Organizational Design Choices in Retail Banking*

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Abstract

Using a database of branch managers in retail banks, this study finds some empirical support for the two main predictions of Jensen and Meckling's (1992) theory on organizational design choices: a) the allocation of decision rights to branch managers is associated with control systems that measure their performance and reward them based on these performance measures, and b) these decision rights and control systems are associated with the costs of transferring knowledge from branch managers to the top management. A simultaneous equation of these organizational design choices indicates that the causal relation among these choices is unidirectional, with decision rights determining control systems. The implications of this finding are discussed.

1. Introduction

Organizational design is an important topic for management accountants and economists, forming a major part of recent economics and management accounting textbooks such as Milgrom and Roberts (1992) and Zimmerman (1997). The exposition of organizational design in these textbooks is consistent with the framework developed in Jensen and Meckling (1992). This study tests the main hypotheses of Jensen and Meckling (1992) in the retail banking industry.

Jensen and Meckling define organizational design as consisting of a) allocation of decision rights, b) the performance measurement system, and c) the reward system. In their model, they focus on how the costs of knowledge transfer in a firm influence the choice of decision rights allocations and performance measurement and reward systems.

Using a database on retail banks organizational practices with respect to branch managers, I test two major predictions of Jensen and Meckling. First, their theory predicts that banks that allocate more decision rights to branch managers are also more likely to measure the performance of branch managers and reward them based on these performance measures. Second, banks where costs of knowledge transfer from branch managers to top management are high are more likely to allocate decision rights to branch managers and measure and reward their performance.

Retail banking is an interesting industry to study because franchising a retail branch is not viable. Jensen and Meckling argue that firms can motivate employees using either explicit performance measurement and reward systems or franchising. Franchising is an implicit control system that motivates employees by giving them residual ownership. Empirical evidence for Jensen and Meckling's franchising argument already exists (Brickley and Dark, 1987). By studying explicit performance measurement and reward systems in an industry where franchising is not viable, this study complements franchising studies.

Consistent with the two predictions of Jensen and Meckling, simple correlation tests

provide some evidence that the three organizational design choices --- allocation of decision rights to branch managers, the performance measurement system, and the reward system --- are associated with each other. I also find that the three organizational design choices are associated with knowledge transfer costs.

Recent management texts argue that the three organizational design choices are simultaneously determined (Brickley, Smith, and Zimmerman, 1996). The simultaneity among the organizational design choices is also evident in mathematical expositions of organizational design such as Baiman and Rajan (1995). In their model, decision rights and reward systems are two endogenous variables that firms simultaneously choose to maximize profits. If firms make organizational design choices simultaneously, correlations among these choices, being equivalent to univariate regressions, are biased and misspecified for testing associations among these choices. One needs a simultaneous model instead (Greene, 1993, Chapter 20).

A simultaneous model of organizational design choices indicates that these choices are still associated with each other, but the causality among them is unidirectional. Allocation of decision rights determines the performance measurement system and the reward system, but not vice versa. Further, knowledge transfer costs have direct effects on decision rights and reward systems and indirect effects on performance measurement and reward systems through changes in decision rights.

The results in this study provide one potential explanation for the mixed evidence on the association between the level of private knowledge held by managers and incentive based pay found in prior studies.[1] These prior studies have not explicitly examined the effect of the level of decision rights allocated to the manager on incentive-based pay. The significant association of

[1] Positive associations between the level of private knowledge held by the agent and incentive pay are documented by Baber, Janakiraman, and Kang (1996) and Bushman, Indjejikian, and Smith (1996). However, some of the results in Bizjack, Brickley, and Coles (1993) and in Baiman, Larcker, and Rajan (1995) are in the opposite direction.

the level of decision rights with both the level of private knowledge and incentive-based pay in this study suggests that decision rights may be a potential correlated omitted variable in prior studies.

The unidirectional causality among organizational design choices found in this study has anecdotal support in the recent Citicorp-Travelers merger. The combined firm, Citigroup, focused on the reallocation of decision rights among Citicorp's commercial bankers and Travelers' Salomon Smith Barney investment bankers before addressing compensation issues (*The New York Times*, 1998). The implications of unidirectional causality are discussed next.

Williamson (1992) argues that the ability of firms to quickly and efficiently respond to changes in exogenous parameters such as knowledge transfer costs is an important issue that has yet to be systematically examined by theoretical and empirical researchers --- Jensen and Meckling's model is a static model focusing on the level of knowledge transfer costs as a determinant of organizational design. Unidirectional causality among organizational design choices provides extremely preliminary evidence that the cost of responding to changes in knowledge transfer costs is low. Unidirectional causality implies that, in response to changes in exogenous parameters, a firm can focus on changing organizational design components in a sequential manner. In contrast, if all components determine each other, the firm would have to consider all components simultaneously --- changing one component would lead to changes in other components which, in turn, would have feedback effects on the first component. Such feedback effects could potentially increase the difficulty of designing a response to exogenous changes.

The remainder of the paper is organized as follows. Section 2 describes Jensen and Meckling's main hypotheses. Section 3 describes the data and develops the variables. Sections 4 and 5 provide the results. The results in Section 5 suggest some directions on how Jensen and Meckling's theory could be extended. Discussing these extensions and summarizing the paper,

section 6 concludes.

2. Hypothesis Development

In this section I first motivate why I choose to test Jensen and Meckling's theory on organizational design over other theoretical papers in the field. I then develop the main hypotheses of Jensen and Meckling. This is followed by a brief discussion of alternative hypotheses.

There is a large body of theoretical literature on organizational design, with different theories emphasizing economic, psychological, sociological, and political models of human behavior (Jensen, 1998, Chapter 1). Economics-based theories typically view organizational design as consisting of multiple components, all of which must fit in equilibrium. Milgrom and Roberts (1995) develop the notion of complementarities to show how various facets of organizational design are interrelated. More specifically, Baiman and Rajan's (1995) model illustrates how the centralization/decentralization choice and the agent's compensation scheme are linked with each other in equilibrium. Jensen and Meckling adopt a similar approach, emphasizing the fit among allocation of decision rights to a manager, a measurement system to measure the manager's performance, and the reward system based on these performance measures.

I focus on Jensen and Meckling (1992) for several reasons. First, their theory of organizational design and their hypothesized associations among the various facets of organizational design are consistent with the exposition of organizational design in recent economics and management accounting textbooks, such as Milgrom and Roberts (1992) and Zimmerman (1997). Jensen and Meckling's theory is also similar to other economic-based theoretical studies on organizational design, as evidenced by the references in Brickley, Smith, and Zimmerman (1996, Chapters 8 – 13). Focusing on Jensen's and Meckling's study is thus

without significant loss of generality. Second, Jensen and Meckling provide empirically testable hypotheses among their organizational design constructs, and suggestions on how to empirically measure their constructs. In contrast, theoretical studies such as Milgrom and Roberts (1995) are too broad in their exposition of organizational design, whereas Baiman and Rajan (1995) are too specific in their assumptions, making it difficult to generate testable predictions based on their theories.

Jensen and Meckling (1992) imagine a firm where ownership of assets and knowledge about the use of those assets are exogenously distributed among the individuals in the firm. In order to use the available knowledge base efficiently, organizational design needs to solve two problems: a) the control problem, or the problem of ensuring that the user of the asset works in the best interests of the owner, and b) the assignment problem, or how the decision rights regarding the use of the asset are allocated in the first place.

The Control Problem

If top management allocates decision rights to lower levels, it needs to implement a control system to ensure that these employees work in top management's best interests.[2] Jensen and Meckling argue that the control system can be implicit or explicit. One form of an implicit control system, franchising, resembles a market system where some of the residual claims of the asset are ceded to the franchisee, thus motivating franchisee effort. Franchising has been empirically examined by Brickley and Dark (1987).

However, the banking industry does not franchise branches.[3] Consequently, according to

[2] The two main problems in principal-agent settings are the moral hazard problem and the adverse selection problem (Kreps, 1990, p. 577). While Jensen and Meckling focus mainly on the moral hazard problem, decision rights can solve the adverse selection problem as well. Talented individuals are more likely to approach firms offering more decision rights or more opportunities in the job. A common measure of talent is education level (Kreps, 1990, Chapter 17). I use the branch manager's education level in my statistical analyses.

[3] Possible reasons for not franchising branches are scale and scope issues and regulation. See Grossman and Hart (1986) for a theoretical exposition of when it is optimal for the top management to retain

Jensen and Meckling's theory, this industry must use explicit control systems that a) measure the performance of lower level employees, and b) specify the relationship between rewards and measures of performance.

Unlike research on franchising, empirical research on the association between decision rights and explicit control systems has been limited. Although divisional manager compensation schemes have been examined, studies have focused on interdivisional dependencies rather than managerial discretion (Bushman, Indjejikian and Smith, 1995; Keating, 1997). Christie, Joye, and Watts (1995) examine the extent to which decision rights are decentralized, but do not link decentralization to performance measurement and reward systems. To study how allocation of decision rights relates to explicit performance measurement and reward systems, I test the following hypothesis of Jensen and Meckling:

H1: More allocation of decision rights to branch managers is likely to be associated with the existence of a performance measurement system and a reward system based on these performance measures.

