

**THE IMPLICATIONS OF DEBT HETEROGENEITY  
FOR R&D INVESTMENT AND FIRM PERFORMANCE**

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**ABSTRACT**

Prior research assumes that debt is homogeneous and provides inappropriate governance for R&D investments. We argue that debt is heterogeneous: although transactional debt does indeed impose strict contractual constraints that provide inappropriate governance for R&D investments, relational debt has very different characteristics that provide more appropriate governance for R&D investments. Using a sample of Japanese firms we find that firms that align their debt structures with their R&D investments outperform those that are misaligned. Furthermore, firms tend to align their debt structure with R&D investments, but only after deregulation permits relatively free access to the various types of debt. (99 words.)

Investments in R&D can help to build capabilities that enhance competitive advantage (Franko, 1989), but are subject to serious exchange hazards that require strong governance safeguards (Hill & Snell, 1988). According to transaction cost economics (TCE), debt and equity are alternate governance structures for safeguarding the capital invested in a firm, with the suitability of each depending on the type of investment made by the firm (Williamson, 1988). As investments in R&D generate intangible assets that serve as poor collateral, lenders of debt are reluctant to fund such investments (Kochhar, 1996; Long & Malitz, 1985; Williamson, 1988). Furthermore, the rigidity of debt contracts can impair the financial flexibility needed to pursue a sustained program of R&D investment (O'Brien, 2003). Thus, prior research has concluded that debt provides inappropriate governance safeguards for R&D investments, and empirical tests have shown that debt and R&D intensity are negatively associated (Balakrishnan & Fox, 1993; Long & Malitz, 1985; Vincente-Lorente, 2001).

Debt is a critical source of funds for most firms, accounting for over 90 percent of all new external financing (Corbett & Jenkinson, 1997; Mayer, 1988). Likewise, strategic investment in R&D is an important use of funds for generating economic returns (Franko, 1989). Thus, the governance implications of debt for R&D investment have enormous practical significance for managerial decisions about how best to finance strategic investments. We contend that the conclusion that debt provides inappropriate governance for R&D requires reevaluation, as it implicitly assumes that debt is homogeneous. In contrast, the financial intermediation literature (see Boot, 2000 for a review) finds critical differences between private loans (*i.e.*, “relational debt”) and public securities (*i.e.*, “transactional debt”). We theorize that while the rigid contractual constraints of transactional debt are indeed inappropriate for R&D investments, relational debt is congruent with R&D investment for three reasons. First, relational lenders help

safeguard the continuity of investment in R&D by helping defaulting firms to work through liquidity problems, rather than automatically forcing them into bankruptcy. Second, they closely monitor borrowers to obtain the subjective information needed for such active intervention. Finally, as relational debt is private, it does not require public information disclosure, thus helping to limit appropriation of the proprietary knowledge from R&D by competitors.

Using TCE we first explain the differences between market and hierarchical governance, the attributes of investments that pose contractual hazards, and why hierarchy provides more appropriate governance for investments involving high contractual hazards (Williamson, 1991). We then describe the hazards associated with R&D investments and why debt has generally been regarded as providing inappropriate governance (Williamson, 1988). Finally, we draw on the financial intermediation literature (Boot, 2000) to show that debt is heterogeneous, comprising two types with divergent implications for R&D investments. Analyzing a large sample of Japanese firms over a twenty year period of deregulation, we find that firms enhance their performance by aligning their debt structures with their R&D investments. Furthermore, firms tend to align their debt structure with R&D investments over time, but only after deregulation permits relatively free access to various types of debt.

## **THEORY AND HYPOTHESES**

Investments by transacting parties are subject to hazard because bounded rationality makes it impossible to specify resolutions for all future contingencies, while opportunism makes it difficult to rely on promises to equitably resolve *ex post* disputes. Thus, governance mechanisms are needed to help transacting parties “fill gaps, correct errors, and adapt more effectively to unanticipated disturbances” (Williamson, 1988: 570). According to Williamson (1991), markets and hierarchies are alternate governance mechanisms that differ in three critical

attributes: (1) dispute resolution - markets resolve disputes by strict adherence to contractual terms that are adjudicated by courts, while hierarchies utilize forbearance law to eschew court intervention and resolve disputes internally by tempering administrative fiat with forbearance; (2) adaptation - markets rely on high-powered incentives to facilitate spontaneous adaptation while hierarchies utilize administrative mechanisms to foster intentional adaptation; (3) compliance monitoring - markets rely on relatively simple mechanisms to evaluate objective contractual criteria while hierarchies utilize more elaborate monitoring of subjective criteria.

The choice of governance mechanism is shaped by the extent to which investments by transacting parties are subject to three types of hazards: (1) asset specificity - the extent to which investments lose value when redeployed to alternate uses; (2) uncertainty about the states of nature and the behavior of other parties; (3) appropriability of the returns arising from the transaction. When hazards are low, markets constitute the efficient governance choice. When hazards are high, however, transactions require stronger safeguards to preserve the mutual gains that arise from maintaining the continuity of exchange. Thus, although hierarchies sacrifice the high-powered incentives of markets and entail higher setup and monitoring costs, they provide stronger safeguards than markets and are therefore appropriate when hazards are high.

### **Williamson's Debt-Equity Framework**

Firms obtain a generic asset (*i.e.*, cash) from investors and in turn make strategic investments, some of which may entail significant exchange hazards. Williamson (1988) argued that debt and equity represent alternative governance mechanisms for safeguarding this capital. Financiers require safeguards to ensure that their investments provide appropriate returns, and managers require safeguards to induce them to make "hazardous" investments. As indicated by

the three attributes of dispute resolution, adaptation, and monitoring, debt and equity can be viewed as providing market and hierarchical governance, respectively.

For dispute resolution, lenders rely on court adjudication (*i.e.*, bankruptcy law) to enforce strict adherence to contracts that specify interest rates, terms of repayment, and liquidity covenants. Owners of equity, by contrast, are not guaranteed any returns contractually and must rely on the forbearance law administered by the board of directors to resolve disputes with managers. As for adaptation, debt affords considerable autonomy to managers, and relies on the high-powered incentives of the threat of bankruptcy to induce spontaneous adaptation by managers. Equity owners, by contrast, rely on the boards' exercise of administrative authority over managers to guide intentional adaptation. Finally, debt precludes the need for elaborate monitoring mechanisms as objective data are sufficient to verify conformance to payment and covenant terms. By contrast, to protect their investment, equity owners use an elaborate monitoring mechanism (the board of directors), which encompasses subjective criteria.

