RIETI Discussion Paper Series 21-E-065

The Liability of Aging in Internal Capital Markets

USHIJIMA, Tatsuo
Keio University

Research Institute of Economy, Trade & Industry, IAA

The Research Institute of Economy, Trade and Industry
https://www.rieti.go.jp/en/

RIETI Discussion Paper Series 21-E-065
August 2021

The Liability of Aging in Internal Capital Markets[1]

Tatsuo USHIJIMA
Keio University

Abstract

Diversified firms differ considerably in the efficiency of their internal capital markets (ICMs), through which scarce capital is allocated across alternative growth opportunities. This study highlights the role of firm age in generating this heterogeneity. Consistent with the hypothesis that organizational aging increases the rigidity of capital allocation, our analysis of Japanese firms identifies a strong inverse association between ICM efficiency and firm age. This correlation is robust to controlling for covariates suggested by alternative explanations such as agency problems and the individual aging of managers. Moreover, the correlation is substantially weakened when a firm is drastically reorganized. These results suggest that the liability of aging (age-based organizational rigidity) significantly affects intrafirm resource mobility, which is crucial for a firm's ability to respond to external changes.

Keywords: diversification, internal capital market, firm age, liability of aging
JEL classification: G31, L22, L25

[1]This study is conducted as a part of the Project "Frontiers in Corporate Governance Analysis" undertaken at the Research Institute of Economy, Trade and Industry (RIETI). This study utilizes the micro data of the questionnaire information based on "the Basic Survey of Japanese Business Structure and Activities" which is conducted by the Ministry of Economy, Trade and Industry (METI). The author is grateful for helpful comments and suggestions by seminar participants at RIETI.

1. Introduction

Diversified firms can reallocate capital across alternative growth opportunities through internal capital markets (ICMs). This ability represents a bright side of diversification if ICM works efficiently because of the information and governance advantages of managers over external investors (Williamson, 1975; Gertner et al., 1994; Stein, 1997). However, the same ability can give rise to a dark side of diversification if incentive and informational problems distort intrafirm fund flows (Meyer et al., 1992; Scharfstein and Stein, 2000; Rajan et al., 2000). Both of these views appear to have some truth to them. Empirical studies such as Shin and Stulz (1998), Rajan et al. (2000), and Gertner et al. (2002) show that diversified firms, on average, reallocate capital inefficiently. However, these studies also document that the variance of ICM efficiency is large, with many firms shifting capital in a value-increasing fashion. Factors underlying this heterogeneity are of interest to various strands of research.

Previous studies on this topic have highlighted the influence of individuals who administer resource allocation processes. Xuan (2009) finds that new CEOs use capital budgets for "bridge building" with unfamiliar businesses. Gasper and Massa (2011) and Duchin and Sosyura (2013) observe that divisions receive disproportionately large funds when their managers share similar backgrounds and social connections with executive managers. Glaser et al. (2013) show that corporate-level cash windfalls stimulate the investment of divisions headed by powerful managers. In contrast, little is known about the role of organizations in which ICM is embedded. A firm's organization has its own character, which affects the behavior and decisions of its people. Accordingly, how an ICM works is also likely to vary across firms according to the attributes of their organization. The present study seeks to explore this understudied issue with particular focus on firm age, measuring the length of time that a firm's organization has existed since its founding (Bakker and Josefy, 2018).

Firm age has implications for a broad range of organizational phenomena. A key insight obtained from this diverse literature is that an organization's aging generates rigidity, which hinders firms from responding to external volatility. This effect, known as the liability of aging (Barron et al., 1994; Ranger-Moore, 1997) or age-based organizational rigidity (de Figueiredo et al., 2015), can be important for ICMs because their workings depend critically on a firm's ability to respond to changes in the distribution of external growth opportunities. As documented by Bower (1970) and Glaser et al. (2013), among others, the capital budgeting of diversified firms involves intricate organizational processes.[1] If organizational aging increases the rigidity of these processes by making them more formalized, routinized, and politically complex, ICM efficiency can decline with firm age. The present study examines this possibility based on Japanese data.

The liability of aging is not the only mechanism that can give rise to a negative correlation between firm age and ICM efficiency. For instance, agency problems may be larger for older firms because their managers have more firm-specific human capital, which insulates them from external governance (Berger et al., 1997). Differential access to external capital may also play a role in generating the correlation because old firms face relatively weak financial constraints (Hadlock and Pierce, 2010). Research has found that ICM efficiency tends to decline when firms have better access to external funds (Dimitrov and Tice, 2006; Hovakimian, 2011; Kuppuswamy and Villalonga, 2016). These and other possible scenarios are not mutually exclusive. However, they

[1] See Sengul, Costa, and Gimeno (2019) for a review of research on the organizational aspects of intrafirm capital allocation.

suggest distinct covariates of firm age, which can be used to narrow down possible explanations. We thus examine how ICM efficiency varies with these covariates as well as firm age.

The sample comprises diversified (multisegment) firms that were publicly traded during 2001 and 2010. We measure ICM efficiency based on two indices. One is Rajan et al.'s (2000) relative value added (RVA), which is widely used in the literature. This index measures segmental growth opportunity with industry Q. To address concerns for measurement errors and biases caused by this methodology (Whited, 2001; Colak and Whited, 2007), we also use an index based on segment-specific Q, which is estimated from segmental characteristics as done by Billet and Mauer (2003) and McNeil and Smythe (2009). Consistent with the hypothesized effect of firm age, both of these measures indicate that ICM efficiency is significantly lower for older firms. The effect of firm age estimated from our baseline regression implies that a one standard deviation (SD) change in logged firm age is associated with a change in RVA that is equivalent to 6.7% of the index's SD. This magnitude is no smaller than the effect size of other determinants of allocative efficiency. Therefore, firm age plays an economically meaningful role in differentiating ICM across firms.

To delve deeper into this finding, we perform two sets of analyses. First, as noted above, we estimate regressions incorporating the covariates of firm age suggested by alternative scenarios, such as agency problems, financial constraints, and the aging of managers. If executive agency problems drive the observed association between ICM efficiency and firm age, it should be weakened when corporate governance variables are included in regressions as a more direct control for agency costs. Likewise, if firm age picks up the effect of managers' age, we should observe a weaker association when the latter variable is directly accounted for. We consider nine covariates suggested by six scenarios. However, the inverse association between ICM efficiency and firm age is hardly affected by the inclusion of these variables in the regressions.