The Assignment Problem

A second issue in allocating decision rights is how much should be delegated to the lower level employees. At one end of the continuum, top management may choose to make all decisions. In such a case, management must gather all relevant information, thus incurring knowledge transfer costs. One type of knowledge transfer cost is interpretation cost. In the retail banking industry, the branch manager may have specific information about a small, local business requesting a loan that is difficult to articulate to a central office. Second, knowledge

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ownership and residual rights related to a lower level division, and when it is optimal to cede ownership and residual rights to the lower level division via franchising.

transfer may entail time costs. Transmitting information to a central office and receiving its consequent decision can take time, causing the firm to lose opportunities in the marketplace. Third, knowledge transfer may have incentive costs. Branch managers anxious about their job security may need incentives to reveal their private information truthfully.

While the knowledge transfer in a management-decision system can be costly, so can a system where employees have high decision-making authority. First, there are transactions costs involved in identifying good performance measures and installing measurement and reward systems to motivate employees. Second, standard principal-agent theory shows that incentive pay systems lead to inefficient risk sharing, the costs of which accrue to the principal or top management (Kreps, 1990, Chapter 16).[4]

Jensen and Meckling argue that firms choose a point between complete centralization and complete decentralization based on the trade-off between the costs incurred in giving employees complete discretion and costs incurred in transferring knowledge to top management. Figure 1 shows this relationship, with A as the optimal point where the sum of the two costs is minimized.

Previous evidence on the relationship between organizational design choices and knowledge transfer costs is mixed. For example, Baiman, Larcker, and Rajan (1995) find that managers of divisions where knowledge transfer is costly have more decision rights, but contrary to expectations, have *decreased* risk in incentive compensation. Their results suggest that further inquiry into the issue may be useful.

In Figure 1, a higher cost of transferring knowledge is represented by the dotted curve

[4] If the top management has relevant knowledge, delegating requires that this knowledge be transferred to the lower level decision maker. One of the criticisms of Demsetz (1992, p.277) is that Jensen and Meckling do not consider the costs of this type of knowledge transfer. However, most theoretical information asymmetry and delegation models consider only information that is private to the agent, not information that is private to the principal (e.g., see Baiman and Rajan, 1995 and the references therein). I ignore this issue

above the original knowledge transfer cost curve. Minimizing the sum of this new knowledge transfer cost and the cost of control systems yields a new optimal point A*. Comparing A and A* leads to the following hypothesis:

H2: The allocation of decision rights to branch managers and the existence of performance measurement and reward systems based on the performance measures are more likely in firms where transfer of knowledge to top management is more costly.

Since hypotheses H1 predicts associations among organizational design choices, one method to test it is to compute correlations. However, extending Jensen and Meckling's theory, Brickley, Smith, and Zimmerman (1996, Chapter 8) argue that firms make all three design choices simultaneously. The simultaneity among the organizational design choices is also evident in mathematical expositions of organizational design such as Baiman and Rajan (1995). In their model, decision rights and reward systems are two endogenous variables that firms simultaneously choose to maximize profits. A simple mathematical model illustrates the case. Let the decision right variable be *d,* the performance measurement system, *m,* the reward system, *r,* the knowledge transfer costs, *k,* The total profit, *P,* is a function of *d, m, r,* and *k.* The firm maximizes:

$$\max_{d,\,m,\,r} P(d, m, r, k)$$

The first order conditions are:

$$\partial P/\partial d = 0$$
$$\partial P/\partial m = 0$$
$$\partial P/\partial r = 0$$

Optimal *d, m,* and, *r,* requires the three first order conditions be solved simultaneously.

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as well.

If this is the case, correlations among the organizational design choices are biased for testing associations among these choices. The reason is as follows. Correlation between two variables is statistically equivalent to a univariate regression between the two variables. If these variables are simultaneously chosen, any regression between these variables that does not account for simultaneity is biased (Greene, 1993, Chapter 20). One would need to estimate a simultaneous model to examine the associations among the variables.

Simultaneity among organizational design choices has not been explored in prior studies.[5] One reason is that good instruments (or predictors) of the endogenous variables have not been available. This study attempts to overcome this problem by modifying a recent econometric technique by Lewbel (1997) that uses functions of the endogenous variables as instruments. Thus, the next hypothesis is:

H3: The three organizational design choices --- allocation of decision rights, the performance measurement system, and the reward system --- are associated with each other and with knowledge transfer costs, after accounting for simultaneity among these choices.

2.1 Alternative Hypotheses

Kreps (1990, Chapter 19) discusses several alternative theories of the firm. These theories have different implications for organizational design than hypotheses H1 and H2. The first alternative theory is the managerial model of the firm where the manager maximizes some element, such as utility or capital, rather than profits. A second theory is behavioral: the firm has a "routine" based on historical antecedents and changes its routine only in response to large shocks such as earning significantly lower profits than its competition. Organizational design,

[5] Baiman, Larcker, and Rajan (1995) examine the allocation of decision rights and the incentive reward system, but not how each choice affects the other.

according to these theories, would be determined by the characteristics of the manager or the firm's behavioral routine. For instance, top management objectives such as desire for power and empire building would dictate decentralization and control system choices rather than knowledge transfer costs. Alternatively, the behavioral theory would suggest historical antecedents as a predictor of decentralization and control system choices. Thus, it is not evident that these alternative theories of the firm would predict H1 and H2 without adequate controls for top management objectives and historical antecedents.

3. Data and Variables

3.1 Data

I examine Jensen and Meckling's predictions in the retail banking industry. Using firms from one industry has several advantages. First, firms in the sample are relatively homogenous in their economics and accounting methods, increasing the comparability of financial measures across the sample. Second, respondents are likely to interpret survey questions similarly, increasing the comparability of survey responses across the sample. These firms face similar external shocks such as technological improvements and regulatory changes, mitigating the need to control for these shocks explicitly. However, a major disadvantage of a single-industry study is the potentially limited generalizability of the results.

The data in this study were collected in 1994, when branch banking was the most common distribution channel for both deposit and loan origination activities (Bank Administration Institute, 1998). Given this situation, it is likely that banks paid close attention to the organizational design of branches. This attention makes the tests of organizational design choices in branch banking quite powerful.

The data in this study come from two sources. The first source is the Wharton Financial

Institutions Center (WFIC) survey which provides information on organizational design and performance of retail divisions of 135 U.S. banks in 1994. The survey was completed in two phases. First, the WFIC research team approached the 70 largest U.S. bank holding companies. From this group, the team secured the participation of 47 bank holding companies, yielding 64 banks (seven bank holding companies provided information on two or more banks). I label these as Group A banks. The team then contacted the next largest 265 bank holding companies via mail. From this group, 64 bank holding companies agreed to participate, yielding 71 more banks. I label these as Group B banks. The Group A and Group B banks yield a sample of 135 institutions.

The WFIC survey consisted of a comprehensive questionnaire on technology, work practices, organizational strategy, and operational performance of the retail bank, addressed to the office of the senior executive of the retail bank. A separate questionnaire to the branch manager of the head office branch elicited more specific details about the branches. Next, the 64 Group A banks owned by the 47 bank holding companies that participated in the first round completed another set of questionnaires. The second set of questionnaires solicited information on retail financials (to be completed by the senior financial officer of the bank), sales and marketing (to be completed by the director of retail marketing), and information technology (to be completed by the senior officer responsible for technology of the bank). However, these additional questionnaires were not mailed to the Group B banks.

The second source of data in this study are the bank call reports. These reports are filed by each bank on a quarterly basis with the Federal Deposit Insurance Corporation (FDIC). The call reports contain organizational structure and demographic information, balance sheets, income statements, and other financial data, and are used by regulators to monitor a bank's financial condition. The combined assets of the banks in the sample are about 22 percent of the

total assets of the approximately 10,000 banks listed in the FDIC database.[6]

3.2 Variable Definitions

This subsection develops empirical measures of allocation of decision rights, the performance measurement system, the reward system, and the costs of transferring knowledge from the branch manager to the top management. In operationalizing these concepts, it is worth noting that, unlike financial measures, it is difficult to obtain precise measures of organizational design variables (Jensen, 1983, pp. 332-333). Difficulty in measuring organizational design choices has led to little consistency in accounting research literature on the empirical definitions of these variables --- researchers have used measures based on theory, data availability, and statistical tractability considerations.

I construct empirical measures of organizational design choices and knowledge transfer costs as follows. First, to the extent possible, I draw upon Jensen and Meckling's work as well as organizational design textbooks such as Milgrom and Roberts (1992) and Brickley, Smith, and Zimmerman (1996), identifying definition elements relevant to this study. Second, I draw on the literature on the economics of the retail banking industry to motivate my measures. Thus, I provide both general and industry-specific motivations for my measures. Finally, I compare my definitions with those used in prior accounting research to assess compatibility with existing definitions. Detailed descriptions of the empirical measures are provided in Appendix A. Table 1 provides the means and the standard deviations of the measures used.

