

Determinants of Control System Design in Divisionalized Firms

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ABSTRACT: We investigate two determinants of two choices in the control system of divisionalized firms, namely decentralization and use of performance measures. The two determinants are those identified in the literature as important to control system design: (1) information asymmetries between corporate and divisional managers and (2) division interdependencies. We treat decentralization and performance measurement choices as endogenous variables and examine the interrelation among these choices using a simultaneous equation model. Using data from 78 divisions, our results indicate that decentralization is positively related to the level of information asymmetries and negatively to intrafirm interdependencies, while the use of performance measures is affected by the level of interdependencies among divisions within the firm, but not by information asymmetries. We find some evidence that decentralization choice and use of performance measures are complementary.

Keywords: *organization design; control system; interdependencies; information asymmetry; performance measures.*

JEL Classification: *D23; D82; L22; M12; M4.*

I. INTRODUCTION

A considerable body of research exists on the use of performance measurement systems (Ittner and Larcker 2001; Luft and Shields 2003). However, there are few attempts to understand the relation between the use of these performance measures and other control choices. We provide evidence on this relation by examining two choices

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made by corporate management in the control system of divisionalized firms: (1) decentralization and (2) use of divisional summary performance measures. Decentralization occurs when corporate management assigns decision rights to lower-level managers. We operationalize decentralization as the extent to which decision-making authority over key decisions is vested with divisional managers (compared with their superiors). Divisional summary performance measures (DSMs) have two defining characteristics. First, they summarize the action choices of divisional managers into one performance metric (e.g., profit, ROI) and, second, they measure performance at the divisional level. Divisional performance can also be measured using specific, non-summary metrics and firm-level summary measures. Specific, non-summary metrics provide information about particular activities carried out within the division (e.g., quality statistics or delivery targets) and therefore do not reflect the overall performance of a divisional manager, while firm-level summary measures capture overall *firm* performance rather than divisional-level performance (e.g., firm ROI or stock price). We operationalize the use of DSMs as the weight these measures receive relative to firm-level summary measures and specific, non-summary measures when a superior assesses a division manager's performance.

While a firm makes multiple control choices, we examine DSMs and decentralization choices for several reasons. First, they are considered two of the most important design choices made by corporate management in divisionalized firms (Ittner and Larcker 2001; Luft and Shields 2003; Jensen and Meckling 1992).¹ Second, the two choices are tightly coupled. Jensen (2001) argues that corporate management will only decentralize when it can implement a performance measurement system that captures the decision rights allocated to divisional managers. DSMs are designed to summarize the decisions over which a divisional manager has responsibility. They provide corporate management with the possibility to assess the contribution of the division to firm value and to determine if divisional managers are using decision rights optimally (Solomons 1965; Zimmerman 1997). Finally, we focus on DSMs, as these measures are present in the majority of divisionalized firms (Vancil 1979; Horngren et al. 1999).

Drawing on prior literature, we predict that decentralization and the use of DSMs are complementary choices and that these choices are jointly determined by: (1) information asymmetries between corporate management and divisional managers and (2) interdependencies among divisions. Our study contributes to the literature on the economics of organization design by extending and integrating prior empirical research (Baiman et al. 1995; Bushman et al. 1995; Keating 1997; Nagar 2002). Earlier studies examined decentralization in relation with compensation systems, but did not consider performance measurement issues (e.g., Nagar 2002; Baiman et al. 1995). Those studies that focus on performance measurement systems have either ignored their relation with decentralization (Keating 1997) or have assumed decentralization to be exogenously determined (Abernethy and Lillis 2002; Gordon and Narayanan 1984; Chenhall and Morris 1986). Yet theoretical work argues that the decentralization and performance measurement are complementary control choices made by management; that is, they are endogenous (e.g., Milgrom and Roberts 1992). To

¹ Jensen and Meckling (1992) include incentive systems as the third key control choice. Milgrom and Roberts (1992, 403), however, do not make a distinction between incentive systems and performance measurement systems as they consider performance measurement systems as "the heart of any incentive system." Our approach is consistent with Milgrom and Roberts (1992) approach. We focus on one aspect of incentive systems, namely, performance measurement systems, while Nagar (2002) and others focus on the variable pay component of incentive systems. As such, our study represents a partial equilibrium analysis of decentralization and performance measurement choices.

the best of our knowledge this is the first study to examine the interrelation between performance measurement system and decentralization choices. A second contribution is the inclusion of both information asymmetry and interdependencies into the model. While both of these determinants have been identified as important in prior research (Baiman et al. 1995; Bushman et al. 1995; Keating 1997), ours is the first study that has assessed their joint effect on control system choices.

The study also contributes methodologically. In recent years there has been serious criticism not only about the use of inappropriate proxies to capture theoretical constructs, but also about the lack of consistency between the levels of theory, analysis, and measurement (Ittner and Larcker 2001; Luft and Shields 2003; Lanen 1995). Consistent with our hypotheses development, we measure the constructs at the divisional level. We use either prior established survey instruments or, where necessary, develop measures to overcome validity concerns with available measures. We address concerns relating to reliability and validity of each of our constructs by avoiding the use of “perceptive” measures (i.e., we ask respondents to provide specific data on organizational practices) and by collecting additional data to test the construct validity of each of the constructs.

We examine the relation between decentralization and the use of DSMs using a simultaneous equation model. This approach allows us to treat decentralization and the use of DSMs as control *choices* (i.e., as endogenous variables). We attempt to reduce concerns about the endogeneity of our main independent variables (i.e., interdependencies and information asymmetry) by our sample selection procedures and additional tests. We test our model using survey data from a representative sample of divisionalized firms listed on the Amsterdam Stock Exchange. We choose divisionalized firms because this enables us to treat interdependencies as exogenous. The decision to create a divisionalized structure is generally considered to precede the design and implementation of a firm’s control system. As argued by Milgrom and Roberts (1992, 546–549) firms initially define divisions to “minimize the connections among them” and to “avoid the need for co-ordination across divisional boundaries.” Once the divisional structure is implemented, however, interdependencies will remain. Our interest is how these interdependencies are managed through organizational design choices. We also explore the effect of relaxing the exogeneity assumption with regard to information asymmetry and show that our original results are robust. The simultaneous equation model, together with the sample selection procedures, begins to address some of the endogeneity problems in management accounting research. However, we recognize that some problems are likely to remain and our results should be interpreted accordingly.

Our findings indicate that decentralization is positively related to the level of information asymmetries and negatively to intrafirm interdependencies. On the other hand, the use of DSMs is only affected by divisional interdependencies. We find some evidence that the relation between decentralization choices and use of DSMs is complementary. Corporate management relies more on DSMs when they have delegated authority to divisions. On the other hand, we find no evidence that a greater use of DSMs affects decentralization. The findings presented here allow us to increase our rather limited understanding of the complex interrelation between control choices as well as the context within which those choices are made (Luft and Shields 2003).

The remainder of this paper is structured as follows. Section II provides the theoretical basis for the empirical model tested. We describe the data and research method in Section III, and present the results of our tests in Section IV. In Section V we provide a summary and concluding remarks.

II. HYPOTHESIS DEVELOPMENT

Accounting researchers have devoted considerable effort to establishing the determinants of the use of performance measures (Ittner and Larcker 2001). We investigate the factors that influence the importance placed on DSMs, as opposed to firm-level summary measures (e.g., firm-wide profit) or specific, non-summary measures (e.g., delivery targets).² We are interested in the relation between decentralization choices and the use of DSMs by corporate management for evaluating divisional managers. We draw on Milgrom and Roberts (1992, 549) and others (Melumad et al. 1992; Aghion and Tirole 1997; Jensen and Meckling 1992) to argue that granting decision rights and using DSMs are complementary actions. We thus expect that the choice to decentralize and corporate management's use of DSMs will be jointly determined and that the relation between the two will be positive. The following two equations summarize our conceptual model.

$$\text{Divisional summary measures (DSMs)} = f(\text{decentralization, information asymmetry, interdependencies, control variables}). \quad (1)$$

$$\text{Decentralization} = f(\text{DSMs, information asymmetry, interdependencies, control variables}). \quad (2)$$

This model is used to assess the interrelations between decentralization and DSMs and to assess the impact of divisional interdependencies and information asymmetry on these choices. We complete the model by including a set of control variables in each equation based on prior literature.³ Theoretical justification for the model follows.

