Firm–Specific Knowledge Resources and Competitive Advantage: The Roles of Economic– and Relationship–Based Employee Governance Mechanisms

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Abstract

The resource–based view of the firm emphasizes the role of firm–specific resources, especially firm–specific knowledge resources, for enabling a firm to gain and sustain competitive advantage. However, since the deployment of firm–specific knowledge frequently requires key employees to make specialized human capital investments that are not easily transferable to other settings, employees with foresight may be reluctant to make these specialized investments. This paper explores both economic– and relationship–based governance mechanisms that potentially mitigate this under–investment problem. The appropriate use of these governance mechanisms enables firms to obtain greater performance from their efforts to deploy firm–specific knowledge resources. Empirical results further support these arguments.

We thank Amy Hillman and Evan Offstein for their helpful comments and suggestions, and Kozhikode Rajiv Krishnan for excellent data assistance. This research was supported by the Hong Kong Research Grants Council through RGC grant HKUST6251/03H.

Published: February 22, 2007
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Abstract

The resource-based view of the firm emphasizes the role of firm-specific resources, especially firm-specific knowledge resources, for enabling a firm to gain and sustain competitive advantage. However, since the deployment of firm-specific knowledge frequently requires key employees to make specialized human capital investments that are not easily transferable to other settings, employees with foresight may be reluctant to make these specialized investments. This paper explores both economic- and relationship-based governance mechanisms that potentially mitigate this under-investment problem. The appropriate use of these governance mechanisms enables firms to obtain greater performance from their efforts to deploy firm-specific knowledge resources. Empirical results further support these arguments.

Key words: Firm-specific Knowledge Resources, Employee Human Capital, Employee Governance Mechanisms, and the Resource-based View of the Firm
A fundamental proposition of the resource-based view of the firm is that a firm with resources that are valuable and rare may generate competitive advantages over its rivals, thereby resulting in temporary superior economic performance (Wernerfelt, 1984; Barney, 1991; Peteraf, 1993). For a firm to sustain its competitive advantage and its superior economic performance, the resources must also be inimitable and non-substitutable to prevent rivals from replicating the value of these resources and thus competing away their economic benefits. It then follows that the sustainability of a firm’s competitive advantage is directly related to the strength of “isolating mechanisms” that prevent rival imitation or substitution (Rumelt, 1984; Mahoney and Pandian, 1992).

Firm-specificity in resources is typically considered one such isolating mechanism. Firm-specific resources are not perfectly mobile and are not easily tradable outside of a firm (Dierickx and Cool, 1989). This feature of firm-specific resources makes it more difficult for competitors to imitate. Furthermore, since by definition, firm-specific resources are likely to be economically valued more by the firms who own these resources than by other firms, the other firms have less incentive to imitate or expropriate these resources that would yield lower economic value.

Among the types of firm-specific resources that have been examined, the resource- and knowledge-based research literatures have generally maintained that firm-specific knowledge has the greatest potential to serve as a source of sustainable performance advantage because of the increasingly important role of knowledge resources in modern corporations. A firm’s knowledge base is the information inputs, knowledge, and capabilities that organizational members draw on when searching for innovative solutions (Dosi, 1988); accordingly, firm-specific knowledge is often the result of firms searching and accumulating new knowledge in areas that enable them to build upon their established knowledge base (Nelson and Winter 1982, Teece 1986, Cohen and
Levinthal 1989). Such firm-specific knowledge resources may include skills needed to complete specific tasks of the firm, capabilities required to operate or maintain customized equipments, and information about specialized job practices for manufacturing unique products (Døving and Nordhaug, 2002). Although knowledge resources in general are subject to diffusion across firms, the resource-based view of the firm (Barney 1991, Peteraf 1993) suggests that firm-specificity in knowledge resources can help the firm appropriate greater economic value from these resources. For example, Helfat (1994) argues that firm-specific knowledge and innovation enables a firm to be in a better position to appropriate the economic rents from its R&D investments.

However, it is rarely the case that a firm’s physical and organizational capital alone can achieve superior economic performance through deploying firm-specific knowledge resources. Instead, the firm often requires its key employees to make accompanying investments in human capital, in the process of absorbing and deploying firm-specific knowledge. When a firm’s key rent-generating knowledge resources are firm specific, the required human capital investments from the firm’s key employees are also likely to increase in the level of specificity. Similar to other types of firm-specific investments, employees’ firm-specific human capital is not tradable or is valued less economically in external labor markets than in the specific firm setting.

Therefore, the same features of firm-specific knowledge that constitute potential sources of sustainable competitive advantage are also likely to give rise justifiably to key employees’ reluctance to make accompanying firm-specific human capital investments. Because employees’ firm-specific human capital are less valuable in other business settings and are therefore not transferable to other jobs, in the absence of complete contracts, employees’ investing in such human capital would create a situation for potential holdup by the firm ex post. Thus, employees with foresight might be reluctant to make specific human capital investments that would place
themselves in a potentially weak (ex post) bargaining position. For example, computer software firms that focus on developing and applying certain proprietary software languages generally have a high level of firm-specific knowledge. And it is often the case that software engineers are reluctant to invest in learning such proprietary languages because their skills developed therein will become irrelevant elsewhere.

Consequently, in the absence of effective economic safeguards for these key employees, it is difficult for a firm to realize the potential economic rents that can be generated by its firm-specific knowledge resources. Thus, a fundamental question is how to enlist the cooperation of key employees to make human capital investments that are firm-specific, without ceding to them excessive economic rents generated from deploying the resource (Rajan and Zingales, 1998).

The current paper emphasizes that characteristics of firm-specific knowledge are likely to lead to employees’ reluctance to invest in accompanying firm-specific human capital. Thus, it is theoretically sound to anticipate that a firm’s governance system, which is established to align its employees’ economic interests with that of the firm, is endogenous to the firm’s resource composition. This issue that has been raised based on organizational economics theory (Rajan and Zingales, 2001; Mahoney 2005) leads to classical organization theory solutions (Ouchi, 1980; Eisenhardt, 1985). In particular, because the employee’s investments in specific human capital are often unobservable, it is unlikely that firms can either effectively monitor the employee or design a compensation contract that directly compensates the employee for making an appropriate level of specific human capital investment. Accordingly, the ineffectiveness of behavior control and direct compensation is likely to induce the firm to rely more heavily on outcome-based incentives (Eisenhardt, 1985) and/or “clan” socialization mechanisms (Ouchi, 1980) to influence their employees’ behavior.
More specifically, the current paper considers two general mechanisms that are available for firms to mitigate the under-investment in firm-specific human capital by its key employees: economic-based means such as employee stock ownership and relationship-based means such as long-term firm-employee relationships. Given the well-established theoretical argument in the organizational economics research literature that there would otherwise be an under-investment in firm-specific human capital, the current paper maintains that the appropriate use of such classical organization theory solutions enables firms to achieve a greater level of economic performance from their firm-specific knowledge resources.

BACKGROUND AND HYPOTHESES DEVELOPMENT

Background

The existence of, and solution to, employee governance problems are critically important in understanding economic rents generated by firm-specific knowledge resources. In particular, firm-specific knowledge can only influence potential economic rents. The governance of the firm’s employees, who help deploy such knowledge in the economic value creating process, moderate the de facto economic rents generated by the firm. Indeed, it is likely that the next generation of resource-based theory and empirical research will place greater emphasis on the logic that a firm’s resource base and the effectiveness of its governance system jointly influence its economic performance (Makadok, 2003; Kim and Mahoney, 2005; Gottschalg and Zollo, in press).

Early discussions on the issues associated with employee investments in specific human capital can be found in the human capital theory, which is best exemplified by the seminal work of Becker (1964). A fundamental premise of the theory is that because specific human capital has
limited economic value in alternative settings, efficient outcomes may be achieved under the condition that the costs and returns of specific human capital investments are shared between the firm and the employees (e.g., Becker, 1964; Bartel and Borjas, 1977; Hashimoto, 1981). One limitation of the human capital theory, however, is that this theory does not explicitly take into consideration the underinvestment problem, or the transaction costs threat of holdup as a result of incomplete contracting, which is a fundamental impediment to the sharing of the costs and returns of specific human capital (Williamson, 1975, 1985; Glick and Feuer, 1984).