[6] The banks in the WFIC survey data and the call reports are matched on name and city. Not all WFIC respondents could be matched. Further, some data are missing in the WFIC survey. Thus the sample size in the tests is less than 135.

3.2.1 The Assignment of Decision Rights

Jensen and Meckling (p. 266-267) define two mechanisms by which decision rights are allocated to lower level employees in the firm: job description and monetary budget. Job descriptions provide explicit authority in areas such as hiring and pricing. In contrast, monetary budgets implicitly limit the branch manager's discretion by limiting branch-level expenditures.

Following Jensen and Meckling's examples of job authority, I examine the extent to which the branch manager has discretion in the following areas: human resource management, business process management, and price-setting ability.

The next issue is the selection of products and processes where more authority is indicative of more discretion. For instance, the branch manager may have authority to choose fixtures in the branch, but this is not reflective of true discretion. As a measure of discretion, I examine the extent to which branch managers have a say in the following areas (the details are in Appendix A):

i) hiring tellers.

ii) deciding promotions within the branch.

iii) determining the hours the branch is open.

iv) changing the process for selling a new investment product.

v) changing rates for small business loans.

I use investment products in (iv) as opposed to the corresponding WFIC survey item on checking accounts because investment products are more complex than checking accounts. Authority to change the selling process for such products is more reflective of discretion allocated to the branch manager.

Note that item (v) uses small business loans as opposed to residential mortgage loans.

Banks typically securitize and sell residential loans, whereas they bear all the risk of small business loans. Thus, good decision-making on small business loans is critical. Further, due to large volumes and securitization, the statistical properties of residential mortgage loans are well-understood at the central level. In contrast, the idiosyncratic nature of small businesses lends itself to local branch manager decision-making. Thus, the ability to set prices on small business loans is a good measure of decision rights allocated to the branch manager.

As noted before, precise empirical definitions of organizational design choices are not available. To test whether the survey items measure some fundamental underlying decision right construct with error, I conduct an exploratory factor analysis of these items. Aggregating the survey items into factors reduces the error in the measurement of the underlying decision right construct. Factors also reduce the dimensionality of the data, increasing statistical tractability. An exploratory factor analysis with rotation of items i) through v) yields two factors with eigenvalues greater than unity. Items i) through iv) load with weights greater than 0.45 on the first factor; only item v) loads with a weight greater than 0.45 on the second factor.[7]

Vancil (1978) divides job authority into functional authority and financial authority. The two factors I obtain are consistent with Vancil's classification. I construct the first factor by first standardizing items i) through iv) to zero mean and unit variance and then aggregating them.[8]

FUNCT: The standardized aggregated sum of the branch manager's authority in hiring, promoting, setting hours, and changing selling processes.

FINAN: The authority of the branch manager to set prices.

Another measure of financial authority identified by Jensen and Meckling is the budget allocated to branch managers.

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[7] The 0.45 cutoff is based on Ittner and Larcker (1995. p.9).

[8] Computing factor scores by standardizing the individual items to zero mean and unit variance and

BUDGET: The log of the expenditure limits for the branch manager that require no authorization from a superior, assuming that these expenditures are within the branch manager's budget.

Prior accounting research has used coarser measures of allocation of decision rights. For instance, Baiman, Larcker, and Rajan (1995, p. 228) use a univariate binary (0/1) variable to represent whether a division has control over certain core functions.

3.2.2 Performance Measurement Systems

Unless delegation of decision rights is accompanied by proper incentives, employees will misuse their discretion. Providing effective incentives requires creating good performance measures. Jensen and Meckling (pp. 268-270) define four types of performance measures that top management can use to measure the outcome of a branch manager's actions: costs, profits, deviation from budgetary targets, and individual performance measures. This list of measures coincides with the description of performance measures in Kaplan and Atkinson (1992) and Brickley, Smith, and Zimmerman (1996). Jensen and Meckling argue that individual performance measures are needed if costs and profits do not measure the outcomes of the actions of the branch manager adequately. Although they do not provide precise examples of individual performance measures, non-financial measures such as customer acquisition rates appear to be good candidates. Amir and Lev (1996) support this idea, showing that customer acquisition activities, while valued by the stock market and potential acquirers of the firm, are not measured by current earnings or profits. Similarly, Kaplan and Norton (1996) argue that current profit measures do not fully capture the lifetime profitability of new customers; thus they advocate the use of non-financial customer acquisition measures.

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aggregating them instead of using the factor scores provided by the exploratory factor analysis is standard

Performance measurement in a firm is reflected in the choice of the performance measures as well as the use of these measures by the firm. I include the following measures from the WFIC survey in my construction of the performance measurement system (the details are in Appendix A):[9]

i) the presence of an accounting system to allocate revenues and costs to determine the profitability of the branch.

ii) the frequency with which senior management requests data on branch profitability.

iii) the frequency with which senior management requests data on customer acquisition.

As noted before, precise empirical definitions of organizational design choices are not available. To test whether the survey items measure some fundamental underlying performance measurement construct with error, I conduct an exploratory factor analysis of these items. Aggregating the survey items into factors reduces the error in the measurement of the underlying performance measurement construct. Factors also reduce the dimensionality of the data, increasing statistical tractability. In a factor analysis with rotation, the three survey items load on one factor with an eigenvalue greater than unity. Each survey item loads with a weight greater than 0.45. Consequently, I standardize and aggregate the three survey items into:

PERF: Importance of performance measurement to top management, as measured by the existence of systems to measure performance, and the frequency with which performance is measured.

In addition to determining rewards and sanctions, performance measurement systems

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statistical practice (Ittner and Larcker, 1995, p. 8; Johnson and Wichern, 1992, p. 433).

[9] The WFIC survey does not have any items on the role of budgets in performance evaluation. See Shields

provide feedback to the branch managers (Brickley, Smith, and Zimmerman, 1996, p. 256). This feedback can be vertical or lateral. Vertical feedback from the top management to the branch manager provides information on the outcome of his actions. Lateral feedback across branch managers is useful if their decisions have spillover effects, or if they share common concerns (Kaplan and Atkinson, 1992, Chapter 13). Kaplan and Atkinson (1992, Chapter 13) argue that lateral feedback is best expressed via disaggregated performance data shared in flexible, semi-structured, face-to-face interactions.[10]

To measure feedback, I examine the following questions in the WFIC survey (the details are in Appendix A):

i) the frequency with which branch financial information is received by branch managers.

ii) the frequency with which branch sales figures are received by branch managers.

iii) the proportion of bank managers that participate in internal focus groups to analyze and collectively solve problems.

In a factor analysis with rotation, the three survey items load on one factor with an eigenvalue greater than unity. Each survey item loads with a weight greater than 0.45. Consequently, I standardize and aggregate the three survey items into:

FEEDBACK: The extent to which feedback is provided to the branch managers about the outcome of their actions.

3.2.3 Reward Systems

Proper incentive or reward systems need to accompany delegation to prevent misuse of

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and Young (1993) for empirical evidence on budget-based incentives.

[10] The WFIC survey also has information about feedback from top management to branch managers on the overall performance of the bank, but Kaplan (1998) argues that this measure is too aggregate to be directly actionable by branch managers and is thus not useful to them. Therefore, I ignore this item.

decision rights by employees. Following Jensen and Meckling (p. 270) and Milgrom and Roberts (1992, Chapters 11-12), I examine two types of reward systems: sensitivity of pay to measured performance, and promotions for performance. I compute the sensitivity of pay to performance as follows (the details of the measures are in Appendix A).

The WFIC survey contains three branch manager compensation questions: dependence of compensation on branch sales, branch performance, and individual performance measures. Note that these performance measures are similar to those used in PERF. Exploratory factor analysis with rotation indicates that the three survey items load on one factor with an eigenvalue greater than unity. Thus, I standardize and average these three survey items to compute:

PAYWORK: Whether the branch manager is compensated on sales, branch performance, and individual performance measures.

However, PAYWORK does not indicate the amount of the branch manager's pay at risk. Thus, I compute:

ATRISK: The percentage of the pay of the branch manager that is bonus or variable.[11]

The optimal reward scheme in an agency problem is to put the agent's pay at risk *and* base that risk on performance measures (Kreps, 1990, Chapter 16). This scheme suggests multiplying ATRISK and PAYWORK, thus awarding the highest score to those branch managers whose pay is at risk and the risk is based on the performance measures.[12]

REWARD = (1 + PAYWORK) * ATRISK

Another common reward system involves promotions for performance. Despite the

[11] The WFIC survey does not indicate the relative weights of the measures in PAYWORK in the percentage of pay at risk.

[12] PAYWORK is scaled from zero to one. Since a zero PAYWORK completely wipes out the effect of ATRISK, I scale PAYWORK by adding one to it, i.e., I use ATRISK * (1 + PAYWORK). The significance of the results in the paper are unaffected if I add 2 to PAYWORK instead of unity when computing REWARD.

prevalence of promotions as a reward scheme in firms, this study, to the best of my knowledge, is one of the first accounting research studies to examine this issue. Although the WFIC survey does not directly ask the sensitivity of promotions to performance, it provides data on the percentage of branch managers that were promoted in 1994. Thus, (the details are in Appendix A):

PROMOTE: The percentage of branch managers that were promoted to other branches and to other jobs within the firm in 1994.