Second, we examine how a large discrete change in organizational structure moderates the effect of firm age. When a firm is radically reorganized, organizational processes associated with capital budgeting are also renewed in accordance with the new structure. Divisional vested interests, which render flexible reallocation of resources politically difficult, are also dissolved as divisions are created, closed, and recombined for reorganization. Accordingly, if firm age captures the effect of organizational rigidity, its effect on ICM efficiency should be weakened when firms drastically restructure organizations. We test this prediction by exploiting a wave of reorganization induced by a large legislative reform, which lifted a long-term ban of holding company structure in Japan. We find that for firms that adopted the structure by separating all of their businesses into subsidiaries, the negative effect of firm age on ICM efficiency was indeed substantially diminished. This pattern is consistent with the notion that major organizational changes reset the aging clock of firms by renewing factors that drive its progress (Amburgey et al., 1993). It also reinforces our view that firm age is inversely correlated with ICM efficiency because it picks up the effect of organizational rigidity.

The rest of this article is organized as follows. The next section develops hypotheses and considers alternative scenarios. Section 3 introduces the data and empirical methodology. Section 4 reports the estimation results. The study’s conclusions are presented in the final section.

2. Hypotheses

2.1. Main hypothesis

Research has examined the effect of firm age on various aspects of firm behavior and performance (Bakker and Josefy, 2018; Coad, 2018). A common theme of this diverse literature is that older firms have more established ways of doing things, which they have developed over their operating history. Organizational scholars stress that this development is a double-edged sword. On the one hand, it enhances a firm's reliability and accountability, thereby working to the advantage of old firms in competition with young firms (Hannan and Freeman, 1984). On the other hand, it impedes a firm's ability to respond to external changes by increasing organizational rigidity (Barron et al., 1994; Ranger-Moore, 1997). This latter effect, known as the liability of aging, is of interest to the present study because the efficiency of an ICM depends critically on a firm's ability to shift capital in response to changes in the distribution of external growth opportunities. It can be that the dark side of diversification stressed by Shin and Stulz (1998), Rajan et al. (2000), and Gertner et al. (2002), among others, is more serious for older firms.

Several factors can give rise to the liability of aging in capital allocation. The first is formal budgeting systems, which define the authority of managers and prescribe the rules and procedures they should follow in allocating scarce capital across alternative opportunities (Merchant, 1981). Diversified firms have a decentralized organization in which information on external opportunities is diffusedly held by operating divisions. The capital budgeting of diversified firms therefore involves a bottom-up process through which divisional investment proposals are created and submitted to headquarters (e.g., Bower, 1974; Glaser et al., 2013). The ensuring processes for funding decisions can be quite involved because, in evaluating submitted proposals, headquarters often require additional input from divisions. Formal budgeting systems streamline these processes by regulating how investment projects are proposed, evaluated, and prioritized for funding. As they are refined through repetition and taken for granted by managers of various levels, budgeting systems operate increasingly smoothly, enabling firms to make investment decisions without a costly delay.

However, the formalization of capital budgeting processes also has drawbacks. Information on emergent changes in the business environment is often soft in the sense of Liberti and Petersen (2019). That is, it is context-specific and cannot be quantified without a loss of content. However, in prioritizing alternative opportunities, formal budgeting systems place a large weight on hard information, which is quantifiable and comparable across contexts (businesses). Accordingly, information that has a large impact on the investment of single-business firms can be underutilized by diversified firms.[2] Moreover, budgeting systems rarely operate on a "zero base." Previous budgets therefore become a strong anchor, which limits a flexible reallocation of capital, especially for firms with a long operating history. These tendencies imply that the capital budgeting of old firms is more inertial than that of young firms.

The second is organizational routines, which are the recurring patterns of communications and actions undertaken by organizational members in performing a given set of tasks (Nelson and Winter, 1982; Hannan and Freeman, 1984; Becker, 2004). Organizational routines enable firms to operate smoothly even without conscious control. Unlike the formal elements of organizations, such as divisional structure and planning systems, routines evolve organically and grow stronger through the repetition

[2] This bias in information usage can also narrow the scope of information collected by operating divisions if they pay insufficient attention to information that is not admissible as a basis of headquarters' funding decisions.

of focal activities. While strong routines underlie the stability and reliability of old firms (Hannan and Freeman, 1984), they also generate path dependency, limiting a firm's ability to respond to external volatility (Barron et al., 1994; Ranger-Moore, 1997). Therefore, older firms can have less efficient ICMs because they have developed stronger routines for capital budgeting activities.

The third is organizational politics (de Figueiredo et al., 2015). The information asymmetry between divisions and headquarters about external opportunities implies that divisions can influence, even manipulate, headquarters' decisions. Accordingly, when divisions pursue their own interest, as suggested by Scrafstein and Stein (2000) and Rajan et al. (2000), among others, they do not behave passively in capital budgeting processes. They vie for scarce resources by engaging in influence activities, such as lobbying and networking (Meyer et al., 1992). Given such divisional behavior, executive managers play the role of political brokers in the sense of March (1962). That is, they moderate and balance competing divisional interests to create a budget that is acceptable to their organization. This political nature of ICMs implies that radically changing capital allocation is difficult for old firms because their divisions have strong vested interests in the status quo.

The above-described mechanisms are interrelated. As firms refine formal budgeting systems, they also develop stronger routines through the repetition of associated activities. Divisions' vested interests also become stronger and more intertwined over time. It therefore stands to reason that as firms grow older, they become less flexible in shifting capital across businesses. We therefore propose the following hypothesis:

Hypothesis 1

The allocative efficiency of diversified firms' internal capital markets is inversely associated with firm age.

We recognize that the hypothesized inverse association between ICM efficiency and firm age may not hold in the early stages of the firm lifecycle because of experiential learning. That is, for young firms still inexperienced in resource allocation, ICM efficiency may increase with firm age because the benefit of the refinement of budgeting systems and organizational routines can outweigh its cost. The political complexity of organizations is also relatively low for young firms. As firms grow older, however, the marginal benefit of learning diminishes, whereas the cost of organizational aging increases. Accordingly, we also examine the possibility that the relationship between ICM efficiency and firm age is nonmonotonic, as described in the following hypothesis.

Hypothesis 2

The association between ICM efficiency and firm age is positive when firms are young and becomes negative as firms grow older.

2.2. Alternative scenarios

It is also important to note that old firms can have relatively inefficient ICMs for reasons other than age-based organizational rigidity. Our analysis considers the following alternative scenarios.

2.2.1. Agency hazards

The managers of older firms have more firm-specific human capital, which shelters them from external governance (Berger et al., 1997). Hence, ICM efficiency may be negatively correlated with firm age because executive agency problems are more serious for older firms. Empire-building managers are unlikely to distort capital allocation because they can accelerate the growth of their firm by having an efficient ICM (Stein, 1997). However, if managers value a quiet life, as stressed by Bertrand and Mullainathan (2003), poorly disciplined managers may adhere to capital allocation patterns historically accepted by their organization. Accordingly, managerial aversion to organizational disruption can generate an inverse association between ICM efficiency and firm age.