### **Hazards Associated with R&D and the Inappropriateness of Debt**

**Asset specificity.** Investments in R&D create knowledge-based intangible assets that have greatest value when utilized in conjunction with the firm's complementary assets (Helfat, 1994). As these investments lose considerable value if bankruptcy forces redeployment outside the firm, they do not serve as good collateral for lenders (Long & Malitz, 1985). Furthermore, the necessity to meet payment terms can reduce financial flexibility and the possibility of unanticipated liquidity problems can induce managers to curtail ongoing R&D programs (O'Brien, 2003), thereby disrupting the continuity of R&D investment that is vital for the accumulation and absorption of knowledge (Dierickx & Cool, 1989).

**Uncertainty.** Evaluating the efficacy of R&D investments is difficult because of the considerable time lag between investment and payoff (Lavery, 1996), and the many external factors and events during the interim that can affect ultimate payoffs (Hill & Snell, 1988). Evaluation criteria also involve highly qualitative judgments, including: the probability of success; congruence with current technologies; fit with other ongoing projects; strategic importance of the project to the firm (Osawa & Murakami, 2002); and indirect or spillover benefits (Oral, Kettani, & Lang, 1991). This uncertainty results in acute hazards from potential adverse selection (the borrowers most likely to be credit risks are the ones most likely to seek financing) and moral hazard (after borrowers obtain financing they may take actions to shift risks onto lenders). Overcoming these problems requires detailed qualitative and subjective information. The elaborate subjective monitoring by boards of directors (Baysinger & Hoskisson, 1990) provides owners the strong safeguards required to resolve the problems of adverse selection and moral hazard, while simple objective monitoring by lenders does not.

**Appropriability.** The returns to investments in R&D are subject to weak appropriability, as the leakage of information about a firm's R&D programs can lead to imitation by competitors (Teece, 1986). Even legal safeguards such as patents are often ineffective, as competitors are often able to engineer around the patents (Levin, Klevorick, Nelson, & Winter, 1987). Equity owners can monitor investments in R&D via the board, a body that can generally be entrusted to protect critical strategic information from leakage. However, providing assurance to lenders that the firm is making appropriate investments in R&D would require the public disclosure of detailed data on the projects, which would necessarily weaken the appropriability regime and erode managers' motivation to make such investments (Bhattacharya & Chiesa, 1995).

Thus, notwithstanding the stronger incentives and lower monitoring and administrative costs, debt fails to provide adequate safeguards for the exchange hazards posed by R&D. Empirical evidence supports the contention that firms that invest heavily in R&D eschew debt and favor equity financing (Balakrishnan & Fox, 1993; O'Brien, 2003; Vincente-Lorente, 2001).

### **The Heterogeneity of Debt**

Although TCE sheds considerable light on the link between strategy and capital structure, an important gap remains. So far, we have followed previous work on this topic by treating debt as homogenous, corresponding to the description offered by Williamson (1988). All debt contracts share several common characteristics, such as contractually specified repayment terms and covenants, and the threat of bankruptcy in the event of default. However, the financial intermediation literature has shown that debt is heterogeneous (we draw extensively from a comprehensive review by Boot, 2000). Consistent with the terminology used in the theory of contracts (Macneil, 1974; Rousseau, 1995), we classify debt contracts into two types: transactional debt entails simple performance attributes and a fixed time frame; while relational debt entails extended duration and complex performance attributes.

Bonds and commercial paper are issued in specific monetary denominations and sold to individuals and institutions in arms' length capital markets. For holders of these debt securities, the performance attribute is simple: the direct returns available from holding the securities. The time frame of contract duration is fixed by the maturity of the securities issue, and in practice even shorter as these securities can generally be readily traded in active secondary markets (Boot, 2000). Bonds are classified as transactional because they involve simple performance criteria and fixed time horizon. In contrast to bonds, loans are private transactions between the firm and financial intermediaries such as banks and insurance companies. These transactions are

typically part of a long-term relationship wherein the lenders generally rollover the loans and also provide additional business services such as letters of credit, check clearance, and cash management services. The performance criteria employed by the lenders are complex, considering the multiple sources of potential returns, and of extended duration as the relationship may continue indefinitely. Loans are therefore considered relational debt. Using the three attributes of governance mechanisms (*i.e.*, dispute resolution, adaptation, and monitoring), we explain why transactional debt provides market governance similar to Williamson's (1988) description of debt, while relational debt is more aptly characterized as hierarchical governance.

**Dispute Resolution.** Transactional lenders consider only the direct returns from debt, and thus adhere strictly to contract law by committing to liquidate borrowers in the event of default. Relational lenders, in contrast, consider the indefinite duration of the multiple sources of revenue from the borrower, and thus are motivated to employ forbearance and help struggling clients by renegotiating or relaxing loan terms and providing additional funds (Boot, 2000). Exercising forbearance may also help attract new clients by enhancing the bank's reputation (Chemmanur & Fulghieri, 1994). Furthermore, debt renegotiation is feasible for relational lenders because it requires agreement from a relatively small number of concentrated lenders (Gorton & Kahn, 2000). In contrast, transactional lenders have neither the motivation to be forbearing (they lack multiple business ties with the firm), nor the ability (renegotiation is infeasible because transactional debt is generally diffusely held). Empirical evidence supports the premise that relational lenders exercise forbearance, as financially distressed firms that rely on relational debt are more likely to both continue to make strategic investments (Hoshi, Kashyap, & Scharfstein, 1990) and to successfully restructure and avoid bankruptcy (Gilson, John, & Lang, 1990).

**Adaptation.** As relational lenders often exercise forbearance to work out problems, they cannot rely on high-powered incentives (*i.e.*, the threat of bankruptcy) to induce borrowers to spontaneously adapt to changing circumstance, and must therefore employ administrative mechanisms for intentional adaptation. Relational lenders gain administrative control in two ways. First, they often obtain board representation (Kaplan & Minton, 1994). Second, *de facto* administrative control is obtained through a combination of tight covenants and selective enforcement. Relational debt contracts have more stringent covenants than transactional debt (Smith & Warner, 1979). By selectively enforcing covenant violations and threatening borrowers with default, relational lenders can force renegotiation and thereby effectively gain a measure of administrative control (Berlin & Mester, 1992). Renegotiation after covenant violation allows banks to actively intervene in the firm's operations by imposing demands such as the liquidation of specific projects and the redirection of strategic investments (Gorton & Kahn, 2000).

**Monitoring.** The exercise of forbearance and administrative control requires access to detailed subjective information. Banks accumulate proprietary information on client firms through their "multiple interactions with the same customer over time across products" (Boot, 2000: 10). Also, banks often obtain seats on the board of directors (Kaplan & Minton, 1994), thus bolstering their access to proprietary information. Relational lenders are therefore better able to evaluate both the firm's ongoing projects and its financial position. Finally, not only do relational lenders have access to more detailed and subjective information, they have the motivation to gather it. Monitoring entails gathering specific information on clients, and relational lenders can amortize these sunk costs of over both an extended time horizon and over multiple business relationships. In contrast, transactional debt tends to be diffusely held, and thus lenders lack the scale economies that would justify elaborate monitoring. Accordingly,

transactional lenders rely solely on monitoring of objective criteria that demonstrate conformance with debt terms.