Determinants of the Use of Divisional Summary Measures (DSMs)

Decentralization

Corporate management decentralizes decision making to encourage divisional managers to initiate and implement decisions that will increase firm value. To avoid or mitigate potential control loss problems, they will implement performance measures that both summarize performance into a metric and reflect the decision rights allocated (Jensen 2001; Wruck and Jensen 1994). Divisional summary measures (DSMs) serve this purpose. They summarize performance based on decision rights delegated to division managers and thus provide a means of monitoring their action choices. *Ceteris paribus*, DSMs will be preferred to other performance metrics. Firm-level summary measures are too noisy because they are not only affected by actions taken at the division level, but also by actions taken elsewhere in the firm (Keating 1997; Bushman et al. 1995). Using specific, non-summary measures to monitor divisional managers effectively transfers authority from division managers to corporate management. Monitoring divisional performance on measures that reflect specific activities of a division reduces the authority of division managers to make trade-offs among these activities necessary to optimize overall divisional performance (Jensen 2001). In this sense, specific, non-summary measures are inconsistent with decentralized decision making. We thus expect that as decentralization increases, corporate management will increasingly rely on DSMs to measure divisional performance.

² Prior literature has assessed the relative importance of firm summary measures versus divisional summary measures (see Keating 1997) and a number of studies have examined the trade-offs between summary measures (e.g., profit, ROI) *vis-à-vis* other more detailed nonfinancial measures (e.g., quality, turnaround times, delivery targets, etc.). While these alternative measures are not the focus of our study, we do undertake additional analysis to assess the impact on firm summary measures and divisional specific measures when the use of DSMs changes.

³ The choice of these control variables also enabled the model to be identified as there was no reason to believe theoretically that the set of variables included in each equation would be the same.

Information Asymmetry

Information asymmetry occurs when lower-level managers have specific knowledge about the functioning of the division that is either not available to corporate management or is too costly for corporate management to obtain (Christie et al. 2003).⁴ The use of DSMs by corporate management assumes either that these measures fully capture managerial performance or top management has sufficient knowledge about the activities performed by divisions to allow for the incompleteness of these measures and to detect possible manipulations of the measures. There is some support that demonstrates the reluctance of corporate management to rely on DSMs when information asymmetry exists between corporate and divisional management (Reichelstein 1992; Dunk 1993; Rockness and Shields 1984). In this situation these measures are inadequate measures of managerial efforts and their use will lead to dysfunctional behavior (Chow et al. 1988). We thus expect to observe a negative relation between information asymmetry and use of DSMs.⁵

Interdependencies

Interdependencies occur when demand functions of divisions are dependent or when divisions have joint supply and cost functions (see Milgrom and Roberts 1992, 108–109, 113–116). These interdependencies create a performance measurement problem as they increase the “noisiness” of DSMs. It is only in a setting where a firm has a “perfect” transfer-pricing system that the impact of intermediate product transfers between divisions will not influence the costs and revenues included in divisional profit or ROI calculations (Bushman et al. 1995; Keating 1997; Lambert 2001). There are two types of interdependencies affecting the use of DSMs: (1) when the focal division is influenced by the activities of other divisions and (2) when the focal division influences the performance of other divisions. As both types of interdependencies increase, the use of DSMs will decrease, but for somewhat different reasons (Lambert 2001; Keating 1997). When the focal division’s performance is influenced by the activities and decisions of other divisions, the measure is “noisy” and thus less informative to corporate management. The measure not only captures activities within the focal division, but it also captures actions of the other divisions. Similarly, if a focal division’s actions and decisions influence the activities of another division, then the use of their own DSMs will encourage the manager to take actions that will optimize his/her own performance, rather than encourage cooperation and optimization of the potential synergies among the divisions. We, therefore, expect a negative relation between both types of interdependencies and the use of DSMs.

⁴ It is also possible that corporate management has specific knowledge that is not available to the division manager. However, this will not relate to the operating activities of the division. The information asymmetry of concern here is information relating to divisional activities.

⁵ High levels of information asymmetry between corporate and divisional management will require the use of alternative forms of control. Control through performance measurement is unlikely to be completely effective regardless of the characteristics of the performance measurement systems. Corporate management will need to resort to less obtrusive forms of controls such as selection procedures and/or training programs as a means of creating a corporate culture that encourages employees to behave in a manner consistent with organizational goals (Brickley et al. 1997; Kreps 1990).

Control Variables: Performance Measurement Characteristics

We control for the effects of the properties of DSMs as suggested by Luft and Shields (2003). We include two performance measure characteristics, namely sensitivity and precision of the measure.⁶ Banker and Datar (1989) argue that the use of a performance measure is positively related to the sensitivity of the measure to the action choices of a manager and also positively to the precision of the measure. Datar et al. (2001) question whether sensitivity of a measure is an important determinant and demonstrate that the use of a measure is influenced by its importance in achieving organizational objectives (see also, Lambert 2001). Therefore, we do not make a prediction for the sign of sensitivity, but we expect that the use of DSMs will be positively related to the precision of the measure.

Determinants of Decentralization

Use of Divisional Summary Measures (DSMs)

There is relatively strong theoretical support in the literature that the use of DSMs and decentralization are complementary choices (Melumad et al. 1992; Jensen 2001; Aghion and Tirole 1997; Milgrom and Roberts 1995; Jensen and Meckling 1992). Solomons (1965) was one of the first to argue that decentralization is conditional on the use of performance measures that capture the contribution of a division to firm value (see also, Vancil 1979, 88). DSMs allow corporate management to give divisional managers “a substantial degree of freedom in their administration of the resources entrusted to them” (Solomons 1965, 9). More recently, Brickley et al. (1997) describe several cases where innovations in division performance measurement fail because concurrent decentralization changes were not made. When the use of DSMs increases, *ceteris paribus*, we assume that corporate management is better able to judge the actions of divisional managers. In turn, they will be more willing to delegate decision rights. In contrast, a reduced use of DSMs will result in a reduction in the decision rights delegated to divisional managers. Corporate management will make this choice when DSMs are limited in capturing the performance of divisions—centralizing decision making becomes a viable control alternative (Milgrom and Roberts 1992, 32). We thus expect that the use of DSMs will be positively related to the level of decentralization.

Information Asymmetry

Ceteris paribus, corporate management will delegate decision rights to divisional managers who possess specific knowledge (Jensen and Meckling 1992; Brickley et al. 1997). Conversely, if knowledge is not impacted at lower levels, corporate management has the information necessary to select optimal action choices for the division. There is no net benefit associated with delegating decision rights (Baiman et al. 1995; Jensen and Meckling 1992). We, therefore, expect a positive relation between the level of decentralization and the level of information asymmetry.

Divisional Interdependencies

Interdependencies among divisions can result in negative externalities for the firm when decision making is decentralized. When divisional managers are delegated decision rights

⁶ We describe above how interdependencies and information asymmetry affect the informativeness of DSMs and hence their use. It seems reasonable to assume that other factors affect the informativeness of DSMs as well. Note that Banker and Datar (1989) argue that informativeness is a function of precision and sensitivity. Our control variables, precision and sensitivity, attempt to capture any remaining differences in the informativeness (use) of DSMs, after accounting for the effect on informativeness of information asymmetry and interdependencies.

they have incentives to optimize their own division's performance and ignore the consequences of their actions on other divisions (Fisher 1994; Bushman et al. 1995; Christie et al. 2003). Corporate management will attempt to minimize these externalities by centralizing decision making. *Ceteris paribus*, we expect that the net benefits associated with decentralization will decrease when interdependencies are high; that is, we expect the relation between interdependencies and decentralization to be negative.

Control Variables: Division-Specific Factors

Prior research argues that the operating environment of a division influences corporate management's decision to delegate decision rights (Brickley et al. 1997; Milgrom and Roberts 1995; Nagar 2002). We, therefore, control for specific contextual factors relating to the division itself, namely the growth opportunities and size. We do not make a prediction about the sign of the association for these two variables due to conflicting arguments and empirical evidence.⁷

Following prior research, we also control for the influence of managerial characteristics on control system design (Nagar 2002). Empirical evidence provides some support that corporate management's choice to delegate decision rights is influenced by the ability of the division manager.⁸ We also expect, *ceteris paribus*, that corporate management will delegate decision rights only when a certain level of trust is developed between corporate and divisional managers.⁹

Our model controls for the effect of moral hazard on decentralization choices. While there is some evidence that mitigates this concern (Baiman et al. 1995; Christie et al. 2003), it is possible that the combination of information asymmetry and size results in significant moral hazard costs. Information asymmetry provides the agent with the information to behave opportunistically and size increases the rents agents are able to extract from this behavior (Milgrom and Roberts 1992, 573). Thus, when both these conditions exist (i.e., large levels of information asymmetry and large size) the cost of decentralization may outweigh the benefits. If this is the case, then we will not observe the main effects of information asymmetry and size on decentralization.