It is possible that a firm promoted a large number of managers because it was doing well, or was growing. Another possibility is that many managers left the firm, so that the remaining managers were promoted. I regress PROMOTE on 1994 growth in deposits, ROA, and branch manager turnover. The regression is insignificant at the 10 percent level, suggesting that PROMOTE does not reflect firm growth or employee turnover. [13]

3.2.4 Costs of Transferring Knowledge to Top Management

It is difficult to measure knowledge transfer costs directly. Following arguments in the literature, I use four measures to assess knowledge transfer costs: two environmental factors: the magnitude of change in the firm's environment and the level of competition, and two firm-specific factors: firm size and firm strategy. A factor analysis of these four measures yields one factor with an eigenvalue greater than unity, suggesting that these four measures measure the same underlying construct. In contrast to this latent variable approach, prior accounting research studies have used differences in SIC codes between the division and the headquarters as measures of knowledge transfer costs (Baiman, Larcker, and Rajan, 1995, p. 219). Christie,

[13] PROMOTE measures the actual percentage of managers promoted. Using the actual realization of a reward scheme instead of measuring the underlying rules has precedent in accounting research literature.

Joye, and Watts (1995) use multiple measures of knowledge transfer costs such as SIC codes and firm size but do not conduct latent variable analysis to examine whether their measures capture the same underlying construct.

Costs of transferring knowledge to top management are likely to be high for firms facing rapid environmental change (Jensen and Meckling, p. 264). The top management in such firms is likely to be overwhelmed in acquiring, interpreting, and acting upon the knowledge transmitted by various divisions in a timely fashion.

To measure changes in the firm's environment, I use changes in the deposit base. An American Bankers Association survey indicates that two out of three retail customers initiate bank relationships with deposits (American Bankers Association, 1997). This figure suggests that changes in the deposit base are good measures of changes in the customer environment. Since I am interested only in the magnitude of the change, and not the sign, I compute:

DEPENV: The absolute value of the median percentage change in the banks' deposit base in 1994. Since most banks in the sample operate in multiple states, the median percentage change is computed over all banks in a given bank's Fed district.

Environmental change can also be reflected in the level of competition in an industry, with more competitive environments creating more change. I measure the degree of competition as:

HERF: The Herfindahl index of the insured deposits computed over all banks in a given bank's Fed district at the end of 1994. The Herfindahl index is the sum of squares of the market shares of insured deposits of all the

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Baiman, Larcker, and Rajan (1995, p. 218) measure compensation risk not by using the percentage of pay at risk, but by using the realized bonus.

banks in the given bank's Fed district (Tirole, 1988, p. 221).[14]

One firm-specific factor affecting the costs of knowledge transfer is firm size (Jensen and Meckling, 1992; Kaplan and Atkinson, 1992; Milgrom and Roberts, 1992). The argument is that the sheer volume of information may overwhelm the top management of a large firm if it acquires detailed knowledge from all divisions in an attempt to make all decisions centrally. To determine firm size, I use the following measure:

SIZE: The log of insured deposits (this measure is correlated with log of total assets at 0.98).

Another firm-specific factor affecting knowledge transfer costs is firm strategy (Demsetz, 1992, pp. 279-280; Brickley, Smith, and Zimmerman, 1996, Chapter 8). In firms following routine activities, top management has most of the relevant knowledge. Hence, knowledge transfer costs from lower level employees to top management are relatively low. In contrast, for firms emphasizing new products and new market segments, the dynamic nature of the marketplace for these products makes quick response a priority. Since branch managers have ongoing contact with customers and customer prospects, they are likely to have better knowledge about local opportunities and customer preferences. The qualitative nature of this knowledge, coupled with its dynamic nature makes it costly for top management to acquire and act on this knowledge in a *timely* fashion.[15] The WFIC survey includes three items that measure the extent

[14] Herfindahl index can be positively associated with knowledge transfer costs. In theory, a higher Herfindahl index is associated with a monopoly environment, suggesting that the top management knows almost everything and costs of gathering knowledge are low. In the data, the highest value of HERF is 0.04, suggesting that the environment is one of oligopolistic competition (a pure monopoly has a market share of 1 and the Herfindahl index is $1^2 = 1$). One can argue that large competitors are likely to introduce new products and marketing campaigns, making the environment uncertain. On the other hand, one can think of low Herfindahl index as representing a situation where no firm is large enough to make a difference to the environment.

[15] One can argue that if the top management designs the new products, they should have all the relevant demand information. This is not necessarily true. Morall (1994) documents cases where top management develops a menu of marketing programs, but lets the branches decide which program to emphasize in their localities.

to which a firm emphasizes the following as a part of its strategy (see Appendix A for details):

i) innovation in the design and delivery of products/services.

ii) innovation in services offered.

iii) innovation in distribution channels.

The three items have a Cronbach alpha of 0.82, suggesting that they measure the same construct. Thus, my measure of firm strategy is:

INNOV: The standardized average of the three items above. Each item above is standardized to zero mean and unit variance.

I examine the convergent validity of INNOV (i.e., whether this variable is associated with external referents in the expected manner) to ensure that it measures the firm's strategic emphasis on new products and services. Correlating INNOV with questionnaire items from the WFIC survey, I find that firms pursuing new products and markets have a broad customer base.[16] Further, these firms are less likely to concentrate on known geographical and customer groups. To expand to new areas and alert customers to new products and services, these firms are more likely to spend large amounts on marketing.

In sum, four measures are hypothesized to be associated with the costs of transferring knowledge from branch managers to top management: DEPENV, HERF, SIZE, and INNOV. An exploratory factor analysis of these measures with rotation yields one factor with an eigenvalue greater than unity. All four measures load on this factor with weights greater than 0.45, suggesting that they measure the same underlying construct, with error. Consequently, I compute:

KNOWCOST: Standardized average of SIZE, DEPENV, HERF, and INNOV. All the four measures are standardized to zero mean and unit variance.

[16] I use 10% two-tailed as the cutoff level of significance.

Other potential factors affecting knowledge transfer costs are regulation and information technology (Jensen and Meckling, 1992; Brickley, Smith, and Zimmerman, 1996). However, one advantage of using a cross-sectional sample in one industry at one point in time is that all firms in the sample face similar regulation and technological forces, mitigating the need to account for these forces explicitly.

4. Correlation Results

Table 2 presents the correlations among all the variables. Note that BUDGET, the level of discretionary expenditures, and PERF, the existence of a performance measurement system and the extent to which the top management uses it, have fewer observations as they are available only for Group A banks.

Hypothesis H1 states that the level of decision authority is associated with the performance measurement system and the reward system. There is some evidence to support this hypothesis in the correlations. Using the 10 percent two-tailed level as the significance cutoff, I find that banks awarding more functional rights to branch managers (FUNCT) also provide them with more feedback (FEEDBACK). The correlation coefficient is $\rho = 0.20$ ($p < 0.05$). While the association between the extent of functional decision rights and the performance measurement system (PERF) is positive ($\rho = 0.12$), it is insignificant at the 10 percent two-tailed level. However, one limitation of the performance measurement system (PERF) is the limited number of observations. Further, banks awarding functional rights also use promotions (PROMOTE) and pay-for-performance incentive schemes (REWARD) with correlations of 0.20 and 0.22 respectively. Other measures of decision rights, namely discretion on expenditures (BUDGET) and financial authority to set prices (FINAN), show no significant relations with control systems measures.

Hypothesis H2, which states that organizational design choices are associated with costs of transferring knowledge to top management, appears to have more support than H1. Using a 10 percent two-tailed significance cutoff level, I find that banks with high knowledge transfer costs (KNOWCOST) award more functional and financial decisions to branch managers ($\rho = 0.31$ and 0.18 respectively), make greater use of performance measurement and feedback ($\rho = 0.45$ and 0.22 respectively), and are more likely to have promotions and pay-for-performance incentive schemes as reward systems ($\rho = 0.26$ and 0.26 respectively).

The implications of these findings for prior studies is as follows. Prior evidence on the relation between the level of private knowledge of a manager and incentive-based pay is mixed.[17] My study indicates that managerial discretion is associated with both incentive-based pay and the level of private knowledge held by the manager.[18] These associations suggest that managerial discretion is a correlated omitted variable in the relation between information asymmetry and incentive-based pay. The fact that most prior studies have not explicitly controlled for managerial discretion is one potential reason for the mixed results. Further evidence to support my conjecture is provided by Bushman, Indjejikian, and Smith (1996). They find that, *ceteris paribus*, regulated firms have weaker incentive schemes, and speculate that reduced managerial discretion in such industries could be a reason. This study provides more direct evidence on the issue. Finally, support for H1 and H2 suggests that organizational design models based on the profit maximizing model of the firm are more representative of reality compared to managerial models or behavioral models of the firm discussed in Section 2.1.