2.2.2. Financial constraints

Research has found that the ICM efficiency of diversified firms tends to improve during a recession (Dimitrov and Tice, 2006; Hovakimian, 2011) and financial crises (Kuppuswamy and Villalonga, 2016). If costly external finance conditions induce firms to utilize internal funds more efficiently, as suggested by these patterns, an inverse association between ICM efficiency and firm age can reflect the relatively weak financial constraints of old firms. There is strong evidence that older firms have better access to credit because firms with a longer history of operations have higher financial stability and better reputations and are more transparent to creditors (Hadlock and Pierce; 2010; Sakai et al., 2010).

2.2.3. Top management team

Young and old firms are managed differently. Unlike young firms in which a small group of entrepreneurs play strong leadership roles, typical old firms are managed by a large group of managers who make important decisions collectively (Finkelstein et al., 2009). Group decision making can improve decision quality by mitigating individual managers' biases. However, it also slows decisions because of the need for consensus. Accordingly, older firms can have less efficient ICM because they have larger management teams, which prevent them from responding quickly to external volatility.

2.2.4. Headquarters

Large top management teams are usually supported by a large group of headquarters staff who collect internal and external information to articulate policy alternatives. Oftentimes, they are also the gatekeeper between top management and divisions. Although large headquarters increase a firm's information collection and processing capabilities, they also increase administrative complexity and bureaucracy. A centralized organizational structure can also hinder the competitive allocation of scarce capital (Hill et al., 1992). Therefore, if old firms have relatively large headquarters, firm age can pick up the effect of centralized structure rather than age-based organizational rigidity.

2.2.5. CEO age

Firm age can also pick up the effect of managers' age. Older firms tend to be headed by older CEOs who have a longer career in business, which enables them to make more seasoned decisions. At the same time, however, older managers also have a more idiosyncratic style of management, stronger commitment to past strategy (Bertrand and Schoar, 2003), and lower cognitive ability (Waelchli and Zeller, 2013). Because these attributes can decrease CEOs' adaptability, firms managed by old CEOs can have relatively inefficient ICMs.

2.2.6. Employee age

Older firms also generally have older workforces. Old employees are more accustomed to how their firm is organized and operated and therefore are more prone to take them for granted than young employees (Ouimet and Zarutskie, 2014; Le Mens et al., 2015). Older employees also generally have larger quasi-rents associated with their job and organizational position. Hence, ICM efficiency and firm age can be negatively correlated because the employees of old firms resist changes that involve a drastic redeployment of resources.

3. Empirical methodology

3.1. Sample and main variables

Our sample comprises Japanese diversified firms that were publicly traded during 2001 and 2010. We define a firm as diversified if it operates multiple industrial segments that are distinct at the three-digit level of the Japan Standard Industry Classification (JSIC). In constructing the sample, we start with all diversified firms in the Nikkei NEEDS financial database. Unless otherwise noted, all data used in this study are taken from this database. We exclude financial institutions, firms with a financial segment, firms with an unclassifiable segment (JSIC code 9999), and firms reporting negative equity or other irregular value[3]. We also exclude firms if the sum of segmental assets deviates from firm-level assets by 25% or more. The resultant sample includes 11,097 firm-year observations.

We define firm age as years elapsed after a firm is incorporated.[4] As reported in Table 1, the mean (median) age of our sample firms is 56.7 (57). We use two indices as a measure of ICM efficiency. The first is the relative value added (RVA) proposed by Rajan et al. (2000). This index measures allocative efficiency based on the extent to which a firm invests relatively more (less) in relatively promising (unpromising) opportunities given its business portfolio. RVA is defined as follows:

$$RVA_{it} = \frac{\sum_j Asset_j (q_j - \bar{q}) \left(\frac{Capex_j}{Asset_j} - \left(\widehat{\frac{Capex_j}{Asset_j}} \right) - \sum_j w_j \left(\frac{Capex_j}{Asset_j} - \left(\widehat{\frac{Capex_j}{Asset_j}} \right) \right) \right)}{Total\ \ Asset_i}, \quad (1)$$

where *Capex*/*Asset* is capital expenditure over assets for segment j, $\widehat{Capex/Asset}$ is the asset weighted average of this ratio of focused firms in the same industry, and w is the share of segmental assets in firm assets. q represents a segment's growth opportunities measured by the weighted average Q of focused firms in the same industry. $\bar{q}$ is the asset-weighted q of all segments in the firm. *Total Asset* denotes firm-level assets. Hence, RVA is a size- and opportunity-weighted sum of segmental investment

[3] Specifically, to remove observations potentially associated with severe distress and irregular accounting, firm-years that meet one of the following conditions are omitted: negative equity, |EBITDA/sales|>100%, CAPEX/sales>100%, and debt/market equity>1000%. Virtually identical results are obtained even when these observations are not removed from estimations.

[4] An alternative firm age measure widely used in the financial literature is years after IPO (Pastor and Verronesi, 2003; Arikan and Stulz, 2016; Loderer et al., 2017; Kieschnick and Moussawi, 2018). We use incorporation age rather than IPO age because many of our sample firms have a long pre-IPO history. The mean (median) IPO age of sample firms is 30.8 (36). Moreover, the distribution of Japanese firms' IPO age is highly rugged due to the disruption of stock exchanges during World War II.

adjusted for industry and firm. It increases with allocative efficiency and takes a positive value if the firm invests relatively more (less) in high (low) Q industries and a negative value if otherwise.

RVA uses the Q of focused firms in the same industry as a proxy for a segment's growth opportunity. This approach necessarily involves measurement errors because firms are heterogeneous even within an industry. Moreover, it generates biases if the segments of diversified firms are systematically different from focused firms (Whited, 2001; Colak and Whited, 2007). As an alternative measure of ICM efficiency, therefore, we also use a revised RVA (RRVA) defined as follows:

$$RRVA_{it} = \frac{\sum_j Asset_j(\tilde{q}_j - \bar{\tilde{q}})\left(\frac{Capex_j}{Asset_j} - \left(\frac{\widehat{Capex_j}}{Asset_j}\right) - \sum_j w_j \left(\frac{Capex_j}{Asset_j} - \left(\frac{\widehat{Capex_j}}{Asset_j}\right)\right)\right)}{Total\ \ Asset_i}. \quad (2)$$

This index differs from the original RVA in the measurement of growth opportunities. Specifically, segmental growth opportunity and the average growth opportunity of a firm's segments are measured by segment-specific Q ($\tilde{q}$) and the asset-weighted average of segment-specific Q ($\bar{\tilde{q}}$), respectively.