Summary of Expectations

Table 1 provides a summary of our expectations.

III. METHOD, MODEL, AND ECONOMETRIC ISSUES

Sample

We use a randomly selected sample of firms listed on the Amsterdam Stock Exchange. We first contacted the financial controller to obtain permission to undertake the study and to identify names of relevant divisions. Once the firm agreed to participate, we visited

⁷ Nagar (2002) argues that growth opportunities will increase the level of decentralization as this facilitates the involvement of divisional managers in scanning and environment and exploiting the opportunities available. However, others argue that corporate management will retain decision-making power to ensure that opportunities for growth are optimized (Aghion and Tirole 1997). Similar ambiguity exists concerning the effect of size on the decentralization. It is often argued that size is related to the level of decentralization (Bolton and Dewatripont 1995; Vancil 1979; Lawrence and Lorsch 1967) and yet empirical evidence is mixed (Miller 1987).

⁸ For example, Baker et al. (1994) and others (Medoff and Abraham 1980) demonstrate that more talented, highly educated individuals are promoted to higher-level positions and thus are given more responsibilities within the firm.

⁹ This relation has not been empirically examined directly. However, research in the management and economics literatures provide theoretical support that this would be the case (see Nooteboom et al. 1997; Lorenz 1999).

TABLE 1
Predictive Effects Investigated in this Study

	<u>Decentralization</u>	<u>Divisional Summary Measures (DSMs)</u>
Choice Variables		
Decentralization		+
Divisional Summary Measures	+	
Test Variables		
Information Asymmetry	+	-
Interdependencies	-	-
Control Variables		
Division Specific Characteristics:		
Growth	NP	
Size	NP	
Moral Hazard	-	
Divisional Managers Characteristics:		
Ability	+	
Trust	+	
Performance Measure Characteristics:		
Sensitivity		NP
Precision		-

divisional managers within the firm to administer the questionnaire. This method of data collection is particularly useful as it enables us to ensure that we have the correct respondent, that the firm has at least two operating divisions (i.e., necessary to test our expectations with respect to interdependencies), that divisions are sufficiently large, and finally to establish that divisions are autonomous and report to either the Chief Executive Officer or Chief Operating Officer of the firm. Our analysis is based on a sample of 78 divisional managers. Twenty-five percent of the firms contacted agreed to participate. Tests for response bias indicate that our sample is drawn from a representative set of firms.¹⁰ Once firms agreed to participate, we achieved a 92 percent response rate from the divisional managers contacted.

Measures

The measurement of the constructs is discussed in turn. Where appropriate we follow Ittner and Larcker's (2001) recommendation and use "harder" data (i.e., more objective data) to support the validity of our measures. Where multiple items are used to measure a construct, we use the factor score.¹¹ All Likert-scale variables were standardized before

¹⁰ We assessed if the sample was representative of all other firms listed on the Amsterdam Stock Exchange. We conducted t-tests (Wilcoxon-tests) for differences of means (medians) on variables relating to net income, sales, total assets, and market value of common equity. There were no significant differences in the mean (median) values for any of these variables except for market value and this was only significant at the 0.09 level.

¹¹ The factor analysis used oblique rotation and retained factors with an eigenvalue greater than unity (Nunnally and Bernstein 1994). The results of the factor analysis are not provided in the paper, but are available from the authors. Researchers can either compute a composite variable that captures the underlying construct by averaging the standardized item scores (Nunnally and Bernstein 1994) or use the factor scores. We use factor scores; however, the results are robust against using either method (the two methods produce variables that are correlated at 0.99 in all cases).

entering them into the factor analysis. The survey instruments used are reproduced in the Appendix.

Choice Variables

Level of decentralization (DECEN). We measure the level of decentralization using an adapted version of the Gordon and Narayanan (1984) instrument. We attempt to capture what Aghion and Tirole (1997) refer to as “real authority” by asking division managers to indicate their influence relative to their superior’s influence on a range of five key decisions (i.e., strategy, human resource management, operations, marketing, and investments) along a Likert-type scale of 1 to 7 where 1 = the division has all the influence and 7 = the superior has all the influence. We reverse-code this measure such that high values indicate high levels of decentralization. We use the results of factor analysis, Chi-squared tests, and the Cronbach alpha statistic (0.73) to support the use of the five-item measure as a unidimensional construct.

Use of divisional summary measures (DSMs). We use Keating’s (1997) notion of own-level measures to capture the use of DSMs. These measures are those that summarize division performance in a single measure. In contrast to Keating (1997), our measure includes both financial summary measures (e.g., profit, ROI) and other quantitative efficiency-type measures (e.g., output data). We ask respondents to assign weights to the relative importance of DSMs measures *vis-à-vis* other performance metrics.¹² These other metrics include firm summary measures (both stock-price-related measures and firm profitability measures) and measures that provide performance information on specific aspects of performance within divisions (specific, non-summary measures). Together these types of performance measures cover the complete continuum of possible quantitative metrics used in a firm. To improve the consistency of the responses, we follow Ittner and Larcker’s (2001) advice and specify the decision context in which performance measures are used. We ask respondents to indicate the percentage weight (out of a total of 100) the superior assigns to each type of performance metric when s/he assesses performance. Convergent validity of the measure is established by the Pearson correlation of DSMs with an alternative measure captured elsewhere in the questionnaire. This alternative measure asks the superior to assign the weight attached to divisional profitability measures compared to other types of measures when assessing performance. Profit measures constitute an important subset of all DSMs. The correlation between these two measures is 0.33 ($p < 0.01$). This provides some evidence of the validity of our measure.

Test Variables

Interdependencies. We adopt Keating’s (1997) instrument to measure interdependencies. The first item asks respondents to identify the extent to which their activities impact on other divisions’ activities (*IMPACT-THEM*), and the other item asks the extent to which their performance is affected by the activities carried out by other divisions (*IMPACT-YOU*). To be consistent with Keating (1997), we treat each item as a separate variable. This approach is supported by Lambert’s (2001) analysis that shows that these two types of interdependencies might have different effects on performance measurement. We investigate

¹² Likert-type scales can be problematic as they allow respondents to answer that all performance measures are used. We wanted respondents to reveal the relative use of performance measures. DSMs can thus be interpreted as the relative weight division summary measures are given by a manager’s superior during performance evaluation.

the convergent validity of *IMPACT-THEM* and *IMPACT-YOU* by computing Pearson correlations with three other measures: (1) *SUPPLY*, (2) *INDEP*, and (3) *CHANGE*. *SUPPLY* is the sum of the percentage of total incoming goods or services sourced from other divisions and the percentage of total outgoing goods or services provided to other divisions. This item captures operating interdependencies caused by joint cost and supply functions or dependent demand functions. *INDEP* asks respondents to indicate the extent to which their unit could operate as a stand-alone firm. The respondents answer on a fully anchored Likert scale (1 = not at all, 7 = completely). High scores on this measure indicate fewer intrafirm dependencies. *CHANGE* measures the time it would take external suppliers to meet the demand of a division's current internal customers. High scores on a fully anchored Likert scale (1 = immediate delivery possible, 7 = delivery only after more than 6 months) indicate more interdependencies within the firm. This variable is also a reasonable proxy for interdependencies. If a division can make a speedy change to an external supplier, then the division is less dependent on other divisions within the firm. Pearson correlations between *IMPACT-THEM* and *SUPPLY*, *INDEP*, and *CHANGE* are significant and in the predicted direction (i.e., 0.50, $p < 0.01$; -0.36, $p < 0.01$; 0.46, $p < 0.01$, respectively). We find similar support for the *IMPACT-YOU* construct and the three alternative measures (i.e., 0.56, $p < 0.01$; -0.32, $p < 0.01$; 0.40, $p < 0.01$, respectively). Together these results strongly support the convergent validity of our interdependency measures. Note also that both *SUPPLY* and *CHANGE* ask for "harder" responses than just perceptions of interdependencies.