In summary, relational and transactional debt employ different forms of governance. Transactional debt utilizes market governance by relying on rigid contractual terms, utilizing high-powered incentives based on a credible threat of bankruptcy, and verifying conformance by monitoring objective data. These characteristics are essentially those offered by Williamson (1988) to describe debt in general. Relational debt, however, is quite different in that it utilizes hierarchical governance by exercising forbearance in response to financial shortfalls, employing administrative controls, and monitoring subjective performance criteria. Furthermore, these three attributes dovetail and reinforce each other. For relational debt, the monitoring of detailed subjective information makes it feasible to exercise administrative control, and administrative control in turn provides access to additional subjective information. Similarly, relational lenders would not display forbearance unless they had both subjective information to evaluate the firm's long term prospects and the administrative controls necessary to influence investment patterns.

Whereas transactional lenders can verify compliance by objective financial criteria and intervene only in the event of default, relational lenders must utilize elaborate and therefore costly administrative and monitoring mechanisms. Furthermore, the propensity for relational lenders to exercise forbearance instead of forcing liquidation attenuates high-powered incentives. Whether or not these additional costs of hierarchical governance are warranted depends on the extent of contracting hazards associated with investments in the firm. Although some studies have explored differences between relational and transactional debt (Anderson & Makhija, 1999; Kang & Stulz, 2000), prior work has not addressed the governance implications of such

differences for R&D investments. Below, we explain how relational debt appropriately governs the high transaction hazards associated with R&D, while transactional debt is inappropriate.

### **R&D and Type of Debt**

**Asset Specificity.** We have noted that the asset specificity of R&D undermines both lender proclivity to fund R&D and managerial incentives to invest in R&D. Relational debt is better suited to governing investments in R&D because, unlike transactional debt, lenders can respond to unexpected disturbances with forbearance and help the firm work through difficulties. Thus, the low liquidation value of R&D investments is not as serious a concern for relational lenders as they can be forbearing and help the firm through liquidity problems, thus preserving the value of R&D investments. Furthermore, the likelihood of forbearance helps protect managerial incentives to maintain the continuity of investment in R&D, which are critical to realizing the benefits from the R&D program (Dierickx & Cool, 1989).

**Uncertainty.** Elaborate monitoring by relational debt reduces information asymmetries and thus helps to alleviate the exchange hazards of investments in R&D that arise from uncertainty. Due to the multiple business relationships and indefinite duration of the relationship, banks generally monitor a client before a loan is issued, while the loan is ongoing, and after the loan is repaid (Aoki & Patrick, 1994), thereby alleviating adverse selection and moral hazard problems. Furthermore, relational lenders' in-depth knowledge, in conjunction with the *de facto* administrative control that they gain over the firm's investment activities, enables them to attenuate the moral hazard problem by potentially intervening and redirecting strategic investments in response to unforeseen contingencies.

**Appropriability.** As transactional debt is purchased and traded in public markets, it necessitates public disclosure of information. Relational debt, however, is a private transaction

between the firm and the lender and does not require public disclosure, thus helping safeguard proprietary information about R&D from leakage. Therefore, relational debt provides stronger appropriability safeguards for investments in R&D (Bhattacharya & Chiesa, 1995).

Misalignment between debt structure and R&D can impose unnecessary costs, distort incentives, and impair firm performance. Low R&D firms are appropriately governed by the high-powered incentives and less invasive administrative and monitoring mechanisms of transactional debt. These firms do not need strong safeguards and would incur unnecessary transaction costs by utilizing relational debt. Conversely, R&D intense firms incur higher exchange hazards and require stronger safeguards. Although relational debt entails weaker performance incentives and higher monitoring and administrative costs, it provides the stronger governance safeguards necessary for R&D intensive firms. Furthermore, the rigidity of transactional debt can cause disruption to R&D programs or delay new products launches when cash shortfalls are experienced (O'Brien, 2003). Even during good times, the anticipation that transactional lenders are unlikely to provide forbearance in the event of a downturn can undermine managerial commitment to risky long-term R&D projects. Additionally, keeping transactional lenders abreast of strategic initiatives would raise the risks of information leakage.

Prior research has demonstrated that misalignment between governance and strategic investments impairs performance in numerous contexts, such as the trucking industry (Nickerson & Silverman, 2003; Silverman, Nickerson, & Freeman, 1997), strategic alliances (Sampson, 2004), and international entry modes (Brouthers, 2002). Therefore, *ceteris paribus*, firms that deviate from the prescription of our theoretical model should experience performance shortfalls.

***Hypothesis 1: There is a positive interaction between R&D intensity and the ratio of relational debt to total debt with respect to their impact on performance.***

As the failure to align governance structures with strategic investments leads to performance shortfalls, the pursuit of improved performance should induce most managers to eventually learn from their environment and their own actions and adopt appropriate governance structures. Even if managers fail to learn, governance mistakes will eventually be “corrected” by either replacement of the managers or by the failure of inefficient firms (Williamson, 1985). Thus, competitive pressures should generally drive firms to adopt appropriate governance structures. The alignment of governance mechanisms with strategic investments predicted by TCE must, however, be qualified by an important practical consideration. Access to various types of debt can be affected by government regulations (Hoshi & Kashyap, 2001), and firms cannot adopt appropriate governance mechanisms if regulations constrain choice. Alignment is possible only if regulations permit firms to freely select their debt structures. Accordingly, we predict that controlling for total debt, firms that are free to choose their debt structures will rely more heavily on relational debt (versus transactional debt) as R&D intensity increases.

*Hypothesis 2: When firms can freely select their debt structures, R&D intensity will be positively associated with the ratio of relational debt to total debt.*

## METHODS

### Study Context

An empirical test of our theory requires a sample of firms that has access to both relational and transactional debt. Firms in many nations lack access to both forms of debt. In the U.S., the restrictions imposed by the Glass-Steagall Banking Act of 1933 severely curtailed the close bank-firm ties that make relationship banking feasible (Carosso, 1970). Although relationship banking is still common for small firms, large public corporations in the U.S. rely largely on transactional debt (Allen & Gale, 2000). In contrast, relational debt from banks is a

critical source of external financing in most other developed countries such as Japan, Germany, and France (Allen & Gale, 2000). Japan provides a particularly useful context for our study because it has a longstanding tradition of relationship banking and, following deregulation in the 1980s and 1990s, a readily accessible transactional debt market. Furthermore, Nickerson and Silverman (2003) point out, deregulatory shocks provide a useful testing context for contrasting alignment patterns before deregulation (when free access to governance choices is unavailable) and after deregulation (when firms have access to alternate governance choices).