Because the segment-specific Q is unobservable, we estimate it from the observable attributes of a segment as done by Billet and Mauer (2003) and McNeil and Smythe (2009). The first step of estimation is to perform the following regression for focused firms in the 2-digit industry to which a segment belongs: [5]

[5] We require that at least 100 observations are available to estimate this regression. If a segment's 2-digit industry contains fewer than 100 firm-years for focused firms, estimation is performed at the finest level at which this condition is satisfied.

$$q_{it} = \alpha_0 + \beta_1\ ra_{it} + \beta_2\ ra_{it}^2 + \beta_3\ to_{it} + \beta_4\ to_{it}^2 + \beta_5\ la_{it} + \beta_6\ la_{it}^2 + \phi_t + u_{it}. \quad (3)$$

The dependent variable is the Q ratio (market value of equity plus liabilities over total assets). ra, to, and la denote ROA (EBITD/asset), turnover (sales/asset), and logged asset, respectively. We include the quadratic terms of these variables to improve the fit of the regression. ϕ is a year fixed effect. We then estimate a segment's Q ($\tilde{q}$) by imputing the segment's own ra, to, and la to the estimated model. To obtain a reasonable estimate, the imputed Q is winsorized at the minimum and maximum values of focused firms' Q in the same industry as done by Billet and Mauer (2003).[6] McNeil and Smythe's (2009) analysis of segmental investment suggests that imputed Q more accurately captures segmental growth opportunities than industry Q.

Table 1 tabulates the descriptive statistics of sample firms' firm-level Q, asset-weighted industry Q ($\overline{q}$), and asset-weighted segment-specific Q ($\overline{\tilde{q}}$). Two points are noteworthy. First, diversified firms are discounted vis-a-vis focused firms in that firm-level Q is on average significantly lower than asset-weighted industry Q. Second, the mean asset-weighted segment-specific Q is significantly larger than the mean asset-weighted industry Q, suggesting that industry-level Q for focused firms tends to underestimate the growth opportunities of segments. The difference between asset-weighted values of industry Q and segment-specific Q is larger at higher percentiles. Hence, underestimation occurs especially for "crown jewels"—businesses that are likely to be valued highly if spun off as a standalone entity.

[6] We obtain qualitatively similar results when this winsorization is not performed.

Table 1 also reports the descriptive statistics of ICM efficiency measures.[7] The mean value of RVA is significantly negative. Hence, as reported by previous studies for U.S. firms, this standard measure of allocative efficiency suggests that the dark side of diversification dominates the bright side among Japanese firms. However, the mean value of RRVA is not significantly different from zero. Table 2 compares the mean values of RVA and RRVA by year. The mean RVA was negative and significantly different from zero throughout the study period. In contrast, a systematic deviation toward neither the bright nor dark side of diversification is observed for RRVA. The difference in mean between RVA and RVAA was significant except for one year. This persistent difference notwithstanding, RVA and RRVA both exhibit a large interfirm variation over the study period. We therefore set out to examine how this heterogeneity in ICM efficiency is associated with firm age.

3.2. Model

To investigate the relationship between ICM efficiency and firm age, we estimate the following regression model:

$$Y_{it} = \alpha + \beta \ \ ln(age_{it}) + \gamma \cdot z_{it} + \phi_t + \theta_j + \epsilon_{it}. \qquad (4)$$

where the dependent variable Y is ICM efficiency measured by either RVA or RRVA. age is firm age, z is a vector of control variables, ϕ is year fixed effect, and θ is an industry fixed effect. We take the log of firm age because not all years count the same in organizational aging (Bakker and Josefy, 2018). That is, the effect of one additional year

[7] We winsorized RVA and RRVA at the top and bottom 1%. Following Rajan et al. (2000), we also multiplied the index by 100.

is unlikely to be the same for young and old firms. The industry fixed effect is based on the three-digit industry of the firm's main (largest) segment. The control variables include firm size (logged sales), firm scope (one minus the Herfindahl index of three-digit segmental sales), cash flow (EBITDA/sales), investment (CAPEX/sales), and leverage (debt/asset). We cluster standard errors by firms.

In addition to this baseline model, we also estimate regressions incorporating the covariates (cov) of firm age suggested by the alternative scenarios considered in Section 2.2:

$$Y_{it} = \alpha + \beta \ ln(age_{it}) + \delta \cdot cov_{it} + \gamma \cdot z_{it} + \phi_t + \theta_j + \epsilon_{it}. \qquad (5)$$

If firm age is correlated with ICM efficiency because older firms have larger agency hazards, we should observe a weaker effect of firm age when more direct measures of agency problems are controlled for. Likewise, the relevance of other scenarios can be assessed by observing how the coefficient for firm age (β) changes when the covariates suggested by those scenarios are included in the regression.

We consider nine covariates. As an inverse measure of agency costs, we use four governance variables: the ownership share of foreign investors, main banks' ownership share, ratio of independent directors, and a dummy for firms with executive stock options. These variables are taken from the NEEDS Cges (Corporate governance evaluation system) and available for years after 2003. To examine the influence of financial constraints, we consider the role of access to public debt based on a dummy for firms with positive bonds outstanding. Japanese corporate laws require firms to designate directors who have the authority to legally represent their firm. Because these internal directors are the core members of a firm's management, we measure the size of the top management team with the number of representative directors. We measure CEO age with the age of a representative director listed first in *Yukashoken Hokokusho* (Japanese 10K). Employee age is the average age of permanent employees also reported in *Yukashoken Hokokusho*. Information on directors and employees is obtained from the Corporate Attribute Data of Nikkei NEEDS.

Data on the size of headquarters supporting top management are obtained from the Basic Survey of Japanese Business Structure and Activities (BSJBSA). The Ministry of Economy, Trade and Industry (METI) conducts this unique annual survey to collect information on the operations and organizations of firms in mining, manufacturing, public utilities, wholesale and retail trade, and selected service industries. In particular, the survey inquires of firms the number of employees assigned to headquarters' functions. We utilize this information and measure headquarters size by the number of headquarters staff normalized by total employment.[8] Table 3 reports the descriptive statistics of the regression variables.

3.3. Preliminary comparisons

As a preliminary analysis of the relationship between ICM efficiency and firm age, Table 4 compares firms in the bottom and top terciles of age distribution. The mean RVA is negative for both groups of firms but significantly lower for old firms (top tercile) than for young firms (bottom tercile). When ICM efficiency is measured by RRVA, it is on average positive for young firms and negative for old firms, and the

---

[8] Because BSJBSA is not a census covering all firms, the estimation sample for specifications with headquarters size is relatively small even though it covers the full study period. See Morikawa (2015) for a more detailed account of the survey and headquarters data.

difference in mean is significantly different from zero. Hence, although these measures disagree on the average ICM efficiency of young firms, they both suggest that older firms on average have less efficient ICMs.

Table 4 shows that old and young firms differ in other important respects as well. The ownership shares of foreign investors and main banks are higher for old firms, implying that these firms are under stronger governance pressures than young firms. However, the independent director ratio and stock options dummy suggest otherwise, because the mean value of these variables is larger for young firms. Older firms also, on average, have better access to public debt, a larger top management team, and older CEOs and employees. However, the average size of headquarters is significantly smaller for old firms than for young firms.