Information asymmetries (*INFORASYM*). Using the six-item scale developed by Dunk (1993), managers rate their information relative to their superior's in their area of responsibility on a seven-point Likert-type scale. The results of the factor analysis (not reported) and scale reliability are consistent with using the six items as a unidimensional scale (Cronbach alpha = 0.86). We investigate the convergent validity of our measure of information asymmetries by computing Pearson correlations with two other variables that should proxy for specific knowledge of the division manager: (1) the manager's experience (in years) in his current position (*EXPINPOS*), and (2) the manager's age (*AGE*). These variables are considered to be reasonable proxies for information asymmetry as more experienced and older managers are likely to have unique knowledge about local circumstances and context. This knowledge might be hard to communicate to superiors, which implies that information asymmetries arise. We also include a proxy for the relative level of knowledge of the division manager about the business *vis-à-vis* the corporate manager by measuring the division manager's experience in the industry relative to his/her superior (*EXPIND*). All three proxy variables are based on hard data and, thus, partially address concerns with the use of perception measures. There is a significant and positive relation between *INFORASYM* and all three alternative measures (*INFORASYM/EXPINPOS* = 0.23, $p < 0.05$; *INFORASYM/AGE* = 0.31, $p < 0.01$; *INFORASYM/EXPIND* = 0.23, $p = 0.06$). These results provide reasonable support for the validity of our measure.

Control Variables for Equation (1) (Use of DSMs)

Performance measurement characteristics. We measure the sensitivity of performance measures (*SENS*) by asking respondents to distribute 100 points over all performance measures in such a manner that the most "sensitive" measure receives the most points. The percentage points assigned to DSMs are used to measure the sensitivity of summary measures. The precision of the measure is captured in a similar manner. The percentage points assigned to DSMs are used as our measure of precision (*PRECISION*).

Control Variables for Equation (2) (DECEN)

Division-specific factors. We developed an instrument to measure growth opportunities (*GROWTH*). The instrument asks managers to rate growth expectations for (1) their own division and for (2) the industry in which their division operates. Respondents rated growth expectations on a seven-point Likert-type scale where 1 = strong decline and 7 = significant increase. Factor analysis and the Cronbach alpha statistic (0.77) support the summation of the two items. We define *SIZE* as a categorical variable that measures the number of employees working in a division. The categories ranged between 1 (< 50 employees) and 8 (more than 2,000 employees). To reduce scale problems, *SIZE* is standardized to have zero mean and a standard deviation of unity. Finally, we control for industry effects in each of the regressions. We do so by defining four indicator variables to capture potential industry effects. Degrees of freedom considerations prevent us from using an indicator for each industry in the sample. Instead, we regroup the industries into four categories (i.e., foodstuff, apparel, and textile; metal, printing and plastics; electronics; services) and include three dummy variables in each of the regressions.

Moral hazard. We include a multiplicative term in the decentralization equation that is composed of an interaction between information asymmetry and size. This interaction term captures the conditions that give rise to moral hazard. Inclusion of the interaction term enables us to assess whether the main effects of information asymmetry and size variables on decentralization remain positive when conditions associated with moral hazard are present (Jaccard and Turrisi 2003; Wooldridge 2000).¹³

Divisional manager characteristics. We identify from prior literature the importance of two divisional manager characteristics on the decision to decentralize, namely, the ability of the divisional manager and the trust between corporate and divisional management. Ability is captured using education as a proxy. Respondents were asked to state their highest level of education and responses are coded as (1) only high school, (2) some college education, (3) complete four-year university-level program. Trust is captured using experience as a proxy. Managers reported the number of years they were employed in their current position (*EXPINPOS*). We standardized the variable to have zero mean and standard deviation unity.

Model and Econometric Issues

Model Specification

We test our hypotheses using a simultaneous equations model that describes the determinants of each of the endogenous variables and their interrelation. Our system of equations is described as follows:

$$\begin{aligned}
 DSM_i = & \alpha_0 + \alpha_1 DECEN_P_i + \alpha_2 INFORASYM_i + \alpha_3 IMPACT-THEM_i \\
 & + \alpha_4 IMPACT-YOU_i + \alpha_5 SENS_i + \alpha_6 PRECISION_i + \varepsilon_i^{DSM}.
 \end{aligned}
 \tag{3}$$

¹³ The interaction term is the cross-product of information asymmetry and size. It can be represented in algebraic form as follows: $Y = a + a_2X_1 + a_3X_2 + a_4X_1X_2$, where Y = decentralization, X_1 = information asymmetry and X_2 = size, and X_1X_2 = cross-product between X_1 and X_2 . While our model includes the interaction term in order to assess its affect on the coefficients relating to information asymmetry and size, *a priori* we also expect the coefficient of the interaction term to be negative, i.e., we expect the relation to be less positive (or more negative) in larger firms compared to smaller firms.

$$\begin{aligned}
 DECEN_i = & \beta_0 + \beta_1 DSM_P + \beta_2 INFORASYM_i + \beta_3 IMPACT-THEM_i \\
 & + \beta_4 IMPACT-YOU_i + \beta_5 SIZE_i + \beta_6 GROWTH_i \\
 & + \beta_7 (SIZE_i * INFORASYM_i) + \beta_8 EDUCATE_i \\
 & + \beta_9 EXPINPOS_i + \epsilon_i^{DECEN}.
 \end{aligned}
 \tag{4}$$

Simultaneity Bias

The endogenous variables *DECEN* and *DSM* are jointly determined in equilibrium; therefore ordinary least squares (OLS) estimation of the model may be inappropriate (Greene 1997). We use the Durbin-Wu-Hausman test (MacKinnon 1992) to determine if simultaneity bias exists.¹⁴ We find no evidence of a simultaneity bias ($F = 0.59$ and 1.08 ; $p = 0.45$ and 0.30) and consequently report OLS results.¹⁵ Note that these test results do not imply that *DECEN* and *DSM* are not interrelated; the test only suggests that OLS estimation of the system is unbiased.

IV. RESULTS

Descriptive Statistics

Table 2, Panel A presents the summary statistics for each variable. All measures in the equations have variation with most of them spanning the entire set of theoretical values. Panel B presents the Pearson correlations among the variables. There is a positive and significant relation between level of decentralization and use of DSMs ($r = 0.29$, $p < 0.01$). We also find that information asymmetries are positively related with decentralization ($r = 0.61$, $p < 0.01$) but have no significant relation with DSMs. Decentralization is negatively related to one form of interdependency (*IMPACT-YOU*; $r = -0.26$, $p < 0.05$), whereas the use of DSMs is negatively associated with the other form of interdependency (*IMPACT-THEM*; $r = -0.27$, $p < 0.05$). The relations between the endogenous and control variables are as expected. Decentralization is positively and significantly associated with *SIZE*, *GROWTH*, and a manager's education ($r = 0.31$, $p < 0.01$; $r = 0.39$, $p < 0.01$; and $r = 0.35$, $p < 0.01$, respectively). The use of DSMs is positively and significantly related to *SENS* and *PRECISION* ($r = 0.36$, $p < 0.01$ and $r = 0.28$, $p < 0.01$). Overall these results provide some preliminary univariate evidence that is consistent with our expectations. The correlations among the exogenous variables are not sufficiently high to warrant concerns with multicollinearity (Griffiths et al. 1993).

Table 3 presents information on the relative use of performance metrics in our sample. Divisional summary measures are by far the most important performance measures used (i.e., on average firms put 57 percent weight on this measure). This is consistent with other evidence on the use of these measures (Horngren et al. 1999) and supports our rationale

¹⁴ The Hausman test is an asymptotic test and its properties in finite samples are unknown. We verified the small sample power of this test using a Monte Carlo simulation. The results (not reported) indicate that the null hypothesis of no simultaneity bias needs to be rejected at lower values of the F-statistic than under asymptotic conditions. The values of the F-statistic we found in our sample are, however, well below the critical values suggested by the Monte Carlo simulation.

¹⁵ As a robustness check we also estimate the model using two stage least squares (2SLS). All results obtained using 2SLS reinforce our earlier conclusions (i.e., signs and significance are not affected) and thus are not reported here. Note that using OLS to estimate the model circumvents the problems associated with weak instrumental variables in 2SLS (Nelson and Startz 1990; Bound et al. 1995). Moreover, given that our sample size is 78 observations, which is rather small given the number of parameters being estimated, the use of OLS would seem preferable.

TABLE 2
Descriptive Statistics and Correlations

Panel A: Summary Statistics

Summary statistics for decentralization (*DECEN*), use of divisional summary measures (*DSM*), information asymmetries (*INFORASYM*), impact of own division on performance of other divisions in firm (*IMPACT-THEM*), impact of other divisions in firm on performance of own division (*IMPACT-YOU*), growth opportunities (*GROWTH*), size of the division (*SIZE*), interaction of size and information asymmetry (*INTERACTION EFFECT*), sensitivity of divisional summary measures (*SENS*), precision of divisional summary measures (*PRECISION*), experience of divisional manager in current position (*EXPINPOS*), level of education (*EDUCATE*). Sample consists of 78 divisions. Data obtained from survey of divisional managers.