As most of the published work on corporate governance uses samples of U.S. corporations, we provide a brief overview of corporate governance in Japan, with an emphasis on debt (for a comprehensive treatment see Hoshi & Kashyap, 2001). A major difference from U.S. firms is that Japanese firms tend to have close inter-corporate ties and place considerable emphasis on implicit contracts founded on mutual trust (Abegglen & Stalk, 1985; Gerlach, 1992). Stable lender ties, termed a “main bank system” are a distinguishing feature of Japanese corporate governance (Aoki & Patrick, 1994 provides a comprehensive overview). Most firms borrow from multiple banks but maintain a lending relationship with a main bank, while most banks operate as a main bank for at least some companies. In a risk-diversifying reciprocal arrangement, the main bank serves as the lead monitor of a *de facto* syndicate of other banks that are subordinate lenders. For other clients, this bank will likely be a subordinate lender and part of a syndicate that delegates monitoring to another main bank. Firms maintain settlement and payment accounts with main banks, and monitoring of such accounts provides banks subjective knowledge about the firm’s operational situation. Banks also often provide their clients valuable services related to mergers, acquisitions, divestitures, and strategic alliances. Senior bank

employees commonly join the boards of firms, providing banks both information and influence. When firms default, the main bank takes the lead in organizing a rescue.

As Hoshi & Kashyap (2001) explain, Japanese capital markets were historically highly regulated and firms relied almost exclusively on relational lenders for debt. Then, in 1979, a long period of gradual deregulation began, culminating in 1996 when all bond issuing criteria were abolished. Some of the important events in the deregulatory process were the clarification of overseas issuance criteria in 1982, and significant easing of issuance criteria that occurred in the mid 1980s, in 1990, and again in 1992. As illustrated in Panel A of Figure 1, our data shows that transactional debt accounted for less than 10% of all debt for the average firm until 1982, when it suddenly began to climb sharply to a peak of near 40% in the early 1990's. Panel B of Figure 1 illustrates the differing patterns in transactional debt for small versus large firms (based on a median split on total assets). While transactional debt for large firms peaked in 1989, it did not peak for smaller firms until 1994. Overall, these data suggest that very few firms could access transactional debt before 1982, and that most firms could likely readily access it following the 1992 easing of issuance restrictions. Accordingly, in our empirical analyses, we distinguish between early (1982-1992) and late (1993-2001) deregulatory periods, with that later period corresponding to relatively free access to the different types of debt.

**Sample.** Our sample began with all public Japanese firms listed in the Pacific-Basin Capital Markets (PACAP) database between the years 1982 and 2002. As market value information was missing for almost 90% of the observations for 2002, we dropped that year from the analysis out of concerns over possible bias. This left 2111 firms and 33,714 firm/year observations. We excluded firms in the highly regulated financial, public utilities, and communications sectors (about 900 observations). We also dropped approximately 3300

observations for which the market value of equity was missing and approximately 1800 observations for which the value of debt was zero. Finally, we deleted approximately 2600 observations that had book value of equity less than 3 billion Yen. These small firms were denied access to transactional debt prior to 1990, and may have had limited access subsequently due to the economies of scale in bond issuance and accentuated information asymmetries (see Anderson & Makhija, 1999). With occasional missing data items, the final sample encompassed 1853 firms and 24,320 firm/year observations. All variables were obtained from the PACAP database, with the exception of R&D and advertising expenses, which were obtained from the Nikkei NEEDS database.

**Dependent variables.** Following prior research (Anderson & Makhija, 1999; Hoshi, Kashyap, & Scharfstein, 1993; Wu, Sercu, & Yao, 2001), we consider all bank loans to be relational debt and all bonds to be transactional debt. As noted by Aoki and Patrick (1994), main banks lead a *de facto* lending syndicate and monitor firms on behalf of all other lenders, so it is appropriate to treat all bank loans as relational debt. The variable *relational* represents the sum of all bank loans divided by total debt, where total debt is the sum of all bank loans and all bonds outstanding. As it is problematic for a dependent variable to be bounded between 0 and 1, we transform it by taking the natural log of ( $relational / (1-relational)$ ). Before the transformation, values of 0 and 1 were replaced by 0.001 and 0.999, respectively. Results are qualitatively identical, however, if we do not transform this variable or if we use the arcsine transformation.

To proxy for performance, we use the firm's market-to-book ratio. This measure, which closely corresponds to Tobin's Q (Chung & Pruitt, 1994), is appropriate because it incorporates not just current performance but also expected future performance. This measure is calculated as the sum of total debt and the market value of equity divided by total assets. Because this

distribution was highly skewed, we construct the variable *performance* by taking the natural log of the market-to-book ratio. Results are similar if *performance* is not logged.

**Independent variable.** Our main theoretical variable of interest, *R&D*, is calculated as total research and development expenditures divided by total assets. We also controlled for other variables that may affect either the mix of debt or performance. *Total assets* is the natural log of the book value of assets, and *sales* is total firm sales (rescaled to trillions of Yen). *Sales* was not logged because we found that logging it did not improve model fit, but would have created a multicollinearity problem (as it was correlated 0.93 with logged assets). Analysis of variance inflation factors revealed that multicollinearity was not a problem in any of the models we report. Interest *coverage* is the income from operations less depreciation charges and divided by interest and discount charges. Although this variable was extremely skewed (and a poor predictor of relational), a log transformation was inappropriate because of both extreme positive and extreme negative values. Instead, the variable was transformed by replacing it with a percentile rank (scaled to be between 0 and 1) indicating each firm's interest coverage relative to all other firms.

The variable *fixed assets* is defined as net fixed assets divided by total assets. *ROA*, or return on assets, is operating income divided by total assets. *Advertising* intensity is the total advertising expenditures divided by total assets. *Volatility* assesses the instability of the firm's earnings, and is measured as the standard deviation of return on assets over the previous five years. Although all types of debt have both costs and benefits (see Harris & Raviv, 1991), our focus is on whether firm strategy influences the type of debt the firm selects, controlling for the absolute amount of debt. Hence, we control for overall firm *leverage*, which is defined as total debt divided by the market value of the firm (*i.e.*, the sum of total debt and the market value of equity). Furthermore, in our performance models, we also control for the interaction between

*R&D* and *leverage* (O'Brien, 2003). Finally, in addition to the firm level control variables described above, we also included a number of industry level control variables. For each industry, *industry performance*, *industry relational*, *industry leverage*, *industry ROA* and *industry volatility* all represent the median value for the corresponding firm level variable of all firms for which that industry is their primary industry.