4. Estimation results

4.1. Main results

Column (1) of Table 5 reports the estimation result of the baseline model using RVA as the dependent variable. The coefficient for logged firm age is negative and significantly different from zero ($p = 0.000$). Hence, older firms on average have less efficient ICMs even when other determinants of allocative efficiency are accounted for. Given the estimated coefficient, one SD change in logged firm age is associated with a change in RVA that is 6.7% of its SD (=0.105*0.560/0.875). Based on this metric of effect size, the importance of firm age as a determinant of ICM efficiency is comparable to that of other variables, such as investment (8.6%) and cash flow (7.0%). The data therefore indicate that firm age plays an economically meaningful role in differentiating ICM efficiency across firms.

The regression reported in Column (2) incorporates the squared term of logged firm age to examine the possibility that the relationship between ICM efficiency and firm age is nonlinear, as described by Hypothesis 2. While the estimated coefficient for the linear term of logged firm age is positive, albeit insignificant ($p = 0.141$), the coefficient for the squared term is significantly negative. These sign patterns suggest a weak inverted U-shaped relationship between ICM efficiency and firm age. However, the estimated coefficients imply that the effect of firm age turns from positive to negative when a firm is approximately 10 years old. Because the ratio of sample firms yet to reach this threshold is less than 3%, the association between firm age and ICM efficiency is essentially negative.[9]

The regression of Column (3) estimates the association as a step function by assigning dummies to firms partitioned into age quintiles (the base case is firms in the first quintile). This flexible specification also shows that ICM efficiency declines with firm age because the coefficients for quintile dummies are negative and larger in absolute value for upper quintiles. The specification for Column (4) uses RRVA as the dependent variable. The coefficient for firm age is significantly negative and similar in magnitude to the corresponding estimate reported in Column (1). Thus, the inverse association between firm age and ICM efficiency is observed regardless of how we measure segmental growth opportunities.

4.2. Augmented regressions

As we noted earlier, older firms can have less efficient ICMs for reasons other

[9] Our sample of Japanese firms includes few truly young firms. If a different sample that is more balanced in the coverage of firm age distribution is examined, one may find stronger evidence for the learning effect.

than the liability of aging. To gain sharper insight into the mechanisms underlying the observed association between ICM efficiency and firm age, we perform two sets of analyses. First, we estimate regressions augmented with covariates suggested by the alternative scenarios. The estimation results are tabulated in Table 6, in which the dependent variables for the odd- and even-numbered columns are RVA and RRVA, respectively. The coefficients of control variables and associated standard errors are omitted from this reporting to conserve space. The size of the estimation sample varies by specification because of the different time and firm coverages of covariates.

The regressions reported in Columns (1) and (2) include governance variables. In both estimations, the coefficient for the stock options dummy is positive and significantly different from zero, implying that managers reallocate capital more efficiently when their financial interests are aligned with shareholders.' However, the coefficients for other governance variables are not significant. Moreover, little change is observed for the effect of firm age, which is negative and significantly different from zero. Hence, the role of agency problems in generating the observed association between firm age and ICM efficiency appears to be small, if any.

To examine the possibility that firm age picks up the effect of financial constraints, the regressions of Columns (3) and (4) incorporate the dummy for firms with bonds outstanding. The effect of this variable is not significantly different from zero regardless of how we measure allocative efficiency. The specifications for Columns (5) and (6) incorporate the number of representative directors. The coefficient for this covariate is also not significant in either regression. It is thus unlikely that older firms have less efficient ICMs because they are headed by a larger top management team. The regressions reported in Columns (7) and (8) incorporate headquarters size.

While the coefficient for this variable is negative, it is not significant in either estimation. The regressions tabulated in the last four columns investigate the possibility that firm age picks up the effect of people's rather than organizations' aging. The reported results show that neither CEO nor employee age is significantly associated with ICM efficiency. Across the board, the effect of firm age on ICM efficiency remains significantly negative.

Overall, therefore, the covariates of firm age suggested by alternative scenarios considered in Section 2.2 have little power to explain the variation of ICM efficiency across firms, whereas the effect of firm age on ICM efficiency is robust to the control for these variables. These results leave the liability of aging as a probable explanation for the observed inverse association between firm age and ICM efficiency. In the next subsection, we perform a more direct test of the role of age-based organizational rigidity in generating the association.

4.3. Reorganization

Studies on age-based organizational evolution suggest that it is not a result of the mere passage of time (Bakker and Josefy, 2018). When firms undergo major changes and factors driving the evolution are refreshed, the aging clock of organizations is reset (Amburgey et al., 1993). In our second set of additional analyses, we draw on this insight and examine how the effect of firm age on ICM efficiency is affected by a large discrete change in organizational structure. The organization of diversified firms is a complex combination of subunits, such as divisions and subsidiaries. These subunits are not only the building blocks of productive activities but also the bases of capital allocation. Therefore, when a firm radically restructures its organization by creating, scrapping, and recombining subunits, its budgeting systems are also renewed in accordance with the new structure. Drastic reorganization also renews routines by changing how organizational members communicate and interact in performing a task. Reorganization also dissolves the vested interests of divisions by redrawing divisional boundaries and reallocating decision rights.

These considerations suggest that drastic reorganization rejuvenates an ICM by refreshing the factors that otherwise move its aging clock forward. That is, if the liability of aging underlies the observed inverse association between ICM efficiency and firm age, the association is likely to be weakened when a firm is radically reorganized. To test this prediction, we exploit a wave of reorganization, which was spurred by a legal reform on the long-term ban of holding company structure. Holding companies were prohibited in Japan after World War II to prevent the revival of *zaibatsu*, the corporate groups that economically supported the country's military expansions. However, after the ban was lifted in the late 1990s to facilitate corporate restructuring, many firms transformed themselves into holding companies by spinning off all of their businesses into subsidiaries. In our sample, approximately one-10th of firms (9.7%) transited to a holding company by the end of the study period. As illustrated in Figure 1, these firms' median ratio of subsidiary employees in total employment increased from approximately 50% to more than 95% in the year of transition (Year 0). Therefore, the change in organization induced by a transition to a holding company is large and discrete.

To investigate how reorganization affects the effect of firm age on ICM efficiency, we estimate the following regression model, including the dummy for holding companies (*hd*) and its interaction term with logged firm age as additional explanatory variables:

$$Y_{it} = \alpha + \beta_1 ln(age_{it}) + \beta_2 \ hd_{it} + \beta_3 \ ln(age_{it}) \times hd_{it} + \gamma \cdot z_{it} + \phi_t + \theta_j + \epsilon_{it}. \quad (6)$$

Our hypothesis is that, while the coefficient for logged firm age (β_1) is negative due to the liability of aging, the coefficient for the interaction term (β_3) is positive because radical reorganization rejuvenates an ICM by renewing the factors that otherwise increase the rigidity of resource allocation.