<u>Variable</u>	<u>Mean</u>	<u>Std. Dev.</u>	<u>Minimum</u>	<u>Median</u>	<u>Maximum</u>
<i>DECEN</i>	0	0.84	-2.37	0.20	1.30
<i>DSM</i>	0.57	0.25	0	0.50	1.00
<i>INFORASYM</i>	0	0.93	-2.18	0.14	1.43
<i>IMPACT-THEM</i>	0	1.00	-1.77	-0.16	1.45
<i>IMPACT-YOU</i>	0	1.00	-1.70	-0.08	1.54
<i>SIZE</i>	0	1.00	-1.78	-0.01	1.32
<i>GROWTH</i>	0	0.77	-1.51	-0.07	1.41
<i>INTERACTION EFFECT</i>	0.04	0.91	-2.10	0	2.24
<i>PRECISION</i>	0.58	0.25	0	0.53	1.00
<i>SENS</i>	0.60	0.21	0	0.60	1.00
<i>EDUCATE</i>	0	1.00	-2.74	0.76	0.76
<i>EXPINPOS</i>	0	1.00	-0.54	-0.30	5.62

(continued on next page)

TABLE 2 (continued)

Panel B: Pearson Correlations between All Variables (refer to Table 2, Panel A for variable definitions)

Correlations are based on 78 observations.

	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>11</u>
1. <i>DECEN</i>	1.00										
2. <i>DSM</i>	0.29***	1.00									
3. <i>INFORASYM</i>	0.61***	0.15	1.00								
4. <i>IMPACT-THEM</i>	-0.17	-0.27**	-0.03	1.00							
5. <i>IMPACT-YOU</i>	-0.26**	-0.11	-0.08	0.66***	1.00						
6. <i>SIZE</i>	0.31***	0.10	0.04	-0.01	-0.14	1.00					
7. <i>GROWTH</i>	0.39***	0.06	0.13	0.06	0.10	0.02	1.00				
8. <i>PRECISION</i>	0.02	0.28**	0.04	-0.19*	-0.28**	-0.01	-0.20*	1.00			
9. <i>SENS</i>	-0.01	0.36***	0.11	-0.20*	-0.19*	0.03	-0.28**	0.34***	1.00		
10. <i>EDUCATE</i>	0.35***	0.17	-0.05	0.01	0.11	0.20*	0.09	0.01	-0.14	1.00	
11. <i>EXPINPOS</i>	0.14	0.14	0.22*	-0.26**	-0.30***	-0.09	0.05	0.18	0.08	-0.39***	1.00

*, ** and *** denotes 10%, 5%, and 1% significance levels (two-tailed), respectively.

TABLE 3
Relative Use (in Percentages) of Four Types of Performance Metrics by a Superior in the
Performance Evaluation of a Divisional Manager
(n = 78)

<u>Type of Performance Metric</u>	<u>Mean</u>	<u>Std. Dev.</u>	<u>Median</u>	<u>Minimum</u>	<u>Maximum</u>
Firm-Level Summary Measures					
Stock-price-related	0.04	0.09	0.00	0.00	0.50
Other firm-level summary measures	0.22	0.21	0.20	0.00	0.90
Divisional Summary Measures	0.57	0.25	0.50	0.00	1.00
Specific, Non-Summary Measures	0.17	0.16	0.13	0.00	0.80

for focusing on these measures. Relatively little weight (4 percent) is given to stock-price-related measures. Indeed, a majority of firms do not use this measure to evaluate the performance of divisions. Firm-level summary measures and specific, non-summary measures receive on average similar weight (22 percent and 17 percent, respectively).

Main Findings

Table 4 presents the OLS estimation results of the two regression equations.¹⁶ The results of Equation (1) (Table 4, Panel A) provide strong evidence that the use of DSMs is positively related to the degree of decentralization ($\alpha_1 = 0.11$, $t = 2.67$). It appears that the choice to delegate decision rights increases top management's use of DSMs. Contrary to our expectations, information asymmetry has no significant influence on the use of DSMs, but we do find that divisional interdependencies are related to the use of DSMs. However, the effect depends on the type of interdependency. Specifically, we find a significant and negative relation ($\alpha_3 = -0.07$, $t = -2.23$) when the division's activities affect other divisions (*IMPACT-THEM*), but a positive and significant effect ($\alpha_4 = 0.07$, $t = 1.96$) when the division is affected by other divisions (*IMPACT-YOU*). This positive relation is unexpected and contrary to our expectations. We also find that the sensitivity of a performance measure increases its use ($\alpha_5 = 0.34$, $t = 2.65$). The precision of a measure is only marginally associated with the use of DSMs ($\alpha_6 = 0.18$, $t = 1.52$). All industry dummies are statistically insignificant in explaining the use of summary measures. The adjusted R^2 of Equation (1) indicates that the model has reasonable explanatory power (i.e., 23.0 percent).

¹⁶ The robustness of our results is tested by (1) relaxing the assumption of exogeneity of information asymmetry, and (2) testing for common method variance. There is some argument that information asymmetry is an endogenous variable (Zimmerman 2001; Aghion and Tirole 1997). We address this issue by including a third equation into our model with information asymmetry as a dependent variable and reestimate our model using 2SLS (based on the results from a Hausman test). The 2SLS estimates for the three-equation model indicate that the coefficients are of a similar magnitude and sign to our two-equation model. Our inferences remain unchanged. We conduct Harman's (1967) single-factor test to evaluate the extent to which common method variance exists in the data. If there is a substantial amount of common method variance, then either a single factor will emerge or one general factor will account for the majority of the covariance among the variables. The test statistic is highly significant ($\chi^2 = 306.5$, d.f. = 199, $p < 0.001$), rejecting the null that one single factor accounts for the covariance among the variables. We conclude that common method bias is not a serious problem in this data set.

TABLE 4
Ordinary Least Squares Regressions

$$DSM_i = \alpha_0 + \alpha_1 DECEN_P_i + \alpha_2 INFORASYM_i + \alpha_3 IMPACT-THEM_i + \alpha_4 IMPACT-YOU_i + \alpha_5 SENS_i + \alpha_6 PRECISION_i + \varepsilon_i^{DSM} \quad (1)$$

$$DECEN_i = \beta_0 + \beta_1 DSM_P + \beta_2 INFORASYM_i + \beta_3 IMPACT-THEM_i + \beta_4 IMPACT-YOU_i + \beta_5 SIZE_i + \beta_6 GROWTH_i + \beta_7 (SIZE_i * INFORASYM_i) + \beta_8 EDUCATE_i + \beta_9 EXPINPOS_i + \varepsilon_i^{DECEN} \quad (2)$$

Panel A: Dependent Variable: DSM (n = 78)

	<u>Predicted Sign</u>	<u>Coefficient</u>	<u>Std. Error</u>	<u>t-statistic</u>	<u>Prob. (two-sided)</u>
Intercept		0.24	0.09	2.67	0.01
<i>DECEN</i>	+	0.11	0.04	2.67	0.01
<i>INFORASYM</i>	-	-0.03	0.03	-0.82	0.42
<i>IMPACT-THEM</i>	-	-0.07	0.03	-2.23	0.03
<i>IMPACT-YOU</i>	-	0.07	0.04	1.96	0.05
<i>SENS</i>	NP	0.34	0.13	2.65	0.01
<i>PRECISION</i>	+	0.18	0.12	1.52	0.13

F-statistic: 3.56
Prob. (F) = 0.001
Adj. R² 23.0%

Panel B: Dependent Variable: DECEN (n = 78)

	<u>Predicted Sign</u>	<u>Coefficient</u>	<u>Std. Error</u>	<u>t-statistic</u>	<u>Prob. (two-sided)</u>
Intercept		-1.55	0.30	-5.03	0.00
<i>DSM</i>	+	0.23	0.24	0.93	0.35
<i>INFORASYM</i>	+	0.46	0.06	7.28	0.00
<i>IMPACT-THEM</i>	-	0.04	0.08	0.53	0.60
<i>IMPACT-YOU</i>	-	-0.27	0.08	-3.21	0.00
<i>SIZE</i>	NP	0.12	0.07	1.84	0.07
<i>GROWTH</i>	NP	0.31	0.08	3.77	0.00
<i>SIZE*INFORASYM</i>	-	-0.09	0.07	-1.34	0.19
<i>EDUCATE</i>	+	0.51	0.11	4.59	0.00
<i>EXPINPOS</i>	+	0.06	0.06	0.99	0.32

F-statistic: 14.83
Prob. (F) = 0.000
Adj. R² 68.3%

Sample consists of 78 divisions.