### **Analysis**

Conducting our analysis presented several critical methodological considerations. First, unobserved heterogeneity is a concern because our data contains multiple observations per firm. To address this concern, we incorporate fixed firm effects in all our models. Fixed effects were deemed superior to random effects because our data encompasses virtually an entire population, rather than random draws from a population, thus undermining a key assumption of random effects (Wooldridge, 2003: 473). Finally, a Hausman test indicated that there was a significant ( $p < 0.01$ ) systematic difference in the coefficients from random effects models versus fixed effects models, indicating that fixed effects models are more appropriate.

A second methodological consideration concerns how the variable *relational* is modeled. As it may take time for firms to align their debt structures with their strategy, a dynamic panel data model that accounts for slow or partial adjustment in *relational* is required. Although including the lag of the dependent variable as a predictor variable helps account for dynamic partial adjustment of the dependent variable, it also introduces bias into the model (see Nickell, 1981). Fortunately, Bruno (2005) describes a method of correcting this bias in unbalanced dynamic panel data models employing dummy variables for [firm] fixed effects. Therefore, we employ Bruno's (2005) corrected least squares dummy variable (LSDVC) approach to model *relational*. Although all three possible methods for correcting the bias offered by Bruno yielded

similar results, we opted for the Blundell-Bond method because initial tests indicated that *relational* was highly persistent over time (see Bruno, 2004).

Finally, a third methodological consideration concerns modeling *performance*. As the market value of a firm can change rapidly in response to new information, modeling performance does not require a dynamic partial adjustment model. However, our theory predicts that the variable *R&D* will impact the firm's choice between relational and transactional debt, and that the interaction between type of debt and strategy will impact firm performance. Thus, in the performance model, both *relational* and its interaction with *R&D* are endogenously determined. If the performance models fail to include every variable that influences both the endogenous variables and the dependent variable, then the endogenous variables will be correlated with the error term and hence traditional OLS methods will suffer from omitted variables bias. Two-stage instrumental variables (IV) regression methods can be employed to eliminate this bias by first regressing the endogenous variables on all the independent variables, and then using predicted values of the endogenous variables in lieu of the observed values in the second stage when *performance* is regressed on the predictor variables.

Before performing the IV regressions, variables that can serve as valid instruments for the endogenous variables must be identified. These instruments are used, along with all the other variables in the performance equation, to produce predicted values for the endogenous variables. However, in order to avoid perfect collinearity, these instruments must be excluded from the performance equation. Thus, these variables should be strongly related to the endogenous variables but weakly related to *performance*. Although two instruments would constitute a just-identified model (given two endogenous variables), we used an overidentified model so that we could conduct a test of overidentifying restrictions (see chapter 15 of Wooldridge, 2003). This

test allows us to verify both that the instrumental variables are correctly excluded from the performance equation and that they are uncorrelated with the error term in the performance equation (*i.e.*, they are exogenous, a critical assumption of IV regressions). Exploratory regressions indicated that *industry relational* and the lag of *relational* might serve as valid instruments, and we created a third instrument by interacting *industry relational* with *R&D*. Although serial correlation can be a concern when using the lag of an endogenous variable as an instrument, the overidentification tests helped confirm that the theoretically predetermined lag of *relational* was indeed exogenous (however, creating an instrument by interacting the lag of *relational* with *R&D* would have created an endogeneity problem).

After determining the variables that were to be used as instrumental variables, and before proceeding with the analysis, we sought to verify that *relational* is indeed endogenous in the performance equation. Although IV regression methods provide improved estimates of the effect of an endogenous variable on a dependent variable, they are also less efficient as they tend to produce much larger standard errors than OLS (see chapter 15 of Wooldridge, 2003). Thus, even if a variable is theoretically endogenous, it is preferable to not model it as endogenous unless tests indicate that endogeneity induces a statistical problem. A Davidson-MacKinnon test of exogeneity confirmed that *relational* and its interaction with *R&D* did indeed jointly create a significant endogeneity problem ( $F=28.4$ ,  $p<0.01$ ). Similar tests indicated that *R&D* did not create an endogeneity problem in any of the models reported.

Finally, it should be noted that analysis of Cook's D statistics on preliminary regressions suggested that four outliers had a statistically significant impact on the performance models and thus were excluded from the analysis. Also, all models included year fixed effects (not reported) in addition to the firm fixed effects. Descriptive statistics for our sample are given in Table 1.

## RESULTS

Table 2 presents tests of Hypothesis 1. Model 1 presents a comparison model using standard fixed effects, while Models 2 through 4 utilize two-stage IV regressions with firm fixed effects. For Models 2 through 4, the Sargan overidentification test statistic was insignificant, confirming that the instrumental variables are indeed exogenous and correctly excluded from the performance equation. Furthermore, the F-statistics for the first stage regressions of these models (*i.e.*, where the predicted values for the endogenous variables were estimated; not reported) were all well above 80, indicating that the instruments jointly served as good predictors of the endogenous variables. Also, the Wald chi-square statistic was highly significant ( $p < 0.01$ ) for models 2 through 4. Finally, it is worth noting that we do not report R-squared statistics because this statistic has no natural interpretation in IV regressions. Although IV methods yield better estimates of the *ceteris paribus* effect of an endogenous variable on a dependent variable, overall model goodness-of-fit is not a consideration and may very well decline when a variable is treated as endogenous (see Wooldridge, 2003: 494-495). Accordingly, it is also inappropriate to test whether inclusion of an endogenous variable improves overall model fit.

Model 1 of Table 2 suggests that *relational* has a significant negative ( $p < 0.01$ ) main effect on performance, while the interaction with *R&D* has no impact. However, as described above, we know that both *relational* and its interaction with *R&D* are endogenous and significantly biased in this model. Model 2 shows that when endogeneity is properly accounted for, the interaction between *relational* and *R&D* is positive and significant ( $p < 0.01$ ), supporting hypothesis 1. This suggests that the governance provided by relational debt becomes more appropriate as R&D intensity increases. Models 3 and 4 further support hypothesis 1 by showing that the significant positive interaction ( $p < 0.01$ ) holds in both the early (1982-1992) and late

(1993-2001) deregulatory periods. Finally, in an unreported model, a variant of the Chow test employing interactions with time period dummies (pages 431-432 of Wooldridge, 2003) revealed that the joint influences of type of debt and R&D intensity on performance were significantly different in the late deregulatory period versus the early period ( $p < 0.01$ ).