Some of the key issues associated with incomplete contracts and underinvestment are addressed by property rights theory (Demsetz, 1967; Grossman and Hart, 1986; Hart and Moore, 1990; Ranjan and Zingales, 1998). The fundamental idea in property rights theory is that in a world of positive transaction costs, the allocation of property rights over an asset is crucial in determining efficiency in deploying the asset (Coase, 1960). When contracts are incomplete, the anticipated profit sharing influences *ex ante* the willingness for transaction partners to specialize (Hart and Moore, 1990). A more recent work by Foss and Foss (2005) has applied and extended the ideas in property rights theory to the resource-based research literature. Foss and Foss (2005) maintain that the ability for a resource owner to create, appropriate, and sustain economic value from resources is influenced by transaction costs (which include the costs of inducing employees to invest in specific human capital). Property rights theory raises concerns of underinvestment and suggests an economic-based solution to the employee underinvestment problem: ownership of firm resources provides employees with more secure economic profit appropriation, fostering the economic incentives of employees to make specific human capital investments within a firm.

In addition to the organizational economics literature on the theory of property rights, a few management research studies also examine issues relevant to employee governance issues.
Castanias and Helfat (1991, 2001) address governance issues in economic rent generation by top managers, and maintain that even when managers have the potential to generate economic rents by deploying their human capital, the total amount of potential rents are not automatically realized if incentives are lacking or misdirected. Coff (1997) develops a fairly comprehensive framework for analyzing and coping with challenges associated with managing human resources. These coping strategies include economic- and relationship-based employee governance mechanisms such as employee retention through firm-specific pay and job satisfaction, profit sharing, and organizational design. Gottschalg and Zollo (in press) explore the roles of both extrinsic and intrinsic governance mechanisms and their alignment with the firm on competitive advantage. Their analysis highlights the strategic relevance of employee governance mechanisms in enabling a firm to achieve competitive advantage.

The current paper directly examines the issue of employee governance mechanisms for economic rent generation, and both builds upon but goes beyond previous research studies in several aspects. First, while previous research studies discuss issues associated with employee governance primarily in general terms, the current paper directly takes into consideration firm heterogeneity in knowledge assets and emphasizes a contingency view of employee governance systems. The paper maintains that employee governance mechanisms are endogenous to the nature of firm knowledge resources. Second, while most research studies focus on financial-based governance mechanisms (with the exception of Gottschalg and Zollo, in press), the current paper also explores the role of trust and relationship building between the firm and its employees. Third, this paper emphasizes that the level of firm-specific knowledge only defines the firm’s potential in generating economic rents. The realized rents generated by such knowledge are moderated by the effectiveness of firm governance mechanisms. Lastly, this paper provides
systematic empirical tests of these arguments, which to our knowledge, none of the previous studies have done.

**Firm-Specific Knowledge Resources and Superior Firm Performance**

The resource-based view typically considers firms as bundles of heterogeneous resources that include tangible and intangible resources, and operational processes and products (Amit and Schoemaker, 1993). Among the resources examined, knowledge is often considered as the most important resource of the firm (Grant, 1996; Kogut and Zander, 1992). Firm knowledge can be broadly classified into two types: firm-specific knowledge and general knowledge. If a firm pursues new knowledge close to its existing knowledge bases and with specific application to its own business setting, it is likely to develop firm-specific knowledge — knowledge that is more useful within the firm but has less applicability across firm boundaries (Pavitt, 1990; Helfat, 1994). Alternatively, other firms may choose to place a greater emphasis on the development of general knowledge, which is more often built upon the knowledge that is available in the market and is less specialized in their own firm settings.

Different knowledge accumulation and development strategies result in key differences across firms in the degree of firm-specificity of their knowledge resources. These inter-firm differences in knowledge accumulation and utilization strategies, and the resulting differences in the degree of firm-specificity of knowledge resources can have important implications for the firms’ economic performance. Because firm-specific knowledge resources are immobile and are not easily tradable outside a firm, such resources have greater economic value if applied within the particular firm than if these resources are used in other business settings. This feature of firm-specific knowledge makes them rare and less likely to be subject to rival imitation and therefore the firm may be able to benefit more economically from deploying firm-specific, rather than
general, knowledge (Peteraf, 1993). For example, Helfat (1994) emphasizes that firms are better able to appropriate the economic rents generated from their firm-specific R&D activities, a key input of firm-specific knowledge:

...The outcome of firm-specific R&D can prove difficult for other firms to imitate, if they do not have access to the assets to which the R&D was applied. Additionally, the firm-specific nature of the R&D process further impedes imitation: when the R&D process has an important tacit element, it is difficult for others outside of the firm to replicate dynamic routines to support new process and product development, other firms may be left playing catch up, for example, by trying to reverse engineer products once another firm has introduced them. Essentially, the difficulty of imitating (or finding effective substitutes for) other firms’ R&D processes or outcomes retards the diffusion of technical knowledge across firms. This in turn enhances appropriability, since direct competition between firms in R&D is reduced... (Helfat, 1994, p. 175)

Moreover, the organizational learning literature suggests that because organizational learning is a cumulative process that concentrates in areas of prior knowledge accumulation, firms have a higher likelihood of successful knowledge application in areas in which they have had prior and firm-specific experience (Stuart and Podolny, 1996). The increased likelihood of success of firm-specific knowledge deployment further induces consistent investments in necessary complementary assets, including human and financial resources and physical facilities (Teece, 1986). Therefore, it is reasonable to expect that a firm’s knowledge stock will produce superior financial outcomes when it is firm specific, i.e., it is concentrated in the areas of a firm’s established capabilities. Consistent with this reasoning, Henderson and Cockburn (1994) corroborate empirically that a firm’s cumulative success, which relies on its existing resources and capabilities, increases the likelihood of its future success.

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1 The competitive dynamics in desktop printer industry may be helpful in illustrating this point. When Hewlett-Packard launched its first ink jet printer based on its unique thermal ink jet technology, competitors with different technology bases (e.g., Epson’s piezoelectric technology) were disinclined to follow Hewlett-Packard’s path because of their comparative disadvantage in thermal ink jet. Similarly, it would take other rivals who are not familiar with such technology a long time before they could imitate Hewlett-Packard. As a result, Hewlett-Packard led the subsequent new innovations around thermal ink jet technology and dominated the ink jet printer market for the following 20 years.
Therefore, a firm that emphasizes the accumulation and deployment of firm-specific knowledge is likely to yield a higher level of firm-specific knowledge resources and thus to be in a better position to appropriate the economic rents generated from such knowledge (Montgomery and Wernerfelt, 1988). We thus have the following baseline resource-based view hypothesis:

\[ H1: \text{Firms with high levels of firm-specific knowledge resources are more likely to achieve higher levels of economic performance.} \]

Firm-Specific Knowledge Resources and Employee Governance Mechanisms

Although the issue of employee willingness to invest in specific human capital is relevant to many firms, firms may differ substantially in terms of their need for employees to invest in such human capital (Williamson, 1985). Some businesses have limited opportunities for their employees to invest in firm-specific human capital. These firms often operate in highly competitive markets with nearly homogeneous products or services. Because these firms are unlikely to have unique technologies and resources, they are typically operated more efficiently by general human capital that can be readily obtained from the labor market and are equally available to many other firms. Examples are firms that operate in markets with standardized tasks and commodity-like outputs. To operate more flexibly in performing such standard tasks, the firm often hires employees on short-term contracts. In contrast, firms operating in complex markets with intensive technology and firm-specific knowledge, which is often characterized by high levels of firm-specific R&D investment and specialized patent applications, have a much greater need for the firms’ key employees to develop firm-specific skills, for example, in terms of process improvement and new product development.