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[17] Positive associations between the level of private knowledge held by the agent and incentive pay are documented by Baber, Janakiraman, and Kang (1996) and Bushman, Indjejikian, and Smith (1996). However, some of the results in Bizjack, Brickley, and Coles (1993) and in Baiman, Larcker, and Rajan (1995) are in the opposite direction.

[18] KNOWCOST measures the costs of transferring knowledge from the branch manager to the top management, not the level of private knowledge held by the branch manager. However, if knowledge transfer costs are high, the amount of knowledge transferred is reduced, possibly leaving the branch manager with more private knowledge.

5. A simultaneous model of organizational design choices

The previous section examined the correlations among the organizational design choices. A correlation between two variables is statistically equivalent to a univariate regression between the two variables. If these variables are simultaneously chosen, simple regressions are biased --- a simultaneous model of organizational design choice is needed to test the associations among these variables. In this section, I first develop such a simultaneous model. I then test this model using a modification of the Lewbel (1997) technique. Section 5.3 provides robustness checks.

For statistical tractability and data availability, I use univariate measures of the three organizational design choices that are available for both Group A and Group B banks. Specifically, I use FUNCT, the level of functional authority given to the branch manager; FEEDBACK, the extent to which the branch manager is provided with feedback on his performance measures; and REWARD, the sensitivity of the branch manager's pay to performance.

Identification in simultaneous equation models is assured if each endogenous organizational design variable is associated with an exogenous variable that has no direct effect on other endogenous variables. The identifying exogenous variables are:

EDUCATE: This variable measures the level of education of the branch manager and is hypothesized to affect only FUNCT. *Ceteris paribus*, a more educated branch manager is more likely to be given more decision rights.[19] Holding decision rights constant, the manager's education is assumed not to affect reward and performance measurement systems.

NUMMERGE: This variable measures the number of acquisitions by the bank in 1994

[19] The two main problems in principal-agent settings are the moral hazard problem and the adverse selection problem (Kreps, 1990, p. 577). While Jensen and Meckling focus mainly on the moral hazard problem, decision rights can solve the adverse selection problem as well. Talented individuals are more likely to

and is hypothesized to affect only FEEDBACK. Organizations experience vast changes in their internal environment following a merger, as customers, employees, and systems from the acquired bank are absorbed. Effective integration of the two firms requires strategic guidance and feedback to the employees from the top management; if the transition is not well managed, especially in competitive industries such as retail banking, customers can be easily lost and transition costs can escalate. Therefore, I conjecture that banks with a large number of acquisitions are more likely to provide frequent information to branch managers and encourage these managers to interact with each other for problem solving.

UNEMP: This variable measures the unemployment level in the state where the bank is chartered, and is hypothesized to measure the employee's reservation wage or alternative employment opportunities. The reservation wage directly affects the incentive compensation scheme in most principal-agent models (Kreps, 1990, Chapter 16). Thus, UNEMP is hypothesized to affect only REWARD directly.

The simultaneous equation model is:

$$FUNCT = a_1 + a_2 FEEDBACK + a_3 REWARD + a_4 KNOWCOST + a_5 EDUCATE + \varepsilon_1 \quad (1)$$

$$FEEDBACK = b_1 + b_2 FUNCT + b_3 REWARD + b_4 KNOWCOST + b_5 NUMMERGE + \varepsilon_2 \quad (2)$$

$$REWARD = c_1 + c_2 FEEDBACK + c_3 FUNCT + c_4 KNOWCOST + c_5 UNEMP + \varepsilon_3 \quad (3)$$

5.1 Estimation of the Simultaneous Model

Since each equation in the simultaneous model has an excluded exogenous variable, the system of equations is identified. However, identification of a model is unrelated to its estimation, an issue to which I turn next.

Since endogenous variables are correlated with the error term, one cannot directly use

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approach firms offering more decision rights or more opportunities in the job. A common measure of talent is education level (Kreps, 1990, Chapter 17).

them as regressors in a system of equation; one needs instruments of these variables to obtain consistent parameter estimates. Typically, one uses a two-stage least-squares approach. The first stage creates predictors for the endogenous variables. The second stage uses these predictors in an OLS regression.

Since equations (1) – (3) are exactly identified, the instrument for each endogenous variable is its identifying exogenous variable. Unfortunately, the identifying exogenous variables are poor --- the correlations between the endogenous variables and the corresponding identifying exogenous variables are insignificant at the 10 percent two-tailed level. Thus the predictors of the endogenous variables using a standard two-stage least squares will be weak. The unavailability of good predictors for the second stage of the two-stage least squares technique has been a major reason for the lack of simultaneous models in accounting research.[20]

To address this problem, I modify a technique recently developed in the econometric literature for obtaining consistent estimates when the independent variables in a regression have measurement errors and no exogenous instruments are available (Lewbel, 1997). Under the assumption that the third moments of the error terms are zero (true for any symmetric distribution of the error term), and the endogenous variables are skewed with zero means, I show in Appendix B that one can regress the endogenous variables on their squares and cross products and use the predicted values in an OLS of (1) – (3) to get consistent parameter estimates.

To develop the predictors for the endogenous variables based on the technique in Appendix B, I first show that the endogenous variables are skewed. The joint multivariate skewness coefficient (see Seber, 1984, Section 4.3.2., for details) for the endogenous variables FUNCT, FEEDBACK, and REWARD is 1.96, significant at the 10 percent two-tailed level.[21]

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[20] The weakness of the identifying variables is one of the main criticisms of O'Brien and Bhushan's (1990) statistical test of the simultaneity between analyst following and institutional ownership (McNichols, 1990, p. 79).

[21] Estimating the simultaneous equations using the standard 2SLS procedure indicates that the third moments of all the three residuals are individually insignificant at 10 percent two tailed level. (I cannot use

Note that skewness can be obtained for any random variable using a suitably convex transformation. However, the organizational design variables are responses to questions constructed using standard survey techniques. The only transformation applied to these organizational design variables is standardization, which does not change their skewness.

After verifying skewness, I obtain the predictors of the endogenous variables. Centering the three endogenous variables, FUNCT, FEEDBACK, and REWARD, around their sample means, I compute their squares and cross products and regress each of the three endogenous variables on the three square and the three cross product terms. The regressions show that the predictor for FUNCT explains 6% of its variation (significant at 6%), the predictor for FEEDBACK 12% of its variation (significant at 1%), and the predictor for REWARD 33% of its variation (significant at 1%). Note that the significance of these results further supports the skewness in the organizational design variables. The proof in Appendix B shows that correlations among the organizational design choices are not sufficient to cause these regressions to be significant --- skewness is required.

5.2 Results of the Simultaneous Model

Table 3 presents the results of the OLS regressions of equations (1) – (3) while Table 4 presents the results for the simultaneous model. Evidence of simultaneity is suggested by the fact that different coefficients are significant in the two sets of regressions. In particular, the OLS regressions of equations (2) and (3) indicate that performance measurement and rewards systems determine each other, but this is no longer true in Table 4 once simultaneity is accounted for.[22]

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the residuals from the procedure in Appendix B to test the third moments of the error terms, as the residuals will be incorrect if the true third moments of the error terms are non-zero.) Thus, the skewness of the endogenous variables and the symmetry of the error terms have both been established, justifying the use of the squares and the cross products of the endogenous variables for predicting the endogenous variables.

[22] Estimation of an equation incorporating simultaneity is essentially an instrumental variable estimation

Table 4 shows that equations (1) – (3) are significant at the 1 percent level. The results indicate that costs of transferring knowledge to the top management determine the allocation of decision rights to branch managers, and both these factors determine the incentive reward system. Decision rights also determine the performance feedback given to branch managers. Thus, even after accounting for simultaneity, there is evidence to support hypotheses H1 and H2 that organizational design choices are associated with each other as well as with costs of transferring knowledge to top management.

One can interpret R^2 as the square of the correlation coefficient. The correlations in Table 2 are typically around 0.20, the square of which is 0.04. The adjusted R^2 in Table 4 are typically around 0.10, suggesting that the simultaneous model can explain organizational design choices better than simple correlations. Thus, developing and testing a simultaneous model may be justified.

The simultaneous model also indicates unidirectional causality in the organizational design choices. Allocation of decision rights to branch managers determine performance feedback and performance-based incentives, but not vice versa. However, the inference of unidirectional causality among the organizational design choices is subject to certain caveats. First, note that the simultaneous model does not incorporate all organizational design choice measures present in Table 2. Second, insignificance of various coefficients in Table 4 does not necessarily mean that the underlying causal associations do not exist. Alternative explanations are that the empirical measures of the relevant organizational design choices or their instruments are poor, leading to insignificant coefficients.

The unidirectional causality in organizational design choices is seen in the recent

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(see Appendix B). A formal test of the difference between the OLS coefficients and instrumental variable coefficients is the Hausman exogeneity test (Kennedy, 1992, p.148). This test involves conducting OLS regressions of an equation after including both the actual values and the predicted values of all the endogenous regressors. Except for equation (1), the predicted values of the endogenous regressors are jointly significant suggesting simultaneity.