Table 3 presents the LSDVC regressions that were used to test whether firms responded to deregulation by aligning debt structure with their R&D intensity (Hypothesis 2). Model 1, a dynamic GLS random effects GLS model which is presented for comparison purposes only, suggests that *R&D* has a significant positive influence ( $p < 0.01$ ) on *relational*. While this effect remains significant in model 2, which employs the LSDVC technique to correct for bias, the coefficient barely reached significance at a less stringent level ( $p < 0.05$ ). This result is not particularly surprising, given that the full sample window encompasses very different regulatory environments. Consistent with hypothesis 2, we find that when we divide the sample into early and late deregulatory periods, there is a strong significant positive relationship ( $p < 0.01$ ) between *R&D* and *relational* in the late deregulatory period, although not in the early period.

To assess the economic significance of our results, we use models 3 and 4 of Table 2 to produce predicted values for firm *performance*, and then convert back to market-to-book ratios. Panel A depicts the early deregulatory period, while Panel B depicts the late deregulatory period. In each panel, the x-axis plots R&D from the 10<sup>th</sup> to the 90<sup>th</sup> percentile. The lines labeled “High Relational” represent firms at the 90<sup>th</sup> percentile of *relational* (which roughly equates to complete reliance on relational debt), while the “Low Relational” line represents firms at the 10<sup>th</sup> percentile of *relational* (who rely almost entirely on transactional debt). In both periods, firms that relied primarily on relational debt experienced strong positive returns to R&D investment, while firms that relied primarily on transactional debt experienced negative returns (although the

economic impact is stronger in the later period). Furthermore, firms favoring transactional debt appreciably outperform those favoring relational debt at low levels of R&D intensity, while the converse is true at high levels of R&D intensity. This graph illustrates that the governance benefits of relational debt can exceed their costs as firm-specific investments (R&D) increase.

## **DISCUSSION**

Using transaction cost economics, we develop and test a causal model to explain why debt structure must align with R&D intensity, and the performance implications of misalignment. Analyzing a large sample of Japanese firms over a twenty year period of deregulation, we found support for our two hypotheses: 1) R&D intensive firms that relied more heavily on relational debt outperformed those that relied more heavily on transactional debt, confirming that alignment of debt structure with R&D confers performance advantages; and 2) R&D intensity is associated with higher ratios of relational debt to total debt during the later phase of deregulation, suggesting that most firms aligned their debt mix with their strategic investments once they were permitted relatively unrestricted access to the various types of debt.

Previous work exploring the relationship between R&D and capital structure has only distinguished between debt and equity, implicitly assuming that debt is a relatively simple and homogenous financial instrument. Our study challenges the accepted view by drawing on the financial intermediation literature to show that debt is a heterogeneous construct with divergent implications for R&D. While some forms of debt conform to the arm's length relationship described by Williamson (1988), other forms entail close ties and complex multifaceted relationships. By applying the core tenets of TCE to this elaborated description of debt, we reach the counterintuitive conclusion that the two forms of debt are not just subtly different, but are actually polar opposites in terms of their governance properties with respect to R&D

investments. Transactional debt employs market governance and cannot provide the strong exchange safeguards that investments in R&D require. Relational debt, however, provides the hierarchical governance that is necessary to align the interests and incentives of investors and the managers of R&D intensive firms.

The heterogeneity of debt has strong practical implications for the managers of all firms, public and private, who must make decisions about the source of financing. By assuming that debt is homogeneous, prior research would yield the incorrect conclusion that all firms with the same aggregate debt level provide comparable governance for R&D, and hence the choice of debt type is irrelevant. Our research shows, to the contrary, that failing to account for debt heterogeneity can have an economically profound impact on the returns to investments in R&D, and thus provides useful guidance on the importance of selecting the right type of debt that best aligns with the firm's strategic investments.

Theories are often influenced by the context most familiar to the theorist. As most large U.S. corporations tend to rely largely on transactional debt (Allen & Gale, 2000; Davis & Mizruchi, 1999), it is understandable why Williamson (1988) treated all debt as transactional debt. Likewise, Jensen's (1986) argument that the governance properties of debt can reduce the agency costs of free cash flow implicitly assumed that all debt was transactional. Prior empirical studies on the relationship between debt and R&D (Balakrishnan & Fox, 1993; Kochhar, 1996; Simerly & Li, 2000; Vincente-Lorente, 2001) also treat all debt as transactional. While treating all debt as transactional is not an unreasonable generalization for U.S. corporations, theories based on this simplification lack generalizability to contexts where relational debt is commonly employed. These contexts include small firms within the U.S., many of the other developed nations in the world (Allen & Gale, 2000), and even a subset of major U.S. corporations that

employ relational debt through ties with commercial banks (Mizruchi & Stearns, 1994). Our treatment of the divergent governance implications of relational and transactional debt yields a more broadly applicable theoretical framework.

Studying firms over a period marked by regulatory changes provides insights into the dynamics of the alignment of debt structure with R&D. As firms lacked free choice over their debt structures, it was not possible to align debt structure with strategic investments until deregulation was fairly advanced. Although competitive forces should induce governance alignment once deregulation permits such choice, alignment may not occur instantaneously for all firms. In fact, our finding that alignment conferred performance benefits even after deregulation actually suggests that many firms do remain misaligned. As Masten (1993) points out, competitive advantage is always relative. If all firms made the correct governance choice, then making the correct choice would not lead to a competitive advantage and there would be no observable relationship between governance and performance. Possible explanations as to why misalignment persists include organizational inertia and adjustment costs (Nickerson & Silverman, 2003), bounded rationality that results in managerial mistakes (Masten, 1993), and governance inseparability (Argyres & Liebeskind, 1999) whereby other activities performed by the firm require different governance choices that limit alignment of debt structure with R&D. More research on the dynamics and constraints to governance alignment could significantly advance both theory and practice.

More research is also warranted for disentangling the divergent views on the governance role of Japanese banks. During the 1970s and 1980s, a period when Japanese firms prospered, the close ties between Japanese banks and firms were lauded for providing superior governance (Abegglen & Stalk, 1985). During the 1990s, however, the Japanese economy fared poorly and

the governance provided by Japanese banks was criticized for excessively close ties bordering on cronyism (Boyer, 2000). Rather than attempt blanket conclusions about whether relational debt always provide superior or inferior governance, we follow prior research in recognizing that most governance mechanisms likely have both benefits and drawbacks (Finkelstein & D'Aveni, 1994). Accordingly, we explore R&D investment as a possible context wherein the benefits outweigh the drawbacks. We find that relational debt is superior to transactional debt for R&D investments, and that misalignment of debt structure with R&D investments hurts firm performance. We have noted multiple reasons for misalignment, such as regulatory constraints in the early stages of deregulation and likely managerial mistakes in later stages. Yet regardless of the root cause, misalignment hurts firm performance in both time periods.