Thus, the need for providing the appropriate incentives for an employee to invest in firm-specific human capital varies with the nature of the firm’s existing stock of knowledge resources.
According to Williamson (1975), a transaction that includes substantial specific investments ties two contracting parties — in this case, the firm who owns the firm-specific knowledge assets and the employees who invest in specific human capital — in a bilateral monopoly relationship, as neither party can walk away without incurring economic losses. This bilateral monopoly situation creates the possibility of ex post opportunistic behavior, or the potential for holdup from either party, depending on who has more power at the time of bargaining (Schelling, 1960; Klein, Crawford and Alchian, 1978; Williamson, 1985).

If contracts were available to ensure ex post that a party can obtain an acceptable amount of economic profits from his/her specific investment ex ante, opportunistic behavior from either party can be effectively insured against through the design of complete contracts. However, the writing of complete (contingent claims) contracts on knowledge-based resources and specific human capital is usually not feasible, as the investments of such assets are not fully measurable and the economic returns derived from the investments can not be clearly distinguished from those derived from other sources. Where contracts are incomplete, the problem of under-investment arises since ex post each party will want to capture a greater share of the economic returns (Tirole, 1988; Hart, 1995). In the case of the current paper, employees with foresight may under-invest in firm-specific human capital, as they are concerned that the firm might ex post use its bargaining power to appropriate some or even most of the economic returns generated from their investments (Williamson, 1985; Shleifer and Summers, 1988).

In addition to the potential for holdup in the process of splitting economic gains, there is also the chance of termination of the relationship for exogenous reasons such as environmental uncertainty. Although there are cases where the employee may holdup the firm by threatening to quit, it is more often the case that the firm initiates the separation. In other words, under bilateral
monopoly, the risk of economic holdup often affects employee more severely than the firm (Glick and Feuer, 1984). One source of the termination of the relationship by the firm is the need for strategic change due to changes in the firm’s operating environment. With such changes, certain firm-specific knowledge and its associated specific human capital that was a source of superior economic performance may become obsolete. For example, technological advancement, discoveries, and inventions can have a negative impact on the rent-generating potential of some co-specialized investments (Rumelt, 1984). Such external changes not only impose additional concern for holdup in renegotiation, but also may lead the firm to change strategy and resource bundles through divesture and diversification. Such strategic changes may lead to the termination of the current bilateral monopoly relationship, leaving the employees in a weaker bargaining position relative to the firm (Titman, 1984; Cornell and Shapiro, 1987). Thus, for firms with high levels of specific knowledge resources, it is critical to adopt appropriate governance mechanisms that will likely increase employees’ willingness to invest in economically valuable firm-specific human capital in the wealth-creating activities of firms (Wang and Barney, 2006).

In sum, firm-specificity in a firm’s knowledge resources is a double-edged sword: on the one hand, firm-specific knowledge is crucial in enabling firms to gain and sustain competitive advantage; on the other hand, such knowledge induces the employee to have high appropriation concerns. Without appropriate economic incentives or some shared norms and values, employees will be reluctant to commit to investments in non-transferable skills, preferring instead to invest in more generic skills that can be applied elsewhere. Therefore, firms with a greater stock of firm-specific knowledge resources are more likely to adopt governance mechanisms that better align employees’ interests with those of the firm.
Ouchi (1980) indicates that cooperative behavior of employees can be achieved by virtue of three general mechanisms: outcome control (e.g., price or market-based economic incentives), behavior control (e.g., managerial monitoring), and clan socialization (e.g., shared corporate value), corresponding to markets, hierarchies, and clan-like organization forms respectively. The current paper maintains that for firms with high levels of firm-specific knowledge resources, behavior control or monitoring by managers may have little effect on inducing the appropriate employee behavior of absorbing and deploying firm-specific knowledge, because the employee's investments in specific human capital are often unobservable or difficult to measure. According to Eisenhardt (1985), such a situation represents imperfect task programmability, which weakens the applicability of managerial control of employee behavior in regards to making firm-specific human capital investment. Furthermore, unobservable employee efforts also make it unlikely that firms can fully regulate employee behavior by designing a compensation contract that directly compensates the employee for his/her effort in making an appropriate level of specific human capital investment.

Thus, a firm with high knowledge specificity is left with two other general governance mechanisms, i.e., outcome control and socialization. Specifically, the current paper discusses two interrelated governance mechanisms that may enable firms to mitigate the employee’s otherwise justifiable reluctance in making firm-specific human capital investments: an economic-based governance mechanism and a relationship-based governance mechanism. We discuss these two general governance mechanisms below in turn.

**Economic-based governance mechanism: employee stock ownership.** The economic-based governance solution is built upon property rights theory, which maintains that an employee will be more willing to invest in specialized human capital if the employee is able to appropriate
a certain share of the economic rents generated from these investments in a fair manner. Property
rights theory (e.g., Demsetz, 1967; Barzel, 1989; Libecap, 1989) maintains that ownership rights
are instrumental in allocating resources toward their highest economically valued uses and thus
these ownership rights are crucial to achieving operating efficiency.

A particular feature of firm-specific knowledge resources and employee human capital
associated with these resources is the often-ambiguous nature of ownership (Coase, 1960). In
general, employment contracts that govern exchanges of employee services are costly to write
and enforce (Coase, 1937; Klein, 1980). Consequently, such contracts are typically incomplete
(Hart, 1995). These un-contracted dimensions of the exchange, which are in essence property
rights, are the ‘residual rights of control” (Grossman and Hart, 1986; Hart and Moore, 1990). When
these residual rights of control do not accrue to the transactional party who has control
over the resource, this party has lower incentive to maximize the economic rent-generating
potential of the resources, and this lower incentive potentially induces highly self-interested
behavior. Therefore, the residual rights or ownership of resources involved in a transaction
should go to the transactional party whose firm-specific investments have the most influence
over the resources and thus contribute the most to firm value but are the most difficult or
impossible to contract over (Grossman and Hart, 1986; Rajan and Zingales, 1998). Specifically,
when the key resource involved is the firm-specific knowledge, it is desirable to grant some
equity ownership to the key employees who have to absorb and deploy such knowledge.

Since employees’ behavior in absorbing and deploying firm-specific knowledge is highly
difficult to observe and measure, insufficient knowledge of the transformation process or
imperfect task programmability will force the employer to adopt outcome control — as opposed
to behavior control — to induce cooperative efforts of employees (Ouchi, 1980; Eisenhardt,
Linking employees’ financial reward directly to the economic value of the firm through granting employees equity ownership likely provides the strongest interest alignment between the firm and its employees (cf. Shleifer and Vishny, 1997).

In these business circumstances, granting employee ownership or property rights is a feasible governance choice. Employee ownership provides both a measure of residual control and a measure of economic profit sharing to encourage productive efforts. Granting employees ownership rights directly, however, is costly to the firm. In addition to the direct reduction of the share of the economic profit accrued to the firm, other shareholders’ investment incentives are worsened, since the shareholders will gain only a fraction of the marginal product with the full marginal cost of their investment (Roberts and Van den Steen, 2000). Therefore, when a firm has a high level of firm-specific knowledge resources, where the concern for employee under-investment is likely to be the greatest, it is more likely that the firm grants its employees ownership rights. Following this organizational economics logic we hypothesize that:

\( H2a: \) A firm’s level of firm-specific knowledge resources is positively associated with its use of employee stock ownership as a governance mechanism.

Informal employee relations. The governance of firm-employee exchanges involves an entire system that goes beyond employee ownership (Ouchi, 1980; Eisenhardt, 1985). Informal relationships between the firm and its employees may serve as an alternative governance mechanism for securing employee willingness to cooperate with firm interests (Barnard, 1938; Selznick, 1957). Such intrinsic motivation is valued for its own sake and appears to be self-sustained (Calder and Staw, 1975). This humanistic approach has been emphasized for decades in organization theory (e.g., McGregor, 1960; Likert, 1961; Argyris, 1964) and more recently in the literature on psychological contracts (e.g., Rousseau, 1995; Morrison and Robinson, 1997),
often in the form of identification with the firm’s strategic goals, shared purposes, and the fulfillment of norms for its own sake (Ouchi, 1980).