Citicorp-Travelers merger. The combined firm, Citigroup, focused on the reallocation of decision rights among Citicorp's commercial bankers and Travelers' Salomon Smith Barney investment bankers before addressing compensation issues (*The New York Times*, 1998). In fact, compensation issues had still not been resolved when *The New York Times* article went to press. Senior Citigroup officials felt that task allocation was more critical; compensation issues, while crucial, could be resolved once responsibilities had been assigned.

The unidirectional causality provides extremely preliminary evidence on extensions of Jensen and Meckling's model. Jensen and Meckling's model is a static model, focusing on the level of knowledge transfer costs. It suggests that a change in knowledge transfer costs would lead to a new equilibrium in organizational design, but is silent on how a firm moves from one equilibrium to another. Williamson (1992) argues that an understanding of such transition dynamics is critical to explain the existence of firms. He argues that, in order to survive, firms must be able to transition at low costs.

One can argue that unidirectional causality leads to low transition costs. In response to changes in exogenous parameters, a firm can focus on changing organizational design components in a sequential manner.[23] In contrast, if all components determine each other, the firm would have to consider all components simultaneously --- changing one component would lead to changes in other components which, in turn, would have feedback effects on the first component. Such feedback effects could potentially increase the difficulty of designing a response to exogenous changes.[24] I wish to emphasize that these arguments are extremely

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[23] Since the simultaneous model is a cross-sectional model in levels, the issue that immediately arises is how I can interpret the results in terms of changes. I make the standard assumption that the firms in the sample are identically independently distributed. This assumption enables me to view multiple firms in my sample as one underlying firm that is facing different circumstances. In time series data, I literally have the data about the same firm in different circumstances and can directly make interpretations about changes. My point is that, under standard assumptions, I can make similar interpretations with cross-sectional data.

[24] As an analogy, consider filling the income tax form. The items in a tax form are related to each other in a sequential manner. Making changes in the tax form would be much harder if items appearing later in the form affected items appearing earlier in the form. One would have to go back and forth repeatedly instead

preliminary; more rigorous empirical tests of transition dynamics require time-series data and theoretical models of dynamic organizational design.

5.3 Robustness Checks

To address the robustness of the results in the previous sub-section, I conduct additional tests. First, I run the standard two-stage least-squares model on equations (1) through (3). In the first stage, I compute the predictors of FUNCT, FEEDBACK, and REWARD by regressing each of these measures on EDUCATE, NUMMBERGE, and UNEMP.[25] The results are weaker, but largely consistent with Section 5.2. Only equations (1) and (3) are significant at the 10 % level. Knowledge transfer costs determine functional decision rights and performance measurement. However, equation (2), the regression with performance measurement system as the dependent variable, is not significant overall. Decision rights, the performance measurement system, and knowledge transfer costs all determine the incentive reward system. Thus, the causality among the organizational design choices remains unidirectional.

Second, I add EDUCATE, FEEDBACK, and UNEMP as additional regressors while computing the predictors of the endogenous variables using the method in Appendix B. This addition does not change the results of the simultaneous model from Section 5.2. Thus, the result that causality in organization design choices runs from decision rights to reward systems appears to be robust.

6. Conclusions

This study tests the main predictions of Jensen and Meckling's (1992) theory on

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of proceeding sequentially.

[25] I do not use KNOWCOST as a regressor in the first stage because the predictors of FUNCT, FEEDBACK, and REWARD become extremely correlated with KNOWCOST, creating multicollinearity interpretation problems for the second stage. Note that the results from the two-stage least-squares method remain consistent even if one does not use KNOWCOST in the first stage.

organizational design in the retail banking industry. It is worth noting that Jensen and Meckling's model is representative of current economic thinking about organizational design, being consistent with the exposition of organizational design in various textbooks such as Milgrom and Roberts (1992) and Brickley, Smith, and Zimmerman (1996). I find some evidence to support Jensen and Meckling's hypotheses that a) the allocation of decision rights to branch managers is associated with control systems that measure performance and reward branch managers based on these performance measures, and b) these decision rights and control systems are associated with the costs of transferring knowledge from the branch managers to the top management. Using correlations, I find that banks awarding more functional rights to branch managers also provide them with more feedback. While the association between the extent of functional decision rights and the performance measurement system is positive, it is insignificant. I also find that banks with high knowledge transfer costs award more functional and financial decisions to branch managers, make greater use of performance measurement and feedback, and are more likely have promotions and pay-for-performance incentive schemes as reward systems.

Since correlations among organizational design choices are biased and misspecified if firms make organizational design choices simultaneously, I estimate a simultaneous equation model to examine the associations among these choices. I find that, even after accounting for simultaneity, functional decision rights, performance feedback, and incentive-based pay are associated.

While there are case-oriented studies investigating the interrelations among knowledge transfer costs, decision rights allocation, and measurement and reward systems (Baker and Wruck, 1989; Miller and O'Leary 1997), this is one of the first papers to examine the issue in an empirical framework. However, the results in this study are subject to the limitations in measuring organizational design constructs. While I have tried to stay close to Jensen and Meckling's interpretations of their constructs and have shown that my measures are comparable

with those used in prior accounting research, more can be done in future research to improve these measures.

Finally, having tested Jensen and Meckling's hypotheses, this study points out some directions for extending their theory. Jensen and Meckling's model is static, focusing on the level of knowledge transfer costs. The transition dynamics through which organizations respond to changes in knowledge transfer costs is not well understood. In all likelihood, such an examination would require dynamic models of organizational design, the investigation of which is left to future research.

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Appendix A: Variable Definitions

Notes:

1. Whenever measures are standardized, they are standardized to zero mean and unit variance.
2. Some WFIC survey items are reverse coded, i.e, the highest value on that item has a survey response of one. These items are reversed for statistical analyses.
3. All the financial measures are obtained from the call reports that banks file with the FDIC on a quarterly basis.

Decision Rights

FUNCT:

Standardized average of the following questions:

(Questionnaire to the head office of the retail bank, Group A and Group B banks,

Scale: 1. Branch decides, senior management has no say.
2. Branch decides, senior management provides advice but no more.
3. Branch decides, senior management influences the decision.
4. Both senior management and branch must approve the decision.
5. Senior management decides, the branch influences the decision.
6. Senior management decides, the branch provides advice but no more.
7. Senior management decides, the branch has no say.)

The extent to which branch managers have a say in:

2. Tellers hired to work in the branch.
2. Promotions within the branch.
2. Hours the branch is open.
2. Changing the process for selling a new investment product.

FINAN:

(Questionnaire to the branch manager of the head branch office of the retail bank, Group A and Group B banks. Scale: Yes/No, coded1/0)

2. At the point of sale, can you, as branch manager, change rates for small business loan?

BUDGET:

(Questionnaire to the chief financial officer of the retail bank, Group A banks only.)

What is the maximum expenditure limit for the branch manager that requires no authorization when the expenditure is within budgetary limit?

(BUDGET is the log of the response, and is zero if the response is zero).

Performance Measurement System

PERF:

Standardized average of the following questions:

(Questionnaires to the chief financial officer of the retail bank and the director of marketing, Group A banks only.

Scale: 1. Daily, 2. Weekly, 3. Monthly, 4. Quarterly, 5. Semi-annually, 6. Annually, 7. Not reported)

How often is the following information reported to senior retail banking executives on a formal basis

2. Branch profitability

2. Customer acquisition

(Questionnaire to the chief financial officer of the retail bank, Group A banks only.
Scale: Allocated / Not determined)
1. Is revenue allocated to determine the profitability of the branch?
(This question is correlated at 100 % with cost allocation to determine the profitability of the branch.)

Feedback Mechanisms
FEEDBACK:
Standardized average of the following questions:
(Questionnaire to the branch manager of the head branch of the retail bank, Groups A and B)
Which describes best how often you, the branch manager, receive the following information
(Scale: 1. Weekly or more often
2. Monthly or more often
3. Quarterly
4. Annually
5. Not received)
1. Financial performance of the branch
2. Sales information of the branch

(Questionnaire to the head office of the retail bank, Groups A and B
Scale: 1. None of them
2. Almost none
3. Less than half
4. About half
5. More than half
6. Almost all
7. All of them)
3. Share of all branch managers participated in internal focus groups / task forces --- employee involvement programs that come together to address a specific issue --- in 1994.

Reward Systems
PAYWORK:
Standardized average of the following questions:
(Questionnaire to the chief financial officer of the retail bank, Group A and B banks. Scale Yes/No, coded 1/0)
Elements of branch manager compensation:
1. Pay based on the performance of the branch.
2. Pay based directly on sales and referrals.
3. Pay based on other individual performance measures.

ATRISK:
(Questionnaire to the head office of the retail bank. Group A and B banks.
Scale: 0 = 0%, 2 = 1-6%, 3 = 7-10%, 4 = 11-15%, 5 = 16-20%, 6 = 21-25%, 7 = greater than 25%.)
1. For the typical branch manager, what percentage of annual pay is bonus or variable?