Data obtained from survey of division managers.

Industry dummies included in both regression equations (not reported).

Variable definitions: Decentralization (*DECEN*), use of divisional summary measures (*DSM*), information asymmetries (*INFORASYM*), impact of own division on performance of other divisions in firm (*IMPACT-THEM*), impact of other divisions in firm on performance of own division (*IMPACT-YOU*), growth opportunities (*GROWTH*), size of the division (*SIZE*), interaction of size and informational asymmetry (*SIZE * INFORASYM*), sensitivity of divisional summary measures (*SENS*), precision of divisional summary measures (*PRECISION*), experience of divisional manager in current position (*EXPINPOS*), level of education (*EDUCATE*).

The results in Table 4, Panel B are consistent with our expectation concerning decentralization and information asymmetry. The relation is positive and significant. It is interesting to note that this relation holds even after considering the potential effect of moral hazard. Recall that there is some concern in the literature that as the potential for opportunistic behavior increased, corporate management would be reluctant to delegate decision rights, even in the presence of information asymmetry. Our equation includes an interaction term to proxy for moral hazard. We find that even when information asymmetry and size are large (the situation where we expect moral hazard problems to be most severe), the relation between information asymmetry and decentralization remains positive and significant.¹⁷ Our findings also indicate (in Table 4, Panel B) that the use of DSMs is unrelated to the level of decentralization, inconsistent with our expectations. We find evidence that interdependencies are negatively associated with decentralization as predicted ($\beta_4 = -0.27$, $t = -3.21$). However, this only occurs with *IMPACT-YOU* (the extent to which a division's performance is affected by activities carried out in other divisions). This suggests that fewer decision rights are assigned to lower-level managers if the spillover effects from other divisions affect a manager's performance. Size and growth opportunities are also positively correlated with decentralization ($\beta_5 = 0.12$, $t = 1.84$ and $\beta_6 = 0.31$, $t = 3.77$). The relation between decentralization and size remains positive when we control for the influence of moral hazard.¹⁸ We find that more highly educated managers receive more decision rights ($\beta_8 = 0.51$, $t = 4.59$). The manager's experience in his current position, and the industry dummies, are all statistically insignificant at conventional levels of significance (i.e., $p > 0.10$). Finally, the adjusted R^2 of the equation is high (68.3 percent).

Additional Analyses

Our results indicate that the use of DSMs increases when firms decentralize and decreases as interdependencies increase. This observation leaves open the question if (and how) other performance measures are used to compensate for the (de)increase in DSMs. Recall that we measure the use of DSM as the weight placed on DSM *vis-à-vis* firm-level summary measures and other more specific, non-summary measures. We are thus able to shed some light on this issue. First, we examine the correlation between DSMs and the use of firm-level summary measures (Questions 2i and 2ii in the Appendix) and between DSMs and the use of specific, non-summary measures (Question 2iv in the Appendix). The correlation between DSMs and the use of firm-level summary measures is significantly negative ($r = -0.76$, $p < 0.01$). The correlation between DSMs and the use of specific, non-summary measures is also negative and significant ($r = -0.42$, $p < 0.01$). These correlations suggest that when corporate management decreases its use of DSMs, they put more weight on firm-level summary measures and/or more specific, non-summary measures. To further remove ambiguity about how different performance measures are used in relation to decentralization choices and our test variables we rerun our original model, but use two alternative performance measure variables: (1) *FLEVEL* and (2) *SPECDIV*.

¹⁷ The partial relation between decentralization and information asymmetry is represented by the expression $\beta_2 + \beta_7 * SIZE$. Therefore, of interest is a F-test of the joint hypothesis $\beta_2 = \beta_7 = 0$. The F-statistic is 30.84 (d.f. = 2, 65; $p < 0.01$). Since *SIZE* is a standardized variable, the coefficient estimate β_2 is the partial effect of *INFORASYM* on *DECEN* evaluated for average-sized divisions. For these divisions, we find that information asymmetry is positively associated with decentralization. Even for the largest divisions, the relation remains significantly positive.

¹⁸ The partial relation between decentralization and size is represented by the expression $\beta_5 + \beta_7 * INFORASYM$. Therefore of interest is the joint test that $\beta_5 + \beta_7 = 0$. The F-statistic is 2.57 (d.f. 2, 65; p-value < 10 percent), which indicates that size and decentralization are associated.

FLEVEL is the use of firm-level summary measures relative to the use of DSMs (defined as the sum of Questions 2i and 2ii divided by the sum of Question 2i, 2ii, and 2iii). This definition (and rescaling) of *FLEVEL* allows us to conclude that any increase (decrease) in the use of this variable implies a decrease (increase) in the use of DSMs. Prior literature (Keating 1997) has suggested that firm-level summary measures will be used to provide incentives for cooperation and reduce the noise of DSMs when interdependencies are high.

SPECDIV is the use of specific, non-summary measures relative to the use of DSMs (defined as Question 2iv divided by the sum of Questions 2iii and 2iv). This definition (and rescaling) allows us to conclude that any increase (decrease) in the use of specific, non-summary measures implies a decrease (increase) in the use of DSMs. Theory suggests that DSMs, rather than specific, non-summary measures will be positively associated with decentralization (see also, Jensen 2001). Using more specific measures is inconsistent with providing decision rights to managers since asking managers to perform on specific measures is analogous to restricting the action choices of these managers.

The results (not presented here) of the regressions are consistent with these expectations. Taking together the results from these additional analyses and the original model, we conclude that a decline in decentralization is associated with a shift from DSMs to specific, non-summary measures and that more interdependencies are associated with a shift from DSMs to firm-level summary measures.

V. DISCUSSION AND CONCLUDING COMMENTS

This study sought to develop a better understanding of the determinants of control system design choices and the interrelation between those choices. The evidence presented here is generally consistent with our expectations. Our results indicate that DSMs are used more intensively in decentralized divisions. This is consistent with earlier empirical work that has shown decentralization choices to be an important determinant of management accounting practices. Within-firm dependencies also influence the use of DSMs. If the focal division impacts the performance of the other divisions within the firm, then corporate management's use of DSMs decreases. This result is consistent with our expectations, with Keating's (1997) empirical findings, and also with Holmstrom's (1979) informativeness hypothesis. Divisional performance measures become "noisier" as interdependencies increase and thus are less effective in evaluating the division's unique contribution. Our additional analysis indicates that corporate management shifts from the use of DSMs to firm summary measures (Keating 1997; Bushman et al. 1995). In contrast, and contrary to our expectations, we find that if other divisions affect the performance of the focal unit, then the use of DSMs increases. This finding is consistent with the informativeness principle if DSMs provide information on how well a manager copes with interdependencies. A principal could use such information to adjust other performance measures so he can "better evaluate the thing the agent does control" (Lambert 2001, 24). While this is *post hoc* rationalization, further theoretical and empirical research is required to fully understand the impact of alternative forms of interdependencies on performance measurement choice.

We find no relation between information asymmetries and the use of DSMs. We expected that corporate management would be reluctant to rely on these measures as they become increasingly "incomplete" when they do not have the same information set as divisional managers. Our results do not support our expectation, but rather indicate that the use of DSMs is only determined by the amount of decision rights allocated to divisional managers. This result needs to be interpreted in the light of the evidence relating to decentralization choices and information asymmetry (discussed below). Information asymmetry

is a significant explanatory variable for corporate management's choice to decentralize. Thus, it would appear that once the fit between decentralization and information asymmetry occurs, performance measures are used to monitor divisional managers' use of decision rights. That is, information asymmetry does not directly influence the use of these measures, but rather indirectly through the assignment of decision rights. As expected, we find that the sensitivity of the DSMs leads to increased use by corporate management.