Moreover, employee stock ownership as a governance mechanism has drawbacks. For example, ownership may not fully safeguard against shirking behavior, because profit sharing is typically not fine-tuned to individual performance. This agency problem can be especially severe if employees need to work in a group, in which setting, it is more difficult to assess individual performance because contracts cannot completely specify all relevant aspects of employee behavior and its desired outcome (Alchian and Demsetz, 1972). Contracts that offer purely economic incentives to reach given goals can potentially give rise to dysfunctional behavioral responses (Miller, 1992). Employees may focus exclusively on the rewarded aspects of the job and disregard the unrewarded ones.

Therefore, socialization or “clan” control is needed when outcome measurability is low (Eisenhardt, 1985; Ouchi, 1980). Socialization can help employees to build a sense of belonging and to accept the firm’s goals as close to their own, thus providing employees strong interest alignment with the firm. The shared value embedded in well functioning informal firm-employee relationships will often inspire employees to self-enforce their formal contracts with the firm. Therefore, the establishment and enforcement of a cooperative solution (Holmstrom and Milgrom, 1991; Gibbons, 1998; Prendergast, 1999) in which each employee agrees to higher work norms may solve problems associated with group work. This agreement may be accomplished using organizational programs to encourage employee involvement in workplace decisions. New communication channels can be opened both to provide employees with more information and to solicit ideas from employees, and to assure workers that any productivity improvements will not result in layoffs or reduced job security. This agreement may substitute or
complement employee ownership to help create a “sense of belonging” and consequently higher employee commitment.

Empirical work generally shows that relational governance is associated with greater employee cooperation and trust, which in turn reduces employee concerns for firm holdup and thus improves the performance of inter-organizational exchanges (Heide and John, 1990; Zaheer and Venkatraman, 1995; Zaheer, McEvily, and Perrone, 1998). Yet, the development and maintenance of relational governance are costly because they often require substantial long-term firm investment in various human resource practices, including for example, recruitment, and training practices that facilitate employee commitment, performance appraisal that emphasize team production and shared values, and long-term or no layoff employment policies (e.g., Collins and Smith, 2006). This cost factor means that the use of relational governance is more beneficial when substantial hazards are present or other control mechanisms become prohibitive. Absent these hazards and constraints, incurring the costs of relational governance may not be warranted. Therefore, we hypothesize the following:

\[ H2b: \quad \text{A firm's level of firm-specific knowledge resources is positively associated with the extent to which it places emphasis on establishing good relationships with employees.} \]

**Interest Alignment and Specific Knowledge-based Performance Advantage**

Although firm-specific knowledge resources are potential sources of the firm’s superior economic performance, if employee interests are not aligned with the interests of the firm, the actual economic performance of the firm may never reach its potential. Therefore, both explicit and implicit governance mechanisms, such as employee stock ownership and firm-employee relationships, should be important in influencing performance advantages of firm-specific knowledge resources through their ability to align the interests of the firm and its employees.
Consistent with this view, organizational capability and motivation are recognized as the two fundamental drivers for firm behavior and consequentially firm-level economic performance (Chen, 1996; Gimeno, 1999). These two different but co-existing drivers jointly influence the economic outcome of the firm. Viewing these joint drivers from the Motivation-Capability logic, the current resource-based theory of the firm focuses mainly on the potential economic rents generated by firm resources — especially by firm-specific knowledge resources. What has been far less examined from this perspective is the willingness of employees to deploy firm-specific resources. Indeed, the governance of employees who actually deploy and utilize firm-level resources towards productive uses moderate the de facto economic rents generated by the firm. Therefore, in order to understand what and how superior firm-level resources are deployed to achieve sustainable competitive advantage, we need to simultaneously consider the firm’s dynamic resource base and the effectiveness of a firm’s governance system (Makadok, 2003).

For a firm to reduce the gap between potential economic rents and realized economic rents, the firm needs to align employee interests with that of the firm, which if not appropriately managed will substantially reduce the capability for firm-specific knowledge to deliver superior economic performance. Hypotheses 2a and 2b suggest that an effective governance system for a firm that emphasizes the accumulation and deployment of firm-specific knowledge will more likely grant employees ownership and build informal relationship with employees. Departure from such governance mechanisms will typically result in imperfectly realized economic rents. Thus, the current paper posits an interaction effect between firm-specific knowledge resources and employee governance mechanisms on firm-level economic performance. In this sense, a firm’s governance system is analogous to a faucet, the inappropriate function of which will hinder the flow of firm-specific knowledge resources towards full realization of economic rents.
H3a: The relationship between the level of firm-specific knowledge resources and firm-level economic performance is positively moderated by employee stock ownership.

H3b: The relationship between the level of firm-specific knowledge resources and firm-level economic performance is positively moderated by firm-employee relationships.

DATA AND METHODS

Data and Sample

We constructed the sample for this research study by compiling several main data sources: the Standard and Poor’s Compustat; the United States patent data; SEC EDGAR data; KLD Research and Analytics Inc. data; and data from the Great Place to Work Institute. Since all of the datasets are provided in multiple years, we are able to construct a panel dataset, based on the overlapping period across the datasets. This results in an unbalanced panel sample of 205 firms and 970 firm-year observations for the period between 1994 and 1999 for our analysis.

Since the current paper builds on the modern property rights research literature, which emphasizes the importance of both human capital and patenting (Rosenkopf and Nerkar, 2001; Kim and Mahoney, 2005), manufacturing industries seemed to be an especially relevant empirical context. Thus, we began our sample selection with the group of firms in manufacturing industries (4-digit SIC codes from 2000 to 3999) that are also listed in the KLD Research and Analytics Inc. database between 1994 and 1999. The KLD data are used to construct the measure for firm-employee implicit relationships. KLD data are widely used in the business and society literature and are considered to be the best data available for a comprehensive measure of corporate social relationships and stakeholder management (Sharfman, 1996; Waddock and Graves, 1997; Hillman and Keim, 2001). Starting from 1991, KLD compiled data for firms in S&P 500, DSI 400 (and starting in year 2001, Russell 4000 firms are also included) in terms of
the issues related to community, corporate governance, diversity, firm-employee relationships, human rights, environment, product, alcohol, tobacco, gambling, firearms, nuclear power and military contracting. The profiles have social ratings evaluating each company’s strengths and concerns in each dimension, except for alcohol, tobacco, gambling, firearms, nuclear power and military contracting, in which only concerns are evaluated. We obtain our firm-employee relationships measure from the “employee relations” dimension of the KLD data. Between 1994 and 1999, KLD data contain information on about 650 firms on average for each year, in which approximately half of them are manufacturing firms.

Information on employee stock ownership for the firms in the initial sample is collected manually from the US Securities and Exchange Commission (SEC). The SEC requires every registered firm to file a definitive proxy statement (DEF14-A) annually, which discloses the beneficial ownership of the firm’s common stock held in excess of 5% by individuals or collectives (as block-holders) as on the date of filing. In most cases there are trustees appointed by the employees who operated on behalf of the employees as a group. This information is available in electronic forms from 1994 through 2006 in the Electronic Data-Gathering, Analysis, and Retrieval system (EDGAR) database of the SEC. The exact percentage of the ownership is coded as reported in the beneficial owners section of the DEF14-A forms. Note that for firms whose employees are not block holders of at least 5% of the firm’s shares this variable is not reported and thus is coded as zero. There are roughly 11% of the observations in our sample have non-zero values. According to the latest estimate of the National Center for Employee Ownership (NCEO, www.neco.org), about 15% to 20% of all public companies today adopted employee stock ownership plans. The somewhat lower percentage of non-zero values in

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2 Detailed descriptions of the items in the firm-employee relationships dimension can be found in the Appendix.
our sample may be attributed to at least two reasons. First, firms that adopted the employee stock
ownership plan but have a total percentage below 5% are not included in the database; second,
the percentage has been reported to be growing over the years. Thus, the number for our sample
period 1994-1999 is expected to be smaller than the 15–20%, which is estimated more recently.