REWARD = ATRISK * (1 + PAYWORK).

PAYWORK can be zero and can completely wipe out the effect of ATRISK. Thus 1 is added to PAYWORK.

PROMOTE:
(Questionnaire to the head office of the retail bank, Group A and B banks.)
What percentage of branch managers were promoted to another branch, or to a job other than branch manager in 1994?

Costs of Transferring Knowledge to the Top Management
INNOV:
Standardized average of the following questions:
(Questionnaire to the head office of the retail bank, Groups A and B
Scale: 1 = Strongly disagree, 2 = Disagree, 3 = Neither, 4 = Agree, 5 = Strongly Agree)

1. We are innovative in the way we design and deliver products/services.
2. We are innovative in the terms of new services offered.
3. We try to be first in with alternative distribution channels/concepts.

DEPENV:
Absolute value of the median annual growth in insured deposits in 1994 of all the banks in the given bank's Fed district.

HERF:
The Herfindahl index of the banks operating in the Fed district of the given bank. Market share is calculated using the percentage of insured deposits (Tirole, 1988, p.221).

SIZE:
Log of the insured deposits of the bank.

KNOWCOST:
The standardized average of INNOV, SIZE, HERF, and DEPENV.

Exogenous Variables for the Simultaneous Equations
EDUCATE:
(Questionnaire to the branch manager of the head branch of the retail bank, Groups A and B)
The level of education:
1. Completed high school
2. Some college
3. College degree
4. Some graduate
5. Graduate degree

NUMMERGE:
Number of mergers the bank completed in 1994. Each merger is coded by size. A merger increasing the total assets by < 25% is coded 1, > 25% is coded as 2.
I use a rank variable as it is not clear that the size of the merger affects the frequency of measurement linearly.

UNEMP:
Unemployment level in 1994 in the state where the bank is chartered.

Appendix B: Using squares of endogenous variables as instruments

This Appendix provides a simple proof of the consistency of regression estimates using squares of the endogenous variables as instruments. Lewbel (1997) has a detailed explanation of the method, but he discusses only the case of measurement error. I extend his method to simultaneous equations.

Consider the regression (i stands for the i^{th} observation):

$$y_i = a_1 + a_2 x_i + \varepsilon_i$$

Assume that x_i is associated with ε_i linearly. This happens in the case of simultaneous linear equations, additive measurement error, omitted (linearly) correlated variables, etc. One can write x_i as:

$$x_i = z_i + b\varepsilon_i$$

where z_i is independent of ε_i.

The OLS estimator is inconsistent in this case and an instrument is required to estimate the coefficient. One can show that, under the following conditions, the predictor of x_i on x_i^2 can be used as an instrument:

1. x_i are i.i.d. This is not a critical assumption, but eases the consistency proof.

2. x_i has zero mean. If not, rescale x_i by subtracting the sample mean. The proof will hold as the sample mean will converge to the true mean in large samples (assumption 1), and the rescaled x_i will have zero mean.

3. $E\varepsilon_i^3 = 0$. The OLS already assumes that $E\varepsilon_i = 0$. Thus, any symmetric distribution of ε_i will satisfy this assumption.

4. *x_i is skewed, i.e.,* $Ex_i^3 \neq 0$. This implies x_i and x_i^2 are correlated.

If assumptions 1 through 3 are true, then it is easy to show that x_i^2 is uncorrelated with ε_i.

$$Cov(x_i^2, \varepsilon_i) = E(x_i^2\varepsilon_i) = E(z_i^2\varepsilon_i + 2bz_i\varepsilon_i^2 + b^2\varepsilon_i^3)$$

Since x_i and ε_i have zero means, so does z_i. Further, z_i and ε_i are independent. All the terms in the previous equation are zero. Thus x_i^2 is correlated with x_i (assumption 4), but not with ε_i.

Let $\hat{x}_i$ be the predictor of the regression of x_i on x_i^2 and a constant. Regressing y_i on $\hat{x}_i$ yields a consistent estimator of a_2 where $y_i = a_1 + a_2 x_i + \varepsilon_i$, i.e., there is no need to use an instrumental variable regression to get a consistent estimate of a_2 (Greene, 1993, Chapter 20).

The intuition is as follows. Note that while $\hat{x}_i$ is an instrument for x_i, it is also a predictor of x_i, i.e.,

$$x_i = \hat{x}_i + e_i$$

By construction, e_i and $\hat{x}_i$ are orthogonal: $(1/n)\sum(x_i \hat{x}_i) = (1/n)\sum([\hat{x}_i + e_i].\hat{x}_i) = (1/n)\sum(\hat{x}_i \hat{x}_i)$. Thus, the instrumental variables regression and a regression of y_i on $\hat{x}_i$ both yield the same result:

$$lim_{n \to \infty} \quad \frac{(1/n)\sum(y_i \hat{x}_i)}{(1/n)\sum(x_i \hat{x}_i)} = \frac{(1/n)\sum(y_i \hat{x}_i)}{(1/n)\sum(\hat{x}_i \hat{x}_i)} = a_2.$$ [26]

If x_i is multidimensional and each dimension follows assumption 1 through 3, it is easy to show that not only are the squares of each dimension uncorrelated with ε_i, but also all the cross products of any two dimensions. Further, if x_i is skewed, each dimension will be correlated with the squares and the cross products of all the dimensions. Thus the squares and the cross products of all the dimensions can be used as instruments.[27]

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[26] Since $y_i = a_1 + a_2 x_i + \varepsilon_i$, the relation between y_i and $\hat{x}_i$ is as follows:

$$y_i = a_1 + a_2 \hat{x}_i + (\varepsilon_i + a_2 e_i)$$

An OLS regression of y_i on $\hat{x}_i$ will estimate the above equation. Note the standard error in the OLS regression will be the standard error of $(\varepsilon_i + a_2 e_i)$. Using this standard error is legitimate in the estimation of a_2 because $y_i = a_1 + a_2 \hat{x}_i + (\varepsilon_i + a_2 e_i)$ is a legitimate equation in its own right.

[27] Correlation among the dimensions in itself will not cause the regression of a dimension on the squares and cross product terms of all the dimensions to be significant. Skewness is required. For instance, assume

x is bivariate normal (no skewness) with dimensions $d1$ and $d2$. If $d1$ and $d2$ are correlated, $d2$ can be written as $d2 = d1 + q$, where q is a normal variable independent of $d1$. Since all the variables are zero mean, it can be easily shown that

$$COV(d1, d1*d1) = E(d1 * d1 * d1) = 0$$
$$COV(d1, d1 * d2) = E(d1 * d1 * (d1 + q)) = 0$$
$$COV(d1, d2 * d2) = E(d1 * (d1 + q) * (d1 + q)) = 0$$

Thus, each dimension is uncorrelated with the squares and cross products of the dimensions.

Table 1. Means and Standard Deviations of the Measures
(The detailed descriptions of the measures are in Appendix A)

Variable	Mean	Std. Dev
Decision Rights Measures		
FUNCT components		
Tellers hired to work in the branch.	2.61	1.57
Promotions within the branch.	3.53	1.18
Hours the branch is open.	4.80	1.08
Changing the process for selling a new investment product.	5.94	1.00
FINAN	0.53	0.50
BUDGET	6.15	3.03
Performance Measures		
PERF components		
Frequency with which the following information is reported to top management		
1. Branch profitability	3.97	1.37
2. Customer acquisition	3.84	1.62
Are revenues and costs allocated to determine the profitability of the branch?	0.97	0.15
FEEDBACK components		
Frequency with which the following information is reported to branch management		
1. Financial performance of the branch	2.50	0.69
2. Sales information of the branch	2.63	1.08
Share of all branch managers participated in internal focus groups	4.18	1.60
Reward System Measures		
REWARD components		
PAYWORK		
Pay based on the performance of the branch.	0.85	0.35
2. Pay based directly on sales and referrals.	0.46	0.50
3. Pay based on other individual performance measures.	0.72	0.45
ATRISK	2.97	1.34
PROMOTE	15.71%	11.77
Knowledge Transfer Cost Measures		
INNOV components		
1. We are innovative in the way we design and deliver products/services.	3.37	1.00
2. We are innovative in the number of new services offered.	3.15	0.96
3. We try to be first in with alternative distribution channels/concepts.	2.55	1.07
DEPENV	3.16%	0.95
HERF	0.02	0.01
SIZE	14.17	1.33
Exogenous Variables		
EDUCATE	2.89	1.09
NUMMERGE	0.56	0.83
UNEMP	5.87%	0.99

Table 2. Pearson Correlation Coefficients among Decision Rights, Performance Measurement Systems, Reward Systems, and Costs of Transferring Knowledge to Top Management in the Retail Banking Industry

	Decision Rights			Performance Measurement Systems		Reward Systems	
	FUNCT	*FINAN*	*BUDGET*	*PERF*	*FEEDBACK*	*REWARD*	*PROMOTE*
FINAN	0.03						
n	99						
BUDGET	0.22	-0.03					
n	22	21					
PERF	0.12	0.23	0.00				
n	36	35	22				
FEEDBACK	0.20**	0.12	0.06	0.40**			
n	100	99	22	36			
REWARD	0.22**	0.11	0.28	0.39**	0.25**		
n	100	99	22	36	100		
PROMOTE	0.20**	0.02	0.07	0.13	-0.01	0.07	
n	100	100	22	36	100	100	
KNOWCOST	0.31***	0.18*	0.26	0.45***	0.22**	0.26***	0.26***
n	100	99	22	36	100	100	100

*, **, *** denote two-tailed significance at 10%, 5%, and 1%, respectively.
FUNCT is the extent of functional authority provided to branch managers; *FINAN* is the branch manager's authority to change prices. *BUDGET* measures the branch manager's discretionary expenditure limit. *PERF* measures the existence of branch performance measurement systems, and the extent to which top management uses these systems. *FEEDBACK* is the amount of feedback given to branch managers about their performance. *REWARD* is sensitivity of the branch manager's pay to performance. *PROMOTE* measures the extent to which promotions are used as a reward for performance. *KNOWCOST* is the cost of transferring knowledge held by the branch manager to the top management.