Columns (1) and (2) of Table 6 report the estimation results using RVA and RRVA as the dependent variable, respectively. As in previous regressions, the main effect of firm age (β_1) is negative and significantly different from zero. However, in both specifications, the estimated interaction effect between logged firm age and the holding company dummy (β_3) is significantly positive, and the sum of these coefficients is close to zero.[10] Hence, the inverse association between firm age and ICM efficiency is substantially weakened when firms are radically reorganized, as if they were reborn as a new organization. Consistent with the notion that organizing businesses into separate entities (subsidiaries) limits the extent to which a firm can move capital across businesses (Bethel and Liebeskind, 1998; Triantis, 2004), the main effect of the holding company structure (β_2) is negative. However, it is only marginally significant (p=0.072) in Column (1) and not significantly different from zero in Column (2).[11]

Columns (3) and (4) examine the possibility that the aging pattern of firms that

---

[10] The hypothesis that the sum of the coefficients is zero cannot be rejected at the 0.1% level for both Columns (1) and (2).

[11] The combination of positive main effect of the holding company dummy and negative interaction effect between logged firm age and the holding company dummy implies that the effect of transiting to a holding company on ICM efficiency is negative for relatively young firms and positive for relatively old firms. Based on the coefficient estimates in Column (1), the threshold age is estimated to be 34, which is about the same as the average age of firms transiting to a holding company.

transited to a holding company was different from those of other firms even before the transition. In this event, the interaction effect between firm age and holding company structure can reflect these firms' idiosyncrasies rather than the rejuvenating effects of reorganization. We check this possibility based on a dummy variable that takes one for transiting firms in their pretransition period. The reported specifications examine how firm age interacts with this dummy (pre-hd) as well as the holding company (posttransition) dummy in affecting ICM efficiency. As in previous estimations, the interaction effect between the holding company dummy and logged firm age is significantly positive in both Columns (3) and (4). In contrast, the interaction effect between logged firm age and the pretransition dummy is not significantly different from zero. Hence, it is unlikely that firms that adopted the holding company structure had followed an idiosyncratic aging path even before the adoption.

We next consider the possibility that the observed rejuvenating effect of reorganization captures the effect of firm attributes associated with a firm's decision to reorganize rather than reorganization itself. In this scenario, firms sharing these attributes can exhibit the same aging pattern regardless of how they are organized. To check this possibility, we estimate a probit model of the probability that a nonholding company is reorganized as a holding company in year *t* given its attributes in *t-1*. Based on the estimated propensity score, we then perform a one-to-one matching to identify firms that did not transit to a holding company but were otherwise comparable to transiting firms. The explanatory variables of the probit model include logged firm age, subsidiary employment ratio, R&D and marketing intensities, share of holding companies in the three-digit industry, and allocative efficiency (the Appendix provides a more detailed description of the model, as well as regression and matching results). The probit regression reveals that firms that transited to a holding company and firms that did not are different in several important respects. After matching, however, transiting firms (*hd*=1) and matched nontransiting firms (*hd*=0) are comparable in all attributes used to estimate the propensity score.

We assume that firms matched to a firm transiting to a holding company become a "pseudo holding company" in the matched year (*t*) and remain so in the ensuing period. The regressions reported in Columns (5) and (6) of Table 6 use a dummy for pseudo holding companies in place of the holding company dummy. The estimated interaction effect between firm age and pseudo holding company dummy is negative rather than positive, although it is not significantly different from zero in Column (5) and only marginally significant in Column (6). Hence, it is unlikely that the observed interaction between firm age and holding company structure is confounded by firm attributes associated with the adoption of the structure.

The regressions tabulated in Columns (7) and (8) compare the effect of firm age between true and pseudo holding companies by omitting other firms from the estimation sample.[12] The significantly negative effect of firm age confirms that ICM efficiency declines with firm age for nonholding companies (base case). However, the positive interaction effect between firm age and the holding company dummy suggests that the effect of firm age on ICM efficiency is substantially mitigated for firms that adopt the holding company structure. Because the estimation sample of these regressions is limited to firms with comparable attributes, this result lends further support to the rejuvenating effect of drastic reorganization.

---

[12] True and pseudo holding companies are both included in the sample for the pretransition period as well. Industry fixed effects are excluded from these regressions because of the limited size of the estimation sample.

Overall, the results reported in Table 6 indicate that the inverse association between firm age and ICM efficiency is substantially mitigated when firms are radically reorganized. While this pattern is consistent with the notion that the aging clock of a firm's organization is reset by major changes (Amburgey et al., 1993), it is hard to reconcile with scenarios other than the liability of aging. It therefore lends further credence to our view that age-based organizational rigidity is instrumental in lowering the ICM efficiency of old firms.

5. Conclusions

An important feature of diversified firms is their ability to reallocate resources in response to external volatility. However, there is considerable heterogeneity in how they move capital across businesses. The present study highlighted the role of organizational aging in generating this variation. Consistent with the hypothesis that organizational aging increases the rigidity of capital budgeting processes and thereby decreases allocative efficiency, our analysis of Japanese firms identified a strong inverse association between firm age and ICM efficiency. This association is robust to controlling for factors suggested by alternative explanations. Moreover, it is substantially weakened when firms are drastically reorganized. These results lend support to the view that ICM efficiency declines with firm age because of the liability of aging (aged-based organizational rigidity).

Previous studies have documented that micro-organizational factors, such as the backgrounds and interconnections of managers, affect intrafirm fund flows. Our study complements these studies by showing that the attributes of organizations, which provide a framework for managerial decision making and behavior, are also instrumental in differentiating ICM efficiency across firms. The present study also contributes to research on the liability of aging. Previous studies on this topic mostly look at relatively simple organizations such as credit unions (Barron et al., 1994), life insurance companies (Ranger-Moore, 1997), and hedge funds (de Figueiredo et al., 2015). Our evidence from diversified firms indicates that studying the internal working of complex organizations provides alternative avenues for delving into the sources and consequences of age-based organizational rigidity.

We have noted multiple mechanisms that potentially underlie the liability of aging in ICMs. However, our evidence provides little information to interpret the mechanisms' relative importance. Overcoming this limitation is a natural next step for future research. In responding to external changes, diversified firms can reallocate human and nonhuman resources as well as financial capital (Helfat and Isenhardt, 2004; Sakhartov and Folta, 2014; Tate and Young, 2016; Lieberman et al., 2017; Dickler and Folta, 2020). How organizational aging is associated with this important ability is another interesting avenue for future research.