The combined firm-employee relationships and employee stock ownership data are then
merged with patent citation and S&P’s Compustat data, where we obtained our measures of
firm-specific knowledge resources and firm economic performance measures respectively. Hall,
Jaffe, and Trajtenberg (2001) have created a data file that contains detailed information on
almost three million U.S. patents granted between 1963 and 1999, and over 16 million citations
made of these patents for those granted between 1975 and 1999. Further, Hall, *et al.* (2001)
matched the file to Compustat data, which is available for download from the website of the
National Bureau of Economic Research (NBER). Because our unit of analysis is the firm, we
aggregated the patents and their citation counts to the firm level (Rosenkopf and Nerkar, 2001).
Finally, data on the 100 best companies to work for from the Great Place to Work Institute is
added to the sample to obtain an alternative measure of firm-employee relationship³. Since this
variable is coded as a dummy, which is 1 if a firm is in the list in a certain year, and 0 otherwise,
adding this dataset does not affect the sample size.

³ The “100 best companies to work for” list was not available in each consecutive year until 1998. Before
1998, the lists were available only for 1984 and 1993. To overcome this constraint, we used data from the
most adjacent year to substitute for missing information for the years 1994-1997. In particular, we
substituted the missing information in years 1994 and 1995 with the 1993 list; and for the years 1996 and
1997, we used the 1998 list. This approach is justified for the following two reasons. First, the list
demonstrates some stability over time, i.e., the majority of the 100 firms included in the list in one year
remain in the list in the next year. Second, we have run alternative tests for 1998 and 1999 only, for which
the lists of companies are available and found that the results are largely consistent with those based on
the substitution approach. To maintain consistency with the remainder of the analysis, we report the
results based on the substitution approach that enables us to cover the full sample from 1994 to 1999.
After merging all the datasets and deleting observations with missing values in our key variables, the final panel data include 205 firms and 970 firm-year observations between 1994 and 1999. The firms are distributed within 17 two-digit and 63 three-digit SIC codes.

**Measures**

**Firm economic performance** (*Tobin’s* *Q*). Tobin’s Q was employed to capture the economic performance of the firm as Tobin’s Q reflects the stock market’s expectations of the future growth and profitability potential of the firm. Tobin’s Q is approximated as the market-to-book ratio. Specifically, the market value numerator is the year-end market value of common stock plus the book value of preferred stock and debt, and the book value denominator is the year-end total asset. This measure is in line with our statistical model, which will be explained later on. Meanwhile, this measure explains over 96% of the variance in a more sophisticated Tobin’s Q ratio that would require arbitrary assumptions about depreciation and inflation rates for the calculation of assets’ replacement values (e.g., Lindenberg and Ross, 1981). In addition, to be consistent with our statistical model, which shall be discussed in the next section, we conducted a log transformation of our proxy of Tobin’s Q.

**Firm-specificity of knowledge resources** (*FS*). Patent citations provide direct evidence of the path of knowledge flow and knowledge spillovers, since each technological innovation explicitly identifies several others as constituting the state-of-the-art technology on which it builds. Each patent has backward citations, like the references in a scientific paper. It is therefore possible to tabulate the frequency with which a particular patent cites previous patents of the same firm vis-à-vis other firms. Some research has used such tabulations to explore questions involving spatial spillovers (Jaffe, Trajtenberg, and Henderson, 1993), international knowledge flows (Jaffe, and Trajtenberg 1999), and spillovers from public research (Jaffe and Lerner 1999).
As having been argued earlier, firm-specific knowledge often results from firms’ searching and accumulating new knowledge on the basis of their established knowledge base (Teece 1986, Cohen and Levinthal 1989). If patents represent knowledge creation, and patent citations represent knowledge flows, the frequency with which a firm cites its own previous patents will indicate the degree to which the innovative knowledge is built upon the firm’s own existing knowledge base, which then reflects the level of firm-specificity of the firm’s knowledge resources. The higher the degree of internal private knowledge accumulation, the more firm-specific is the firm’s innovative knowledge. Based on this premise, measures of firm-specific knowledge resources may be constructed using patent citations. The level of firm-specific knowledge resources thus can be measured by examining the extent to which a firm’s current knowledge is derived from knowledge previously existing within the firm (cf. Hoetker and Agarwal, in press). Based on patent citation data from 1975 to 1999, we generate two proxies of the level of firm-specific knowledge resources: (1) the share of citations which are self-cites, and (2) the average number of self-cites scaled by firm size. In particular, the first measure of the level of firm-specific knowledge is calculated by counting the aggregate number of patent citations made in a firm’s new patents in a certain year that cited the firm’s previous patents, and then dividing this by the total patent citations made in all of the firm’s new patents in that year. As for the second measure, the level of firm-specific knowledge is calculated using the total number of self-cites within a certain year divided by the total firm assets in a firm in that year.

Note that the firm-specific knowledge measure using shares of self-cites explicitly takes into consideration the extent to which a firm’s knowledge is valued by the firm itself relative to other firms. However, one possible drawback of this measure is that some firms might cite their
own patents even when they are not economically valuable. Therefore, the share-based firm-specificity measures may be biased toward firms holding only a few patents, which almost no one else cites. Nevertheless, in addition to an alternative measure of firm-specific knowledge that helps to mitigate this concern, potential bias is further reduced by a control variable included in the analysis: patenting intensity, which is measured based on the total number of firm patents in a given year.

**Firm-employee relationships.** Two measures of firm-employee relationships are constructed. The first measure is based on the ‘employee relations’ dimension from KLD data. The employee relations dimension has a total of 7 strengths (strong union relations, no layoff policy, cash profit sharing, employee involvement, strong retirement benefits, health and safety strength, and other strengths) and 3 concerns (poor union relations, health and safety concern, workforce reduction) in the index. Considered as one of the best data sources for corporate social performance to date, KLD data have been applied by many recent studies to measure a firm’s social performance (e.g., Agle, Mitchell, and Sonnenfeld, 1999; Berman et al., 1999; Hillman and Keim, 2001). Following these research studies, we subtract the total number of concerns from the total number of strengths to arrive at a net score for firm-employee relationships. For example, if a firm hypothetically gets two “strengths” for no layoff policy and retirement benefits, plus one “concern” for workforce reductions, the firm’s net score for the firm-employee relationships dimension will be 1 (i.e., two strengths minus one concern). Note that we excluded the “cash profit sharing” and “employee involvement” dimensions from the list, as they are relevant for financial-based governance mechanisms. In addition, the strength and concern associated with “union relations” are also removed as this dimension is geared toward lower level employees, while the current paper’s focus is on key knowledge workers.
The second measure of firm-employee relationships is a simple dummy variable based on data on the 100 best companies to work for. This measure may better capture our construct because, according to Great Place to Work Institute, the organization that compiled the data, the definition of “a great place to work” is a place where employees: "trust the people they work for, have pride in what they do, and enjoy the people they work with." A great workplace is measured by the quality of the three interconnected relationships that exist there: (1) The relationship between employees and management; (2) The relationship between employees and their jobs/company; and (3) The relationship between employees and other employees. The measure is thus a dummy variable that is coded as 1 if a firm in our sample is on the top 100 best companies list and 0 otherwise.

Employee stock ownership. Employee stock ownership is measured by the percentage of beneficial ownership of the firm’s common stock held by employees as a collective\(^4\). Data on this variable are obtained from the EDGAR database of the SEC.

Other variables. R&D expenditure is traditionally used as a measure of investment in technological know-how. Previous research studies (e.g., Hall, 2000; Hall, Jaffe, and Trajtenberg, 2005) have also considered R&D expenditure as an innovation input and an important determinant of the intangible component of market value. R&D expenditure is expected to positively contribute to Tobin’s Q. We, thus, control for the effects of R&D expenditure in the market value equation. Specifically, to be consistent with our statistical model, we scale the firm’s yearly R&D expenditure by the firm’s total assets \((RD/A)\) in the analysis.

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\(^4\) Because the relatively large number of zeros in this variable, we conducted a supplementary analysis by coding employee stock ownership as a dummy variable (those having employee ownership of 5% or above are coded as 1, otherwise, 0). In addition, we also constructed a third measure of employee stock ownership using the coding of “cash profit sharing” in ‘employee relations’ dimension from KLD data. The main empirical results from these alternative approaches are quite consistent with our existing empirical findings. Details of the alternative empirical results are available from the authors upon request.
A firm’s patents are considered the output of the firm’s investment in knowledge creation and innovative activities (e.g., Griliches, 1981; Hall, 2000; Hall et al., 2005). Therefore, *patenting intensity* represents another important component of a firm’s intangible resources that contribute to the firm’s market value. Patenting intensity is simply calculated by the aggregated number of patents in a firm over the firm’s total assets in a given year (*PAT/A*).