Table 3. Equation-by-equation OLS of the Simultaneous Model of Functional Rights Given to Branch Managers, Performance Feedback, and Incentive-based Pay in the Retail Banking Industry

Dependent Variable	*FUNCT*	*FEEDBACK*	*REWARD*
Regressors	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)
INTERCEPT	0.27	-0.11	0.26
	(0.93)	(-1.02)	(0.45)
FUNCT		0.16	0.12
		(1.56)	(1.24)
FEEDBACK	0.12		0.18*
	(1.15)		(1.84)
REWARD	0.14	0.20**	
	(1.30)	(2.05)	
KNOWCOST	0.11***	0.04	0.08*
	(2.31)	(0.93)	(1.81)
EDUCATE	-0.09		
	(-0.98)		
NUMMERGE		0.22*	
		(1.89)	
UNEMP			-0.04
			(-0.46)
Adjusted R^2	0.10***	0.10***	0.09**
n	97	100	100

*, **, *** denote two-tailed significance at 10%, 5%, and 1%, respectively.

The simultaneous model estimated using equation-by-equation OLS is:

$$FUNCT = a_1 + a_2 FEEDBACK + a_3 REWARD + a_4 KNOWCOST + a_5 EDUCATE + \varepsilon_1$$
$$FEEDBACK = b_1 + b_2 FUNCT + b_3 REWARD + b_4 KNOWCOST + b_5 NUMMERGE + \varepsilon_2$$
$$REWARD = c_1 + c_2 FEEDBACK + c_3 FUNCT + c_4 KNOWCOST + c_5 UNEMP + \varepsilon_3$$

FUNCT is the extent of functional authority provided to branch managers. *FEEDBACK* is the amount of feedback given to branch managers about their performance. *REWARD* is sensitivity of the branch manager's pay to performance. *KNOWCOST* is the cost of transferring knowledge held by the branch manager to the top management. *EDUCATE* is the level of branch manager's education. *NUMMERGE* is the number of mergers conducted by the bank in 1994. *UNEMP* is the unemployment level in 1994 in the state where the bank is chartered.

Table 4. Simultaneous Model of Functional Rights Given to Branch Managers, Performance Feedback, and Incentive-based Pay in the Retail Banking Industry

Dependent Variable	*FUNCT*	*FEEDBACK*	*REWARD*
Regressors	Coefficient (t-statistic)	Coefficient (t-statistic)	Coefficient (t-statistic)
INTERCEPT	0.12	-0.09	-0.01
	(0.41)	(-0.86)	(-0.02)
$\overline{FUNCT}$		1.01***	1.37***
		(3.08)	(2.82)
$\overline{FEEDBACK}$	0.41		-0.57
	(1.55)		(-1.35)
$\overline{REWARD}$	0.12	-0.09	
	(0.69)	(-0.50)	
KNOWCOST	0.10**	0.05	0.09**
	(2.31)	(1.26)	(2.04)
EDUCATE	-0.04		
	(-0.42)		
NUMMERGE		0.19	
		(1.62)	
UNEMP			0.00
			(0.03)
Adjusted R^2	0.10***	0.13***	0.13***
n	97	100	100

*, **, *** denote two-tailed significance at 10%, 5%, and 1%, respectively.

The simultaneous model estimated is:

$$FUNCT = a_1 + a_2 FEEDBACK + a_3 REWARD + a_4 KNOWCOST + a_5 EDUCATE + \varepsilon_1$$
$$FEEDBACK = b_1 + b_2 FUNCT + b_3 REWARD + b_4 KNOWCOST + b_5 NUMMERGE + \varepsilon_2$$
$$REWARD = c_1 + c_2 FEEDBACK + c_3 FUNCT + c_4 KNOWCOST + c_5 UNEMP + \varepsilon_3$$

FUNCT is the extent of functional authority provided to branch managers. *FEEDBACK* is the amount of feedback given to branch managers about their performance. *REWARD* is sensitivity of the branch manager's pay to performance. *KNOWCOST* is the cost of transferring knowledge held by the branch manager to the top management. *EDUCATE* is the level of branch manager's education. *NUMMERGE* is the number of mergers conducted by the bank in 1994. *UNEMP* is the unemployment level in 1994 in the state where the bank is chartered.

$\overline{FUNCT}$, $\overline{FEEDBACK}$, and $\overline{REWARD}$ are the predictors of regressing *FUNCT, FEEDBACK,* and *REWARD* respectively on $FUNCT^2$, $FEEDBACK^2$, $REWARD^2$, *FUNCT * FEEDBACK, FUNCT * REWARD,* and *FEEDBACK * REWARD.*

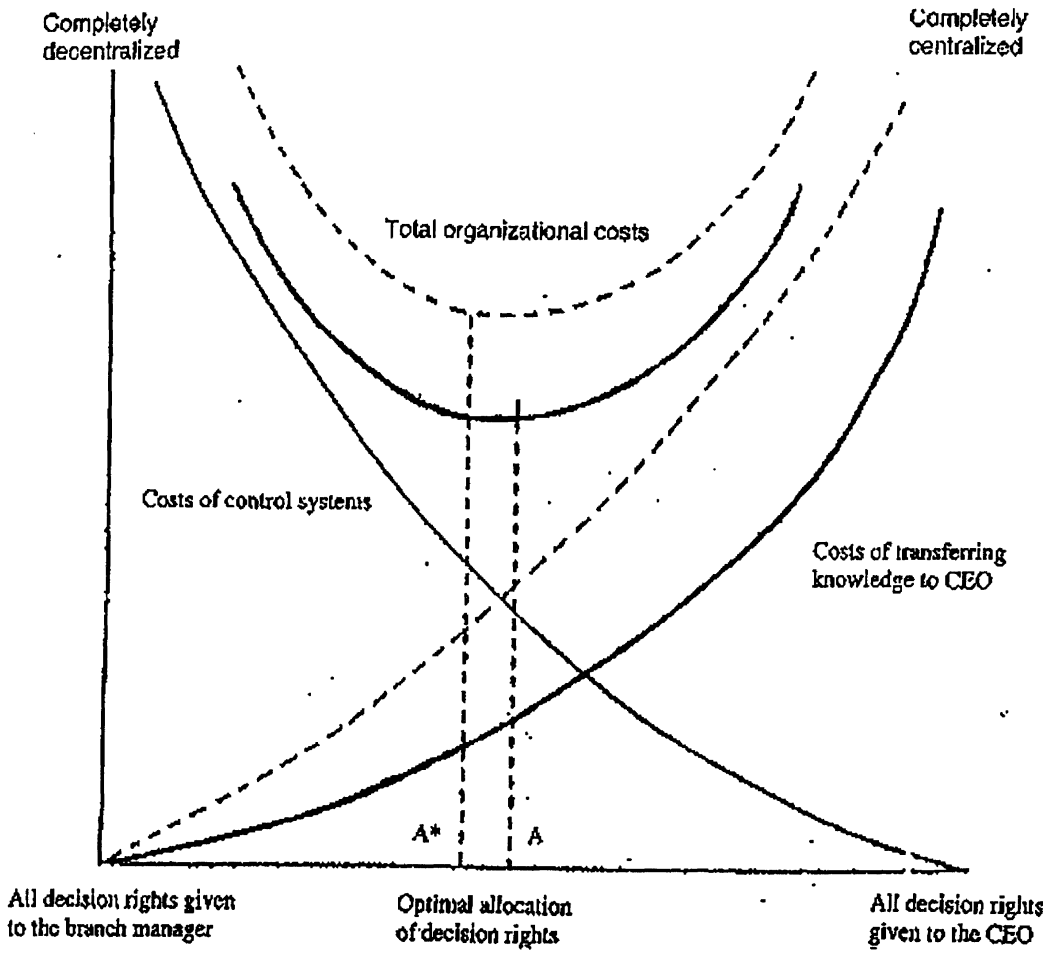

Figure 1. The costs of allocating decision rights to branch managers
(Adapted from Jensen and Meckling, 1992, p. 263)