Appendix

For the analyses reported in Columns (5) and (6) of Table 7, we estimate a probit model of the probability that a firm that was not a holding company in year *t-1* becomes a holding company in year *t*, using the holding company dummy (*hd*) as the dependent variable. The estimation is performed on all firms with *hd* = 0 for year *t-1*. Explanatory variables include firm age (logged), ICM efficiency, firm size, firm scope profitability, investment, leverage, subsidiary employment ratio, R&D intensity (R&D expenditure/sales), marketing intensity (advertising and sales promotion expenditures/sales), the ratio of holding companies in the same three-digit industry, and year dummies. Except for year dummies, all explanatory variables are lagged one year. Table A tabulates the probit estimation result, in which ICM efficiency is measured by RVA, as well as the mean value of explanatory variables for transiting firms (*hd* = 1) and nontransiting firms (*hd* = 0) matched based on the estimated propensity score. The unreported results using RRVA instead of RVA are substantially similar and available from the authors upon request.

Table A: Probit estimation result for propensity score matching

	Probit model of P(*hd* (*t*)=1 | *hd* (*t-1*) =0))	Mean value after matching		
	Coefficient	Transiting (*hd* =1)	Non-transiting (*hd* =0, matched)	P-value
Firm age (*t-1*)	-0.147 (0.091)	3.817	3.770	0.693
RVA (*t-1*)	0.139 ** (0.061)	0.085	0.036	0.805
Firm size (*t-1*)	0.035 (0.036)	11.49	11.16	0.248
Diversification (*t-1*)	-0.088 (0.250)	0.341	0.389	0.289
Profitability (*t-1*)	-1.572 (1.052)	0.067	0.079	0.292
Investment (*t-1*)	-0.564 (1.384)	0.039	0.049	0.266
Leverage (*t-1*)	0.046 (0.302)	0.283	0.304	0.499
Subsidiary employment (*t-1*)	0.809 *** (0.226)	0.565	0.580	0.743
R&D intensity (*t-1*)	-9.000 ** (4.080)	0.007	0.007	0.97
Marketing intensity (*t-1*)	4.066 *** (1.311)	0.022	0.020	0.776
Industry share of holding companies (*t-1*)	2.349 *** (0.616)	0.067	0.086	0.347
Year fixed effect	Yes			
# Observations	9265			
Log likelihood	-314.40			
Pseudo R-squared	0.1197			

Note: In parentheses are standard errors. The P-value is the difference in the mean between transiting and nontransiting firms. *** Significant at the 0.01 level. ** Significant at the 0.05 level.

References

Amburgey, T.L., Kelly, D., Barnett, W.P., 1993. Resetting the clock: The dynamics of organizational change and failure, Administrative Science Quarterly 38, 51-73.

Arikan, A.M., Stulz, R., 2016. Corporate Acquisitions, diversification, and the firm's life cycle, Journal of Finance 71, 139-194.

Bakker, R.M., Josefy, M., 2018. More than just a number? The conceptualization and measurement of firm age in an era of temporary organizations, Academy of Management Annals 12, 510-536.

Barron, D.N., West, E., Hannan, M.T., 1994. A time to grow and a time to die: Growth and mortality of credit unions in New York city, 1914-1990, American Journal of Sociology 100, 381-421.

Becker, M.C., 2004, Organizational routines: A review of the literature, Industrial and Corporate Change 13, 643-677.

Berger, P. G., Ofek, E., Yermack, D.L., 1997. Managerial entrenchment and capital structure decisions, Journal of Finance 52, 1411-1438.

Berger, P. G., Ofek, E., 1995. Diversification's effect on firm value, Journal of Financial Economics 37, 39-65.

Bertrand, M., Mullainathan, S., 2003. Enjoying the quiet life? Corporate governance and managerial preferences. Journal of Political Economy111, 1043-1075.

Bertrand, M., Schoar, A., 2003. Managing with style: The effect of managers on firm policies, Quarterly Journal of Economics 118, 1169-1208.

Bethel, J.E., Liebeskind, J. P., 1998. Diversification and the legal organization of the firm, Organization Science 9, 49-67.

Billett, M.T., Mauer, D.C., 2003. Cross-subsidies, external financing constraints, and the contribution of the internal capital market to firm value, Review of Financial Studies 16, 1167–1201.

Bower, J.L., 1970. Managing the Resource Allocation Process: A Study of Corporate Planning and Investment, Harvard Business School, Division of Research, Boston: MA.

Coad, A., 2018. Firm age: a survey, Journal of Evolutionary Economics 28, 13-43.

Colak, G., Whited, T.M., 2007. Spin-offs, Divestitures, and Conglomerate Investment, Review of Financial Studies 20, 557-595.

Dickler, T.A., Folta, T.B., 2020. Identifying internal markets for resource redeployment, Strategic Management Journal 41, 2341-2371.

Dimitrov, V., Tice, S., 2006. Corporate diversification and credit constraints: Real effects across the business cycle, Review of Financial Studies 19, 1465–1498.

Duchin, R., Sosyura, D., 2013. Divisional managers and internal capital markets, Journal of Finance 68, 387-429.

de Figueiredo Jr. R.J.P., Rawley, E., Rider, C.I., 2015. Why are firms rigid? A general framework and empirical tests, Organization Science 26, 1502-1519.

Finkelstein, S., Hambrick, D.C., Cannella, A.A., 2009. Strategic Leadership: Theory and Research on Executives, Top Management Teams and Boards, Oxford University Press, Oxford.

Gasper, J.M., Massa, M., 2011. The role of commonality between CEO and divisional managers in internal capital markets, Journal of Financial and Quantitative Analysis 46, 841-869.

Gertner, R.H., Scharfstein, D.S., Stein, J.C., 1994. Internal versus external capital markets, Quarterly Journal of Economics 109, 1211-1230.

Gertner,R., Powers, E., Scharfstein, D., 2002. Learning about internal capital markets from corporate spin-offs, Journal of Finance 57, 2479-2506.

Glaser, M., Lopez-De-Silanes, F., Sautner, Z., 2013. Opening the black box: internal capital markets and managerial power, Journal of Finance 68, 1577-1631.

Hadlock, C.J., Pierce, J.R., 2010. New evidence on measuring financial distress: Moving beyond the KZ index, Review of Financial Studies 23,1909-1940.

Hannan, M.T., Freeman, J., 1984. Structural inertia and organizational change, American Sociological Review 49, 149-164.

Helfat, C.E., Eisenhardt, K.M., 2004. Inter-temporal economies of scope, organizational modularity, and the dynamics of diversification, Strategic Management Journal 25, 1217-1232.

Hill, C.W.L., Hitt, M.A., Hoskisson, R.E., 1992. Cooperative versus competitive structure in related and unrelated diversified firms, Organizational Science 3, 501-521.

Hovakimian, G., 2011. Financial constraints and investment efficiency: Internal capital allocation across the business cycle, Journal of Financial Intermediation 20, 264-283.