R&D and patenting intensities are also included in the equations with employee stock ownership and firm-employee relationships as dependent variables. It is reasonable to expect that firms with greater knowledge resources in general (as indicated by R&D expenditure and patenting activities) have greater difficulty measuring employee efforts and are thus more likely to adopt employee stock ownership plans or to engage in building firm-employee relationships. In addition, we control for the effects of *firm size* and *financial slack* in these two equations. Previous research studies (e.g., Gregg and Machin, 1988; Kruse, 1996) have found empirically that larger companies have a greater level of employee stock ownership. Firm size may also affect firm-employee relationships positively, due to the presence of economies of scale in engaging in relationship building activities. Financial slack has been argued to affect the extent to which a firm adopts employee stock ownership plans (Poole and Jenkins, 1990; Jones and Kato, 1993) and firms with greater slack are more likely to engage in activities that build up their relationships with various stakeholders, including employees (Waddock and Graves, 1997).

Firm size is proxied by the natural logarithm of the total number of employees in a firm, given the evident positive skewness in this variable. Using the number of employees instead of total assets or sales to proxy for firm size fits better with this study, given employees’ willingness in making firm-specific human capital investments as the focus of our analysis. Following the methods of previous studies by Bourgeois (1981) and Singh (1986), we use each
firm’s current ratios (current assets divided by current liabilities) to represent available firm financial slack. In addition, year dummies and industry dummies at a three-digit SIC level are incorporated in all equations to control for time and industry fixed effects.

**Estimation Method**

*Overall model.* Our hypotheses require that we empirically test a system of equations simultaneously, since both employee stock ownership and firm-employee relationships are endogenously determined. First, we need to test whether the level of firm-specific knowledge resources is associated with the degree of employee stock ownership; second and simultaneously, we test whether the level of firm-specific knowledge resources is associated with the use of implicit firm-employee relationships; third, we must examine whether the level of firm-specific knowledge resources affects firm-level performance and whether the relationship between firm-specific knowledge resources and firm performance is moderated by employee stock ownership and firm-employee relationships. Specifying and testing the third equation independently would introduce significantly biased estimates due to the endogeneity of employee stock ownership and firm-employee relationships variables.

The equations are tested using a series of two-stage models that take into consideration of the endogeneity of the governance mechanisms. For the equations with employee ownership and firm-employee relationships as a continuous measure using KLD data, we apply a two-stage least squares method (2SLS) (Greene, 1997). In the first stage of 2SLS, new dependent or endogenous variables (in this case, employee stock ownership and firm-employee relationships) are created to substitute for the original ones. In the second stage, the regression is computed in the usual (OLS) fashion, but regressing on the newly created variable(s). The purpose of the first stage, in addition to the tests of equations 1 and 2, is thus to create new variables that reduce the biases
caused by the endogeneity in the variables in equation 3. Thus in this empirical study, the 2SLS estimation consists of two stages and the test of three equations. The first stage tests equations 1 and 2, which have employee stock ownership and firm-employee relationship respectively as the dependent variables. New variables are obtained by regressing the first-stage models. The second stage empirically tests equation 3, which has firm-level economic performance (market value) as the dependent variable, uses the newly estimated employee stock ownership, firm-employee relationships and their interactions with other factors that affect market value as regressors.

However, since our second measure of firm-employee relationships is a dummy variable, we apply Heckman’s (1979) self-selection model for equations with the dummy measure of firm-employee relationships. Although both 2SLS and Heckman’s self-selection techniques address the endogeneity of explanatory variables using two-stage models, one of the notable differences between these two techniques resides in the nature of the first-stage dependent variable. In 2SLS, the first-stage dependent variable is generally continuous. Heckman’s self-selection technique, on the other hand, is more appropriate for estimating models with discrete (choice) first-stage dependent variables.

As stated in the measures section, in addition to the level of firm-specific knowledge resources, R&D, patenting intensities, firm size, and financial slack are also included in the first-stage equations. Industry and year dummies are included to account for the differences across these dimensions.

The second-stage performance equation. Following the pioneering work of Waugh (1928) and Griliches (1961), and many later studies (e.g., Griliches, 1981; Hall, 2000; Hall et al., 2005), we determined the economic returns on firm-specific knowledge resources using the hedonic regression method which generally regresses the market value of a firm on the bundles
of resources that compose the firm, including measures relating to intangible resources such as knowledge and innovations. This research approach is often used when the direct valuation of the economic value generated from a resource is not available, and the resource can only be valued when bundled with other resources of the firm. For example, it is not easy to separate the knowledge about how to generate an innovation from the other resources of the firm that convert this innovation into a marketable product (Hall, 2000). However, assuming that the financial market is reasonably efficient in evaluating the total economic value of a firm (through stock price), we can use the hedonic regression method to infer the economic rents of an intangible resource from its regression coefficient estimate.

We therefore followed the basic approach employed in the market valuation literature that relates the market value of the company to the economic value of its tangible assets and various measures of its intangible assets (Griliches, 1981; Hall, 2000). $MV_i$ is defined as the market value of company $i$. The assets of the firm are made up of two parts: physical or tangible assets which are recorded and are measured as part of the total assets of the firm; and knowledge or intangible assets which largely go unrecorded and do not appear in the accounts as part of the total assets. The recorded economic value of the tangible assets is defined as $A_i$, and the corresponding measures of the economic value of the intangible assets are defined as $K_i$. The model is thus represented by:

$$MV_i = q (A_i + \gamma K_i)^\sigma$$

(1)

Taking the logarithms of both sides,

$$\log MV_i = \log q + \sigma \log A_i + \sigma \log (1 + \gamma K_i / A_i)$$

(2)
where $\log(1 + \gamma K_i / A_i)$ is generally approximated by $\gamma K_i / A_i$ in the literature (Hall et al., 2005). $\gamma$ measures the shadow value of knowledge assets relative to the tangible assets of the firm. $\sigma$ is unity under constant returns to scale, which is expected to be the case in a cross-sectional setting. $\log A_i$, the log of book assets, can then be moved to the left side of the equation:

$$\log(MV_i / A_i) = \log q + \gamma K_i / A_i.$$  \hspace{1cm} (3)

As Tobin’s Q is defined as a firm’s market value to the replacement value of the firm’s assets, and the replacement value is approximately the value of the tangible assets of the firm, $MV_i / A_i$, the ratio of a firm’s market value to the value of its tangible assets is in fact Tobin’s Q. Therefore, the above equation can be estimated with the logarithm of the conventional Tobin’s Q ($Q_i$) as the dependent variable, as we did here. Therefore, our final estimation model can be represented as follows:

$$\log Q_i = \log q + \gamma K_i / A_i + \epsilon_i$$  \hspace{1cm} (4)

where $\epsilon_i$ is a normally distributed error term.

On the basis of the model shown above, we came up with its expanded version:

$$\log Q = \alpha_0 + \beta_1 RD / A + \beta_2 PAT / A + \beta_3 FS + \gamma_2 FS * EmployeeOwnership$$

$$+ \gamma_3 FS * EmployeeRelations + \eta X + \epsilon$$  \hspace{1cm} (5)

Thus, equation (5) is the final second-stage equation to be estimated in this study. The $\beta$ parameters refer to intangible assets including both general and firm-specific knowledge assets: the ratio of R&D to total assets ($\beta_1$), the ratio of patent counts to total assets ($\beta_2$), and the level of firm-specific knowledge assets ($\beta_3$). The $\gamma$ parameters refer to the variables hypothesized to affect market value through providing motivations for employees to cooperate with the firm,
including interactions of the level of firm-specific knowledge assets with employee stock ownership ($\gamma_2$) and firm-employee relationships ($\gamma_3$).