Interestingly, it is possible that the free access to debt following deregulation may have exacerbated misalignment for some firms. As deregulation progressed throughout the 1980s, some of the most creditworthy industrial firms paid down relational debt and turned to less expensive transactional debt. To replace lost business, banks began lending extensively to firms that were pouring money into generic assets like real estate during the bubble era of the 1980s (Hoshi & Kashyap, 2001). Although relational debt provides appropriate governance for specific investments like R&D, it is inappropriate for the governance of generic investments like real estate, for which the tight budget constraints and high-powered incentives of transactional debt are better suited. Consequently, when the economic bubble burst, these firms were unable to repay and saddled banks with bad debt. A report by Japan's Cabinet Office (2001) confirms that less than 10 percent of the bad debts of banks during this crisis were in manufacturing industries (where assets tend to be more specific), while over 54 percent were in firms in the retail sector (which invested heavily in the generic assets).

There remain several limitations in our study that warrant further investigation. First, our study relied on archival measures of relational and transactional debt. Qualitative research on the extent to which banks exercise hierarchical governance should help provide more fine-grained understanding of the implications for R&D investments. Second, while Japan represents an appropriate setting for our study, debt regulations and bank relationships in each country are somewhat idiosyncratic. Replicating our study can better establish the extent to which our TCE arguments extend to other national contexts. Third, we have followed prior research in treating R&D investments as homogeneous. However, research has pointed out that strategic investments can be heterogeneous, differing in the extent to which they are directed towards the exploration of new possibilities versus the exploitation of known certainties (March, 1991). Further research can clarify whether relational debt is equally beneficial for both forms of R&D. Fourth, we study large firms that have access to bond markets. Although small firms often lack access to bond markets, they do vary in the extent to which they forge strong bank relationships. Investigating the implications of this variation for strategic investments would also be worthwhile. Finally, while we have advanced the literature by distinguishing between loan debt and bond debt, it is possible there may also be important differences within loans and within bonds. For example, bonds are often held by institutional investors with conflicting goals (Hoskisson, Hitt, Johnson, & Grossman, 2002), suggesting that there may be benefits to further disaggregation.

Just as further disaggregating debt may prove enlightening, further insights might also be gained by disaggregating equity owners. Thus, similar to lenders of debt, owners of equity could be classified as either transactional or relational based on whether they use simple or complex performance criteria and employ short or long time horizons. For example, Lee and O'Neill (2003) used a stewardship perspective to argue that stable long-term owners of Japanese firms

constitute “patient capital” that helps foster a long-term view of investments. A TCE perspective can complement the stewardship view by explaining the causal mechanism whereby “patient” (relational) owners provides the safeguards that help foster managerial stewardship with regard to R&D investments. Similarly, David, Yoshikawa & Rasheed (2006) found that foreign owners, who tend to be more transient or short-term, induce Japanese firms to cut R&D. If transient owners can be characterized as transactional, then a TCE perspective can help to explain why the market governance provided by transactional ownership tends to reduce specific investments like R&D. Furthermore, the distinction between relational and transactional owners is relevant not only for Japanese firms, but also for U.S. firms. Several studies have explored the implications of ownership structure for strategic investments like R&D in U.S. firms. Large block ownership (Hill & Snell, 1988), long-term pension fund ownership (Hoskisson *et al.*, 2002) and activism (David, Hitt, & Gimeno, 2001) have all been found to favor R&D. Conversely, transient (as opposed to dedicated) institutional owners curtail R&D investments when faced with earnings shortfall (Bushee, 1998). These studies suggest that there is considerable promise in exploring the extent to which different types of owners can be classified as relational versus transactional, and the implications of such ownership for strategic investments like R&D.

## REFERENCES

- Abegglen, J. & Stalk, G. 1985. Kaisha: The Japanese corporation. New York: Basic Books.
- Allen, F. & Gale, D. 2000. Comparing financial systems. Cambridge, MA: MIT Press.
- Anderson, C. W. & Makhija, A. K. 1999. Deregulation, disintermediation, and agency costs of debt: Evidence from Japan. Journal of Financial Economics, 51: 309-339.
- Aoki, M. & Patrick, H. 1994. The Japanese main bank system. Oxford: Clarendon Press.
- Argyres, N. S. & Liebeskind, J. P. 1999. Contractual commitments, bargaining power, and governance inseparability: Incorporating history into transaction cost theory. Academy of Management Review, 24: 49-63.
- Balakrishnan, S. & Fox, I. 1993. Asset Specificity, Firm Heterogeneity and Capital Structure. Strategic Management Journal, 14: 3-16.
- Baysinger, B. & Hoskisson, R. A. 1990. The composition of boards of directors and strategic controls: Effects on corporate strategy. Academy of Management Review, 1: 72-87.
- Berlin, M. & Mester, L. J. 1992. Debt covenants and renegotiation. Journal of Financial Intermediation, 2: 95-133.
- Bhattacharya, S. & Chiesa, G. 1995. Proprietary Information, financial intermediation, and research incentives. Journal of Financial Intermediation, 4: 328-357.
- Boot, A. W. A. 2000. Relationship banking: What do we know? Journal of Financial Intermediation, 9: 7-25.
- Boyer, R. 2000. Japanese capitalism in crisis: A regulationist interpretation: Routledge.
- Brouthers, K. D. 2002. Institutional, cultural, and transaction cost influences on entry mode choice and performance. Journal of International Business Studies, 33: 203-221.
- Bruno, G. S. F. 2004. Estimation, inference and Monte Carlo analysis in dynamic panel data models with a small number of individuals, Universita Bocconi working paper.
- Bruno, G. S. F. 2005. Approximating the bias of the LSDV estimator for dynamic unbalanced panel data models. Economic Letters, 87: 361-366.
- Bushee, B. 1998. The influence of institutional investors on myopic R&D investment behavior. Accounting Review, 73: 305-333.
- Cabinet Office; Annual report on Japan's economy and public finance 2001-2002; April 22, 2006, 2006.
- Carosso, V. P. 1970. Investment banking in America: A history. Cambridge, MA: Harvard Business School Press.
- Chemmanur, T. J. & Fulghieri, P. 1994. Reputation, Renegotiation, and the Choice between Bank Loans and Publicly Traded Debt. Review of Financial Studies, 7: 475-506.
- Chung, K. H. & Pruitt, S. W. 1994. A simple approximation of Tobin's Q. Financial Management, 23(3): 70-74.
- Corbett, J. & Jenkinson, T. 1997. How is investment financed? A study of Germany, Japan, the United Kingdom, and the United States. The Manchester School Supplement, 0025-2034: 69-93.
- David, P., Hitt, M. A., & Gimeno, J. 2001. The influence of activism by institutional investors on R&D. Academy of Management Journal, 44: 144-157.
- David, P., Yoshikawa, T., Chari, M., & Rasheed, A. 2006. Strategic Investments in Japanese corporations; Do foreign portfolio owners foster underinvestment or appropriate investment? Strategic Management Journal, 27: 591-600.
- Davis, G. F. & Mizuchi, M. S. 1999. The money center cannot hold: Commercial banks in the US system of corporate governance. Administrative Science Quarterly, 44(2): 215-239.