Information asymmetry and interdependencies are both significant determinants of decentralization. Higher levels of information asymmetry increase the level of decentralization even in the presence of moral hazard. This is consistent with earlier research arguing that the costs associated with decentralization are more than outweighed by the benefits (Baiman et al. 1995; Christie et al. 2003). Consistent with our hypothesis, we find a negative association between interdependencies and decentralization. However, the negative relation is only found when other divisions affect the focal division. This suggests that division managers perceive their decision authority declines only when other divisions affect their operations. On the other hand, there is no effect on their sense of empowerment (or disempowerment) when their division influences others. This result is intuitively appealing, particularly given that we operationalized decision rights using Aghion and Tirole's (1997) notion of "real" authority, i.e., we captured divisional managers' assessment of their influence over a range of decisions. It is entirely possible that divisional managers believe there is little or no "real" delegation of authority when there are factors over which he/she has no control. We also find that larger- and higher-growth divisions tend to be more decentralized.

While we took care to address methodological concerns, three caveats should be recognized when considering the evidence in this paper. First, we concede the simplicity of the model. No empirical study can investigate all organizational design choices at the same time. Therefore, this is a partial equilibrium study in which modeling choices are informed by prior research and theory. However, there is a potential for specification error in the regression and for correlated omitted variables. There may be other determinants of organization design choices and other control mechanisms that will influence decentralization and performance measurement choices. For example, we do not have data on whether performance measures are used in annual bonus plans. We can, therefore, not test directly the influence of compensation contracts on metric use or decentralization. Second is the potential for measurement error, which is often associated with survey data that relies on the perceptions of respondents. Measurement error affects the consistency of the parameter estimation of the structural model and its standard errors. We tried to minimize this problem by asking respondents to provide "harder" data on organizational practices. The use of multi-item scales also mitigates some of the measurement error concerns. Nevertheless, some of our data may be subject to measurement error. Third, there is a possibility of cross-sectional positive serial correlation between our observations. If firms adopt firm-wide organizational design practices, then multiple observations within one firm may be correlated. Industry-wide adoption of organizational routines might not be completely controlled for in our dummy specification. It should be noted, however, that any existing positive serial correlation would bias the standard errors of the parameter estimates downward.

Despite these caveats, this study has the potential to contribute to our understanding of control system design and the factors that influence corporate management's choices when implementing control systems into divisions. We extend prior literature by examining the interrelation between decentralization and performance measurement choices and also by assessing the joint effect of information asymmetry and interdependencies on those choices.

We find strong evidence for the importance of information asymmetries and interdependencies as determinants of these choices. Finally, we find some evidence that control choices are interrelated.

**APPENDIX
Instruments**

1. Decentralization (DECEN)

In this section, we would like you to compare your influence with the influence of your superior on the following decisions.

- i. Strategic decisions (e.g., development of new products; enter and develop new markets; your unit’s strategy)
- ii. Investment decisions (e.g., acquiring new assets and financing investment projects; information systems)
- iii. Marketing decisions (e.g., campaigns; pricing decisions)
- iv. Decisions regarding internal processes (setting production/sales priorities; inputs used and/or processes employed to fill orders; contracting input suppliers)
- v. Human resources decisions (e.g., hiring/firing; compensation and setting career paths for the personnel employed within your unit; reorganizing your unit; creation of new jobs)

If you and/or any of your subordinates make the decision without the knowledge of your supervisor, you and/or others of your unit are considered to have *all* influence.

	My unit has all influence	2	3	4	5	6	7	
i. Strategic decisions	1							n/o
ii. Investment decisions	1							n/o
iii. Marketing decisions	1							n/o
iv. Decisions regarding internal processes	1							n/o
v. Human resource decisions	1							n/o

2. Divisional Summary Measures (DSMs)

Indicate the weights your supervisor assigns to each of these measures to assess your unit’s performance. Your answers should total 100 percent.

- i. Stock-price-related measures _____%
- ii. Firm-level performance measures (e.g., firm output, firm ROI, firm profit margins, firm income) _____%
- iii. Measures summarizing the total performance of *your unit* (e.g., your unit’s income, unit EVA or ROI, unit output) _____%
- iv. Measures that provide performance information on specific aspects within your business unit (e.g., R&D, production efficiency or quality programs, unit product costs) _____%
- v. Other measures not mentioned (please specify) _____ _____%

Total 100%

3. Alternative Performance Measure Instruments (PROFIT)

Indicate the weights your supervisor assigns to each of these measures to assess your unit's performance. Your answers should total 100 percent.

- i. Stock-price-related measures _____%
 - ii. Profit measures (e.g., ROI, profit margins, net profit) _____%
 - iii. Cost measures (e.g., average cost price, R&D costs) _____%
 - iv. Turnover measures _____%
 - v. Nonfinancial performance measure regarding strategy, marketing and investments (e.g., customer satisfaction, market share, R&D progress) _____%
 - vi. Nonfinancial performance measures related to internal processes regarding personnel (e.g., productivity, quality, coaching and training projects) _____%
 - vii. Other nonfinancial performance measures (please specify) _____%
- Total 100%**

4. Interdependencies

This section relates to the relationships between your unit and other organizational units.

- | | No
impact
at all | | | Some
impact | | | A very
significant
impact | |
|---|------------------------|---|---|-----------------------------------|---|---|---------------------------------|--------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| (a) To what extent do your unit's actions impact on work carried out in <i>other</i> organizational units of your firm (<i>IMPACT-THEM</i>) | | | | | | | | n/o |
| (b) To what extent do actions of managers of other units of the firm impact work carried out in <i>your</i> particular unit (<i>IMPACT-YOU</i>) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | n/o |
| (c) What percentage of your total production is delivered to other organizational units of your firm? (<i>SUPPLY</i>) | | | | | | | | _____% |
| (d) What percentage of your total production uses inputs acquired from other organizational units of your firm? (<i>SUPPLY</i>) | | | | | | | | _____% |
| | Not at
all | | | For about
half the
business | | | For all
business | |
| (e) To what extent could your organizational unit operate as a stand-alone business (<i>INDEP</i>) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | n/o |

(f) How long would it take external suppliers to meet the demand of your current internal customers?
(CHANGE)

1	2	3	4	5	6	7	n/o
They can deliver without delay	It would take them 1 month	It would take them 2 months	It would take them 3 months	It would take them 4 months	It would take them 5 months	It would take them 6 or more months	

5. Information Asymmetries (INFORASYM)

	My supervisor is much more familiar		We are about equally familiar		I am much more familiar	
(a) Compared to your superior, who is in possession of better information regarding the activities undertaken in your organizational unit?	1	2 3	4	5 6	7	n/o

(b) Compared to your superior, who is more familiar with the input-output relationships inherent in the internal operations of your organizational unit?	1	2 3	4	5 6	7	n/o
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	My supervisor is much more certain		We are about equally certain		I am much more certain	
(c) Compared to your superior, who is more certain of the performance potential of your organizational unit?	1	2 3	4	5 6	7	n/o

	My supervisor is much more familiar		We are about equally familiar		I am much more familiar	
(d) Compared to your superior, who is more familiar technically with the work of your organizational unit?	1	2 3	4	5 6	7	n/o

	My supervisor has a much better understanding		We have about the same understanding		I have a much better understanding		
	1	2 3	4	5 6	7		n/o
(e) Compared to your superior, who is better able to assess the potential impact on your activities of factors external to your organizational unit?							
(f) Compared to your superior, who has better understanding of what can be achieved in your organizational unit?							

6. Growth

	Strong Decline		No growth		Significant increase		
	1	2 3	4	5 6	7		n/o
i. What is your expectation with respect to the growth opportunities that exist within the <i>industry</i> in which you compete?							
ii. What is your expectation with respect to the growth opportunities your <i>specific unit</i> faces?							