The constant term $\alpha_0$ can be interpreted as the log of Tobin’s Q when the other variables in the equation are zero. $X$ encompasses other possible factors that may affect the value of intangible assets and Tobin’s Q. In the analysis, time and industry fixed effects are included to control for differences across industries and over time, as a firm’s market value is expected to vary across these dimensions.

To address the concern on autocorrelation and unobserved heterogeneity that are likely to be present when estimating a panel data set, we further apply standard techniques for panel data analysis. A Hausman (1978) test is conducted to determine the appropriate estimation method. The test results demonstrate that significant correlations exist between the error and the regressors, suggesting that firm-fixed effects models are preferred over random effects for our statistical analysis. Therefore, we have applied 2SLS with fixed effects to test the models.

RESULTS

Table 1 shows descriptive statistics and correlation matrices for the main variables used in the study. The two measures of the level of firm-specific knowledge resources (share of self-citations made and number of self-citations made) are highly correlated with each other (correlation = .42). In addition, both measures are positively correlated with market value, or logged Tobin’s Q. Also consistent with our expectations, both firm-specific knowledge measures have largely positive and statistically significant correlations with the two employee governance mechanisms: “employee stock ownership” and both measures of “firm-employee relationships” (except for the correlation between number of self-cites and employee stock ownership, which is
statistically insignificant, although the sign is still positive). R&D and patenting intensities are also positively correlated with logged Tobin’s Q, as would be expected.

--------------- Insert Table 1 about here --------------------

Table 2 shows the empirical results of the first stage models, which include regressions of employee stock ownership and both measures of firm-employee relationships against factors thought to affect the extent to which a firm adopts the employee governance mechanisms. Models 1, 3, 5, and 7 use the share of self-cites as the measure of the level of firm-specific knowledge; models 2, 4, 6, and 8, on the other hand, use number of self-cites as the firm-specific knowledge measure.

--------------- Insert Table 2 about here --------------------

The results from the first-stage analysis are largely consistent with the prediction of hypotheses 2a and 2b, which indicate that firms with a high level of firm-specific knowledge resources are more likely to adopt appropriate governance mechanisms to align employees’ efforts with that of the firm. Employee stock ownership is found to be positively associated with the level of firm-specific knowledge resources when measured by the share of self-cites (Models 1 and 3, $p < .05$). The relationship becomes statistically insignificant when the number of self-cites is used for the firm-specific knowledge measure; but the sign maintains positive (Models 2 and 4). More consistent patterns are found in the equation with firm-employee relationships as the dependent variables. When the continuous measure of the variable (based on KLD data) is used, the coefficients on both measures of firm-specific knowledge resources are positive and statistically significant (Models 5 and 6, $p < .01$ and $p < .001$ respectively). The effects are
weaker when the dummy variable measure of firm-employee relationship is used; but they are still at least marginally significant (Model 7 and 8, \( p < .05 \) and \( p < .1 \) respectively). Therefore, we find some support for hypothesis 2a and strong support for hypothesis 2b, providing empirical evidence for our argument of the endogeneity of employee governance mechanisms.

The results shown in Table 2 also indicate that employee stock ownership and firm-employee relationships (especially with the continuous measure of firm-employee relationships) are negatively associated with each other, indicating that these two governance mechanisms are likely to be substitutive. Furthermore, large firms are found to be more likely to have a high level of employee stock ownership. Financial slack is positively associated with firm-employee relationships, consistent with the perspective that cash rich firms are more likely to engage in activities that build up their relationships with employees (e.g., Waddock and Graves, 1997). But the same effect is not found when employee stock ownership is used as the dependent variable. Similarly, consistent with our prediction, R&D intensity is positively related to firm-employee relationships; but the effect is not statistically significant for employee stock ownership.

**Second-stage Financial Performance Estimates**

Table 3 presents the empirical results from the second-stage estimation of the models. For the models applying 2SLS (Models 2, 3, 6, and 7), we use the estimated employee stock ownership and firm-employee relationships variables generated in the first stage and their interactions with other factors that affect market value as regressors. For the models applying the Heckman’s self-selection model (Models 4 and 8), we add the correction for self-selection (inverse Mills ratio or Lambda) in the equations. Models 1 to 4 use the share of self-cites as the firm-specific knowledge measure; and models 5 to 8 use the number of self-cites as the firm-specific knowledge measure.
The effects of the key regressor, the level of firm-specific knowledge, and other intangible resources, including R&D and patenting intensities, are shown in Models 1 and 5. Both of the firm-specific knowledge measures show positive and statistically significant associations with market value, indicating that firms with a higher level of firm-specific knowledge assets are more likely to achieve a higher level of economic performance. Therefore, hypothesis 1 is supported. Also as predicted, both R&D and patenting intensities are positively and significantly ($p < .001$) related to firm market value (log (Tobin’s q)).

In Models 2 and 6, employee stock ownership and its interactions with measures for the level of firm-specific knowledge assets are added. When the share of self-cites is used as the firm-specific knowledge measure, the interaction term is positively related to firm market value ($p < 0.05$, Model 2). When the number of self-cites is used, the coefficient on the interaction becomes statistically insignificant, although the sign is still positive (Model 6). These results provide only limited support for hypothesis 3a, which states that the effect of firm-specific knowledge assets on firm performance is positively moderated by employee stock ownership.

To gain a better understanding of the moderating role of employee stock ownership on the relationship between firm-specific knowledge assets and firm market value, we conducted supplementary analysis by splitting the sample into two sub-samples according to firm size (with the mean firm size, or number of employees, as the cutoff point) and running the regressions again using employee stock ownership as a moderator. The rationale for conducting this supplementary analysis is as follows. One of the drawbacks of group incentive schemes such as employee stock ownership is that the connection between individual performance and reward
grows weaker as the number of employees in the group grows larger. This drawback is sometimes referred to as the “1/N problem”: with N employees in a company, each employee will get an average only 1/N of any extra surplus generated by his/her better performance (Holmstrom, 1982). Furthermore, when a firm or a team is large, the contribution of a particular employee to team output cannot be measured and paid accordingly. This perspective suggests that the link between firm-specific knowledge assets and firm economic performance may be stronger for smaller firms. With the reduced small firm sample, we found support for this view: the coefficients on the interaction terms turn positive and statistically significant for both measures of firm-specific knowledge assets5. The detailed empirical results from the small firm sample are shown in Table 4.

----------------------------- Insert Table 4 about here -----------------------------

Models 3 and 7 in Table 3 provide the results after adding the continuous measure of firm-employee relationships and its interaction with measures of firm-specific knowledge assets to Models 1 and 5. For both firm-specific knowledge measures, the coefficients on the interaction terms are positive and significant ($p < .001$). Models 4 and 8 replace the firm-employee relationships measure with the dummy variable. For both firm-specific knowledge measures, the coefficients on the interaction terms remain positive and marginally significant ($p < .1$). These results suggest that the effect of firm-specific knowledge assets on firm performance is positively moderated by firm-employee relationships, supporting hypothesis 3b.

5 We conducted additional analysis using large firms only and found that the interaction terms are insignificant. Moreover, as an alternative supplementary test, instead of splitting the sample based on firm size, we conducted three-way interaction among employee stock ownership, knowledge specificity, and firm size. We found that the three-way interaction term is negative and statistically significant, a result consistent with that of using the split samples. These empirical results are available upon request.
DISCUSSION AND CONCLUSIONS

The resource-base view emphasizes the role of firm-specific resources, especially firm-specific knowledge assets, for enabling a firm to achieve superior economic performance (Barney, 1991; Kogut and Zander, 1992). However, little research attention⁶ has explored the governance mechanisms that may influence the actual economic benefit that can be obtained from firm-specific resources. This paper maintains that the features of firm-specific knowledge resources that constitute potential performance advantages are simultaneously likely to give rise justifiably to employee reluctance to invest in firm-specific human capital. And moreover, adopting governance mechanisms that align employee interests with that of the firm enables the firm to achieve a greater level of economic performance from its efforts to deploy firm-specific knowledge assets by virtue of reducing the gap between potential and realized economic rents.