- Dierickx, I. & Cool, K. 1989. Asset stock accumulation and sustainability of competitive advantage. Management Science, 35: 1504-1511.
- Finkelstein, S. & D'Aveni, R. A. 1994. CEO duality as a double-edged sword: How boards of directors balance entrenchment avoidance and unity of command. Academy of Management Journal, 37: 1079-1108.
- Franko, L. G. 1989. Global corporate competition: Who's winning, who's losing and the R&D factor as one reason why. Strategic Management Journal, 10: 449-474.
- Gerlach, M. L. 1992. Alliance capitalism: The social organization of Japanese business. Berkeley: University of California Press.
- Gilson, S. C., John, K., & Lang, L. H. P. 1990. Troubled debt restructurings: An empirical study of private reorganization of firms in default. Journal of Financial Economics, 27: 315-353.
- Gorton, G. & Kahn, J. 2000. The design of bank loan contracts. Review of Financial Studies, 13: 331-364.
- Harris, M. & Raviv, A. 1991. The theory of capital structure. Journal of Finance, 46: 297-335.
- Helfat, C. E. 1994. Firm-specificity in corporate applied research and development. Organization Science, 5: 173-184.
- Hill, C. W. L. & Snell, S. A. 1988. External control, corporate strategy, and firm performance in research-intensive industries. Strategic Management Journal, 9: 577-590.
- Hoshi, T., Kashyap, A., & Scharfstein, D. 1990. Bank monitoring and investment: Evidence from the changing structure of Japanese corporate banking relationships. In R. G. Hubbard (Ed.), Asymmetric information, corporate finance, and investment: 105-126. Chicago: University of Chicago Press.
- Hoshi, T., Kashyap, A., & Scharfstein, D. 1993. The choice between public and private debt: An analysis of post-deregulation corporate financing in Japan: National Bureau of Economic Research.
- Hoshi, T. & Kashyap, A. 2001. Corporate financing and governance in Japan. Cambridge, MA: MIT Press.
- Hoskisson, R. E., Hitt, M. A., Johnson, R. A., & Grossman, W. 2002. Conflicting voices: The effects of institutional ownership heterogeneity and internal governance on corporate innovation strategies. Academy of Management Journal, 45: 697-716.
- Kang, J.-k. & Stulz, R. M. 2000. Do banking shocks affect borrowing firm performance? Journal of Business, 73: 1-23.
- Kaplan, S. N. & Minton, B. A. 1994. Appointments of outsiders to Japanese boards. Journal of Financial Economics, 36: 225-258.
- Kochhar, R. 1996. Explaining firm capital structure: The role of agency theory vs transaction cost economics. Strategic Management Journal, 17: 713-728.
- Laverty, K. J. 1996. Economic "short-termism": The debate, the unresolved issues, and the implications for management practice and research. Academy of Management Review, 21: 825-860.
- Lee, P. M. & O'Neill, H. M. 2003. Ownership structures and R&D investments of U.S. and Japanese firms: Agency and stewardship perspectives. Academy of Management Journal, 46: 212-225.
- Levin, R. C., Klevorick, A. K., Nelson, R. R., & Winter, S. G. 1987. Appropriating the returns from industrial research. Brookings Papers on Economic Activity, 3: 783-831.
- Long, M. & Malitz, I. 1985. The investment-financing nexus: Some empirical evidence. Midland Corporate Finance Journal, 3(3): 53-59.

- Macneil, I. R. 1974. The many futures of contracts. Southern California Law Review, 47: 691-816.
- March, J. G. 1991. Exploration and exploitation in organizational learning. Organization Science, 2: 71-87.
- Masten, S. E. 1993. Transaction costs, mistakes, and performance: Assessing the importance of governance. Managerial and Decision Economics, 14: 119-129.
- Mayer, C. 1988. New issues in corporate finance. European Economic Review, 32: 1167-1188.
- Mizruchi, M. S. & Stearns, L. B. 1994. A longitudinal study of borrowing by large American corporations. Administrative Science Quarterly, 39(1): 118-140.
- Nickell, S. J. 1981. Biases in dynamic models with fixed effects. Econometrica, 49: 1417-1426.
- Nickerson, J. A. & Silverman, B. S. 2003. Why firms want to organize efficiently and what keeps them from doing so. Administrative Science Quarterly, 48: 433.
- O'Brien, J. 2003. The capital structure implication of pursuing a strategy of innovation. Strategic Management Journal, 24: 415-431.
- Oral, M., Kettani, O., & Lang, P. 1991. A methodology for collective evaluation and selection of industrial R&D projects. Management Science, 37: 871-886.
- Osawa, Y. & Murakami, M. 2002. Development and application of a new methodology of evaluating industrial R&D projects. R&D Management, 32: 79-86.
- Rousseau, D. M. 1995. Psychological contracts in organizations: Understanding written and unwritten agreements. Thousand Oaks: Sage.
- Sampson, R. C. 2004. The cost of misaligned governance in R&D alliances. Journal of Law Economics and Organization, 20: 484-526.
- Silverman, B. S., Nickerson, J. A., & Freeman, J. 1997. Profitability, transaction alignment, and organizational mortality in the U.S. trucking industry. Strategic Management Journal, 18: 31-52.
- Simerly, R. L. & Li, M. F. 2000. Environmental dynamism, capital structure and performance: A theoretical integration and empirical test. Strategic Management Journal, 21: 31-49.
- Smith, C. W. & Warner, J. 1979. On financial contracting: An analysis of bond covenants. Journal of Financial Economics, 7: 117-161.
- Teece, D. J. 1986. Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. Research policy, 15: 285.
- Vincente-Lorente, J. D. 2001. Specificity and opacity as resource-based determinants of capital structure. Strategic Management Journal, 22: 157-177.
- Williamson, O. E. 1985. The economic institutions of capitalism: Firms, markets, and relational contracting. New York: Free Press.
- Williamson, O. E. 1988. Corporate finance and corporate governance. Journal of Finance, 43: 567-591.
- Williamson, O. E. 1991. Comparative economic organization: The analysis of discrete structural alternatives. Administrative Science Quarterly, 36: 269-296.
- Wooldridge, J. M. 2003. Introductory econometrics. Mason: OH: South-western.
- Wu, X., Sercu, P., & Yao, J. 2001. Reexamining the relation between corporate debt mix and growth in Japan, Paper presented at the EFA Annual Meeting in Barcelona.