b>0.29</b></i> | <i><b>0.27</b></i>   | 0.09                 | 0.02                   | <i><b>-0.25</b></i>           |
| Information asymmetry         | <i><b>0.53</b></i>  | 1                     | 0.08                        | 0.04               | 0.11                 | 0.12                 | <i>0.22</i>            | -0.14                         |
| Operating interdependencies   | <i><b>-0.25</b></i> | 0.00                  | 1                           | -0.14              | <i><b>-0.23</b></i>  | -0.01                | -0.06                  | 0.04                          |
| Span of control               | <i><b>0.26</b></i>  | 0.01                  | -0.12                       | 1                  | <i><b>0.29</b></i>   | <i><b>0.36</b></i>   | <i>0.19</i>            | 0.11                          |
| Number of principals          | <i><b>0.25</b></i>  | 0.11                  | <i>-0.19</i>                | <i><b>0.29</b></i> | 1                    | -0.04                | <i>0.22</i>            | 0.08                          |
| Urgency of decisions          | 0.08                | 0.14                  | 0.16                        | <i><b>0.34</b></i> | -0.09                | 1                    | 0.16                   | 0.06                          |
| Principal's reputation        | 0.04                | 0.18                  | -0.04                       | 0.03               | -0.01                | 0.16                 | 1                      | <i><b>0.24</b></i>            |
| Performance measure diversity | <i><b>-0.30</b></i> | -0.18                 | 0.09                        | 0.11               | 0.08                 | 0.06                 | <i><b>0.25</b></i>     | 1                             |

**Table 3.**

Ordinary least squares estimation of the relation between the level of local authority and (i) information asymmetries, (ii) operating interdependencies, (iii) span of control, (iv) number of principals, (v) urgency of decision-making, (vi) reputation of principal for moderate interventionism, (vii) performance measure diversity, (viii) performance measure diversity squared, and (ix) a dummy variable that takes the (before standardization) value of (performance measure diversity-4) if performance measure diversity is greater than or equal to four and zero otherwise.

Based on 78 observations. Industry dummies are included but not reported (all indicator variables are insignificant at conventional levels). Standard errors in parentheses. \*, \*\*, \*\*\* denotes 10%, 5% and 1% significance levels (two-tailed) respectively.

|   |              | <b>Quadratic<br/>Regression</b>                      | <b>Spline<br/>Regression</b>                         |
|---|--------------|--|--|
| <b>Regressors</b>                               | <i>P. S.</i> | <i>Coefficient<br/>Estimate<br/>(Standard Error)</i> | <i>Coefficient<br/>Estimate<br/>(Standard Error)</i> |
| - Intercept                                     |              | 0.74<br>(0.74)                                       | 1.88<br>(0.98)*                                      |
| - Information<br>asymmetry                      | ?            | 0.46<br>(0.07) ***                                   | 0.46<br>(0.06)***                                    |
| - Operating<br>interdependencies                | -            | -1.94<br>(0.81) **                                   | -1.87<br>(0.80)**                                    |
| - Principal's span<br>of control                | +            | 0.86<br>(0.35) **                                    | 0.90<br>(0.35)**                                     |
| - Number of<br>principals                       | +            | 0.97<br>(0.65)                                       | 0.89<br>(0.65)                                       |
| - Urgency of<br>decisions                       | +            | -0.02<br>(0.12)                                      | -0.00<br>(0.12)                                      |
| - Principal's<br>reputation for<br>intervention | +            | -0.60<br>(0.32) *                                    | -0.57<br>(0.31)*                                     |
| - Performance<br>measure diversity              |              | -0.81<br>(0.33) **                                   | 1.04<br>(0.75)                                       |
| - Performance<br>measure diversity<br>squared   | -            | -0.61<br>(0.35) *                                    |  |
| - Spline dummy                                  | -            |  | -2.85<br>(1.20)**                                    |
| NOBS  |              | 78   | 78   |
| ADJ. R2   |              | 49.99%   | 51.78%   |
| F-statistic                                     |              | 8.00   | 8.52   |
| Prob(F)   |              | <1%  | <1%  |