The key results from the current paper’s empirical analysis broadly support the theory developed herein. The empirical findings indicate that firms with a greater level of firm-specific knowledge resources are more likely to adopt appropriate governance mechanisms to align employees’ interests with that of the firm. The specific governance mechanisms discussed in the current paper include both an economic-based governance mechanism of granting employee stock ownership, and a relationship-based governance mechanism of building firm-employee relationships. Furthermore, the increased use of these governance mechanisms strengthens the relationship between the level of firm-specific knowledge and a firm’s economic performance. Therefore, this paper extends the resource-based view of the firm by emphasizing that the firm’s dynamic resource base and the effectiveness of its governance mechanisms jointly influence the firm’s actual generation of economic rents.

⁶ Exceptions are Gottschlag and Zollo (in press) and Makadok (2003), which maintain that accurately predicting firm performance requires that resource-based research not overlook governance mechanisms.
In addition to its contribution to theory, this paper is, to our knowledge, the first empirical effort following the tradition of the resource- or knowledge-based view to test the antecedents of both explicit and implicit employee governance mechanisms and their roles in affecting firms’ knowledge-based advantages. Furthermore, this paper makes contributions to the research literature that examines the organizational consequences, especially the economic performance effect, of adopting employee stock ownership. While quite a few research studies have examined the relationship between employee stock ownership and performance, the overall empirical evidence is inconclusive (Kruse and Blasi, 1997). Moreover, there is little information on the mechanisms through which employee stock ownership may influence performance. Although the inconclusiveness in the empirical results might be attributed to differences across data, measurements, sampling and statistical methods, the current paper’s analysis suggests another possibility: because employee stock ownership is endogenous to firms’ asset composition, whether and to what extent a firm benefits from employee ownership is also determined by the fit between this governance mechanism and firm’s resource compositions.

**Limitations and Future Research Direction**

This paper also has some limitations that require future research to advance its key arguments. First, since this paper follows an equilibrium approach of the resource-based view by viewing firms as a bundle of idiosyncratic knowledge resources, by design it is not able to address how the heterogeneity of firm-specific knowledge across firms is created in the first place. Future research can fill this gap in the literature by take a dynamic and process focused approach to explore the origin of firm-specific knowledge creation and moreover, the employee governance issues in the entrepreneurial process of knowledge creation.
Second, although the interrelationship between the two alternative governance mechanisms is not the focus of the current paper, the empirical results provide evidence for both substitutive and complementary effects. Although directly regressing one governance mechanism on the other seems to suggest that employee stock ownership and firm-employee relationships are substitutive (Table 2), the difference in the determinants of the two governance mechanisms suggests some degree of complementarity. The complementarity aspect might come from the failure of employee stock ownership to safeguard against employee underinvestment problem when individual performance is difficult to identify. In this setting, informal relationships may serve as a complementary governance mechanism to employee stock ownership in resolving the employee underinvestment problem (Ouchi, 1980; Eisenhardt, 1985; Gibbons, 1998). However, without more careful empirical design and data collection, these arguments will merely remain as plausible speculations. Therefore, future research will make valuable contributions to the management research literature by carefully examining the inter-relationships between firms’ explicit and implicit governance mechanisms.

Third, the current paper may suffer from some drawbacks that stem from data limitations. For example, although the richness of KLD data renders it an appropriate choice for information on “firm-employee relationships,” the dataset still has its limitations. Specifically, the types of employees that the current paper focuses on are the firm’s key employees who invest in firm-specific human capital. But the items listed in the “Employee Relations” dimension of the KLD data are relevant for a broader range of employees, including lower level employees. Although we have removed some items that are specially related to low-level employees and furthermore, applied an alternative measure of firm-employee relationship, it does not resolve all of the

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7 An examplar is Poppo and Zenger’s (2002) research, which specifically examines whether formal contracts and relational governance function as substitutes or complements.
concerns. Similarly, employee stock ownership may be targeted to various levels of employees, including lower level employees. Although some previous empirical studies have shown that important employees are likely to have greater stock ownership (Brickley and Hevert, 1991) and that knowledge-intensive firms have greater employee ownership (Ryan and Wiggins, 2002; Chen and Huang, 2006), data on the specific shareholding of key knowledge workers would enhance the validity of the empirical findings.

Furthermore, although patent data provided rich information about technological knowledge flow, it also has inherent limitations that might constrain our measurement of firm-specific knowledge assets and thus the interpretation of regression results. Future research can use survey or field data to explore knowledge flow and the degree of firm-specificity in other aspects of knowledge assets, for example, in R&D investments (Helfat, 1994) or in other non-patented knowledge assets. The exploration of the role of firm-specific knowledge assets can be even extended to firm-specificity in heterogeneous knowledge-creation processes. For example, the superior economic performance of a firm may not come from firm-specificity in their innovative output, but in the firm’s unique configurational capability for continuously generating new knowledge innovations ahead of their competitors.

The resource-based view places human resources among the most important resources available to a firm, and central to the debate about how firms achieve competitive advantage (Coff, 1999; Mahoney, 2005). Therefore, the willingness of a firm’s employees to invest in essential firm-specific knowledge should be an important area of study in the evolving science of organization. It is hoped that this research constitutes another step toward a better understanding of the effect of employee knowledge and learning on firm behavior and performance at the strategic level.
References


Figure 1: The Conceptual Model

- Employee Stock Ownership
- Firm-Employee Relations
- Market Value (Performance)

Equation 1
- Exchange Hazards
- Equation 2
- Superior Resource Position

Equation 3
- Firm-Specific Knowledge Resources
<table>
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<th>Variables</th>
<th>Mean</th>
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N = 970;
* p < .05;
Table 2
The Determinants of Employee stock ownership and Firm-employee relationships:
Results from First-Stage Models with Firm Fixed Effect

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<th>DV: Firm-employee relationships (Dummy) Probit Models</th>
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N = 970; Standard errors are shown in parentheses; Industry and year dummies are included but not reported; Significant at the * p < .10  ** p < .05  *** p < .01  **** p < .001 level.
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N = 970;
Standard errors are shown in parentheses;
Industry and year dummies are included but not reported;
Significant at the * p < .10  ** p < .05  *** p < .01  **** p < .001 level.
Table 4

Reexamining the Moderating Role of Employee Stock Ownership for Small Firms (with Firm Fixed Effect)

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N = 482;
Standard errors are shown in parentheses;
Industry and year dummies are included but not reported;
Significant at the * p < .10 * p < .05 ** p < .01 *** p < .001 level;
The sample includes firms with size below the mean level; and size is measured by the log of the number of employees.
Appendix

The categories in the “Employee Relations” dimension of the KLD dataset

STRENGTHS

*Strong Union Relations (EMP-str-A):* The Company has a history of notably strong union relations.

*No-Layoff Policy (EMP-str-B):* The Company has maintained a consistent no-layoff policy. KLD has not assigned strengths for this issue since 1994.

*Cash Profit Sharing (EMP-str-C):* The Company has a cash profit-sharing program through which it has recently made distributions to a majority of its workforce.

*Employee Involvement (EMP-str-D):* The Company strongly encourages worker involvement and/or ownership through stock options available to a majority of its employees through gain sharing, stock ownership, sharing of financial information, or participation in management decision-making.

*Strong Retirement Benefits (EMP-str-F):* The Company has a notably strong retirement benefits program.

*Health and Safety Strength (EMP-str-G):* The Company is noted by the US Occupational Health and Safety Administration for its safety programs. KLD began assigning strengths for this issue in 2003.

*Other Strength (EMP-str-X):* The Company has a good employee safety record or demonstrates other noteworthy commitments to its employees’ well being.

CONCERNS

*Poor Union Relations (EMP-con-A):* The Company has a history of notably poor union relations.

*Health and Safety Concern (EMP-con-B):* The Company recently has either paid substantial fines or civil penalties for willful violations of employee health and safety standards, or has been otherwise involved in major health and safety controversies. KLD changed the name of this rating from Safety Controversies in 2003.

*Workforce Reductions (EMP-con-C):* The Company has reduced its workforce by 15% in the most recent year or by 25% during the past two years, or it has announced plans for such reductions. Before 1994, the concern is only assigned to companies that have laid-off 15% of workers in the most recent year.