7. Sensitivity (SENS)

Please indicate the extent to which the following performance measures reveal the performance of your unit in a relatively *timely* manner. If the performance measures are all equally timely in your unit, then each measure (i–iv) receives 25 percent. If one measure is timelier, then it will receive a weight of more than 25 percent. Hence, your answers should total 100 percent.

i. Stock-price-related measures	_____%
ii. Profitability, cost or revenue measures (e.g., ROI, profit margins, income, production costs, R&D costs)	_____%
iii. Nonfinancial performance information on investments, strategy, marketing, internal processes, and human resources	_____%
iv. Other nonfinancial measures not mentioned (please specify) _____	_____%
Total	100%

8. Precision

Please indicate the extent to which the following performance measures reveal the performance of your unit *accurately*. In this context, accurateness means that your unit’s effort is well reflected in

the performance measure. We would like you to compare the accurateness of the measures below. If the performance measures are all equally accurate in your unit, then each measure (i–v) receives 20 percent. If one measure is more accurate, then it will receive a weight of more than 20 percent. Hence, your answers should total 100 percent.

i. Stock-price-related measures	_____%
ii. Measures jointly summarizing the performance of your and other units (e.g., firm-wide profit)	_____%
iii. Measures summarizing the total performance of your unit (i.e., your unit's income, total output of your unit)	_____%
iv. Measures that provide performance information on specific aspects within your organizational unit (e.g., R&D, production efficiency or quality programs)	_____%
v. Other measures not mentioned (please specify) _____	_____%
Total	100%

REFERENCES

- Abernethy, M. A., and A. Lillis. 2001. Interdependencies in organization design. *Journal of Management Accounting Research* 13: 107–129.
- Aghion, P. J., and J. Tirole. 1997. Formal and real authority in organizations. *Journal of Political Economy* 105 (11): 1–29.
- Baiman, S., D. Larcker, and M. V. Rajan. 1995. Organizational design for business. *Journal of Accounting Research* 33 (2): 205–229.
- Baker, G., M. Gibbs, and B. Holmstrom. 1994. The internal economics of the firm: Evidence from personnel data. *The Quarterly Journal of Economics* 109 (4): 881–919.
- Banker, R. D., and S. M. Datar. 1989. Sensitivity, precision and linear aggregation of signals for performance evaluation. *Journal of Accounting Research* 27 (1): 21–39.
- Bolton, P., and M. Dewatripont. 1995. The time and budget constraints of the firm. *European Economic Review* 39 (3–4): 691–699.
- Bound, J., D. A. Jaeger, and R. M. Baker. 1995. Problems with instrumental variables estimation when the correlation between the instruments and the endogenous explanatory variable is weak. *Journal of the American Statistical Association* 90 (430): 443–450.
- Brickley, J. A., C. W. Smith, and J. L. Zimmerman. 1997. *Managerial Economics and Organizational Architecture*. New York, NY: Irwin.
- Bushman, R. M., R. J. Indjejikian, and A. Smith. 1995. Aggregate performance measures in business unit manager compensation: The role of intra-firm interdependencies. *Journal of Accounting Research* 33 (Supplement): 101–128.
- Chenhall, R. H., and D. Morris. 1986. The impact of structure, environment, and interdependence on the perceived usefulness of management accounting systems. *The Accounting Review* 61 (1): 16–35.
- Chow, C. W., J. C. Cooper, and W. S. Waller. 1988. Participative budgeting: Effects of a truth-inducing pay scheme and information asymmetry on slack and performance. *The Accounting Review* 63 (1): 111–123.
- Christie, A. A., M. P. Joye, and R. L. Watts. 2003. Decentralization of the firm: Theory and evidence. *Journal of Corporate Finance* 9: 3–36.
- Datar, S., S. Cohen Kulp, and R. A. Lambert. 2001. Balancing performance measures. *Journal of Accounting Research* 39 (1): 75–92.
- Dunk, A. S. 1993. The effect of budget emphasis and information asymmetry on the relation between budgetary participation and slack. *The Accounting Review* 68 (2): 400–410.
- Fisher, J. 1994. Technological interdependence, labor production functions, and control systems. *Accounting, Organizations and Society* 19 (6): 493–505.

- Gordon, L. A., and V. K. Narayanan. 1984. Management accounting systems: An empirical evaluation. *Accounting, Organizations and Society* 9 (1): 33–47.
- Greene, W. H. 1997. *Econometric Analysis*. 4th edition. Upper Saddle River, NJ: Prentice Hall.
- Griffiths, W. E., R. C. Hill, and G. C. Judge. 1993. *Learning and Practicing Econometrics*. New York, NY: John Wiley.
- Harman, H. H. 1967. *Modern Factor Analysis*. 2nd edition. Chicago, IL: University of Chicago Press.
- Holmstrom, B. 1979. Moral hazard and observability. *Bell Journal of Economics* 10: 74–91.
- Hornngren, C. T., G. Foster, and S. M. Datar. 1999. *Cost Accounting: A Managerial Emphasis*. Upper Saddle River, NJ: Prentice Hall.
- Ittner, C. D., and D. F. Larcker. 2001. Assessing empirical research in managerial accounting: A value based perspective. *Journal of Accounting and Economics* 32 (1–3): 349–410.
- Jaccard, J., and R. Turrisi. 2003. *Interaction Effects in Multiple Regression*. 2nd edition. Thousand Oaks, CA: Sage Publications.
- Jensen, M. C., and W. H. Meckling. 1992. Specific and general knowledge and organizational structure. In *Contract Economics*, edited by L. Werin, and H. Wijkander. Cambridge, U.K.: Blackwell Publishers.
- . 2001. Value maximization, stakeholder theory, and the corporate objective function. *Journal of Applied Corporate Finance* 14 (3): 8–21.
- Keating, A. S. 1997. Determinants of divisional performance evaluation practices. *Journal of Accounting and Economics* 24: 243–274.
- Kreps, D. 1990. Corporate culture and economic theory. In *Perspectives on Positive Political Economy*, edited by J. Alt, and K. Shepsle. Cambridge, U.K.: Cambridge University Press.
- Lambert, R. A. 2001. Contracting theory and accounting. *Journal of Accounting and Economics* 32 (1–3): 3–88.
- Lanen, W. N. 1995. Discussion of aggregate performance measures in business unit manager compensation: The role of intra firm interdependencies. *Journal of Accounting Research* 33 (Supplement): 129–134.
- Lawrence, P. R., and J. W. Lorsch. 1967. *Organization and Environment: Managing Differentiation and Integration*. Homewood, IL: Irwin.
- Lorenz, E. 1999. Trust, contract and economic cooperation. *Cambridge Journal of Economics* 23: 301–315.
- Luft, J., and M. Shields. 2003. Mapping management accounting: Graphics and guidelines for theory-consistent empirical research. *Accounting, Organizations and Society* 28: 169–250.
- MacKinnon, J. G. 1992. Model specification tests and artificial regressions. *Journal of Economic Literature* 30 (1): 102–146.
- Medoff, J. L., and K. G. Abraham. 1980. Experience, performance and earnings. *Quarterly Journal of Economics* (December): 703–736.
- Melumad, N., D. Mookherjee, and S. Reichelstein. 1992. A theory of responsibility centers. *Journal of Accounting and Economics* 15: 445–484.
- Milgrom, P., and J. Roberts. 1992. *Economics, Organization and Management*. Upper Saddle River, NJ: Prentice Hall.
- , and ———. 1995. Complementarities and fit: Strategy, structure and organizational change in manufacturing. *Journal of Accounting and Economics* 19: 179–208.
- Miller, G. A. 1987. Meta-analysis and the culture free hypothesis. *Organization Studies* 8 (4): 309–326.
- Nagar, V. 2002. Delegation and incentive compensation. *The Accounting Review* 77 (2): 379–395.
- Nelson, C. R., and R. Startz. 1990. The distribution of the instrumental variables estimator and its t-ratio when the instrument is a poor one. *Journal of Business* 63 (1): S125–S140.
- Nooteboom, B., H. Berger, and N. G. Noorderhaven. 1997. Effects of trust and governance on relational risk. *Academy of Management Journal* 40 (2): 308–338.
- Nunnally, J. C., and I. H. Bernstein. 1994. *Psychometric Theory*. 3rd edition. New York, NY: McGraw-Hill.

- Reichelstein, S. 1992. Constructing incentive schemes for government contracts: An application of agency theory. *The Accounting Review* 67 (4): 712–731.
- Rockness, H. O., and M. D. Shields. 1984. Organizational control systems in research and development. *Accounting, Organizations and Society* 9 (2): 165–177.
- Solomons, D. 1965. *Divisional Performance, Measurement and Control*. Homewood, IL: Irwin.
- Thompson, J. D. 1967. *Organizations in Action*. New York, NY: McGraw-Hill.
- Vancil, R. F. 1979. *Decentralization: Managerial Ambiguity by Design*. New York, NY: Dow Jones-Irwin.
- Wooldridge, J. M. 2000. *Introductory Econometrics: A Modern Approach*. Cincinnati, OH: South-West College Publishing.
- Wruck, K., and M. C. Jensen. 1994. Science, specific knowledge, and total quality management. *Journal of Accounting and Economics* 18 (3): 247–287.
- Zimmerman, J. L. 1997. EVA and divisional performance measurement: Capturing synergies and other issues. *Journal of Applied Corporate Finance* 10 (2): 98–109.
- . 2001. Conjectures regarding empirical managerial accounting research. *Journal of Accounting and Economics* 32 (1-3): 411–428.