Kuppuswamy, V., Villalonga, B., 2016. Does diversification create value in the presence of external financing constraints? Evidence from the 2007–2009 financial crisis, Management Science 62, 905-923.

Le Mens, G., Hannan, M.T., Polos, L., 2015. Age-related structural inertia: A distance-based approach, Organization Science 26, 756-773.

Liberti, J.M., Petersen, M.A., 2019. Information: Hard and soft, Review of Corporate Finance Studies 8, 1–41.

Lieberman, M.B., Lee, G.K., Folta, T.B., 2017. Entry, exit, and the potential for resource redeployment, Strategic Management Journal 38, 526-544.

Loderer, C., Stulz, R., Waelchlig, U., 2017. Firm rigidities and the decline in growth opportunities, Management Science 63, 1–20

March. J.G., 1962. The business firm as a political coalition, Journal of Politics 24, 662-678.

McNeil, C. R., Smythe, T.I., 2009. Division Manager Lobbying Power and the Allocation of Capital, Financial Review 44, 59-85.

Merchant, K.A., 1981. The design of the corporate budgeting system: Influences on managerial behavior and performance, Accounting Review 4, 813-829.

Meyer, M., Milgrom, P., Roberts, J., 1992. Organizational prospects, influence costs, and ownership changes, Journal of Economics and Management Strategy 1, 9-35.

Morikawa, M., 2015. Are large headquarters unproductive? Journal of Economic Behavior and Organization 119, 422-436.

Nelson, R.R., Winter, S.G., 1982. An Evolutionary Theory of Economic Change, Harvard University Press, Cambridge, MA.

Ouimet, P., Zarutskie. R. 2014. Who works for startups? The relation between firm age, employee age, and growth, Journal of Financial Economics 112, 386-407.

Pástor, L., Veronesi, P., 2003. Stock valuation and learning about profitability, Journal of Finance 58, 1749-1790.

Rajan, R., Servaes, H., Zingales, L., 2000. The cost of diversity: The diversification discount and inefficient investment, Journal of Finance 55, 35-80.

Ranger-Moore, J., 1997. Bigger may be better, but is older wiser? Organizational age and size in the New York life insurance industry, American sociological review 62, 903-920.

Sakai, K, Uesugi, I., Watanabe, T.,2010. Firm age and the evolution of borrowing costs: Evidence from Japanese small firms, Journal of Banking and Finance 34, 1970-1981.

Sakhartov, A.V., Folta, T.B., 2014. Resource relatedness, redelpoyability, and firm value, Strategic Management Journal 35, 1781-1797.

Scharfstein, D., Stein, J.C., 2000. The dark side of internal capital markets: Divisional rent-seeking and inefficient investment, Journal of Finance 55, 2537-2564.

Sengul, M., Costa, A.A., Gimeno, J., 2019. The allocation of capital within firms, Academy of Management Annals 13, 43-83.

Shin, H. H., Stulz, R.M., 1998. Are internal capital markets efficient? Quarterly Journal of Economics 113, 531-52.

Stein, J. C., 1997. Internal capital markets and the competition for corporate resources, Journal of Finance 52, 111-133.

Tate, G., Yang, L., 2015. The bright side of corporate diversification: Evidence from internal labor markets, Review of Financial Studies 28, 2203-2249.

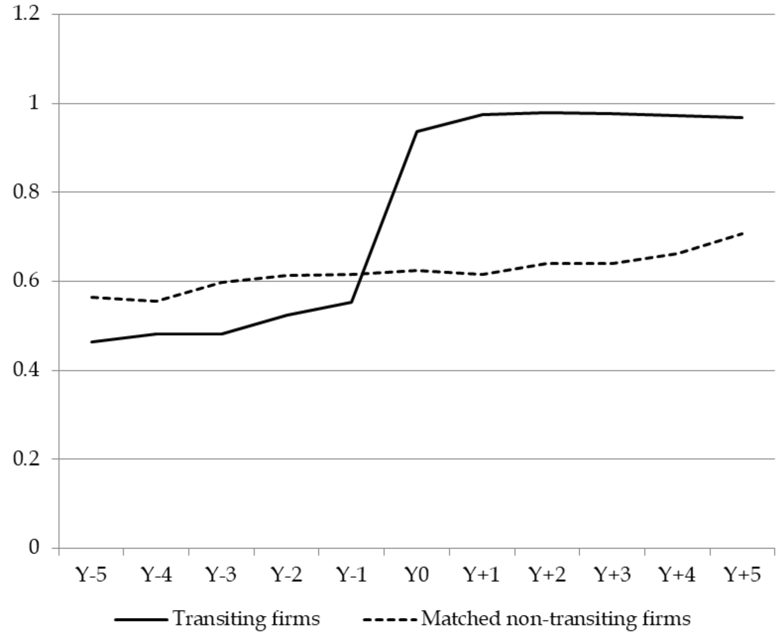
Triantis, G.G., 2004. Organizations as internal capital markets: the legal boundaries of firms, collateral, and trust in commercial and charitable enterprises, Harvard Law Review 117, 1102-1162.

Williamson, O.E., 1975. Markets and Hierarchies: Analysis and Antitrust Implications. New York: Free Press.

Whited, T.M., 2001. Is It Inefficient Investment that Causes the Diversification Discount? Journal of Finance 56, 1667-1691.

Xuan, Y., 2009. Empire-building or bridge-building? Evidence from new CEOs' internal capital allocation decisions, Review of Financial Studies 22, 4919-4948.

Figure 1: Subsidiary employment ratio before and after the transition to a holding company



Note: This figure illustrates the median ratio of subsidiary employees in total employment for firms that transited to a holding company (real line) and nontransiting firms that are matched to a transiting firm (dotted line). Y0 refers to the year of transition for transiting firms and the year of matching for nontransiting firms.

Table 1: Descriptive statistics of key variables

Variable	# Obs	Mean	SD	P5	P50	P95
Firm age	11,097	56.7	22.3	16	57	93
Tobin's Q	11,097	1.080	0.706	0.673	0.988	1.717
Asset-weighted industry Q ($\bar{q}$)	11,097	1.224	0.546	0.806	1.107	2.006
Asset-weighted segment-specific Q ($\bar{\bar{q}}$)	11,097	1.363	0.700	0.810	1.170	2.526
Relative value added (RVA)	11,097	-0.148	0.875	-1.619	-0.019	0.843
Revised relative value added (RRVA)	11,097	-0.003	1.321	-1.713	-0.003	1.592

Note: P5, P50, and P 95 denote the 5th, 50th, and 95th percentiles, respectively.

Table 2: Descriptive statistics of ICM efficiency measures by year

		RVA			RRVA			RVA minus RRVA		
Year	# Obs	Mean		SD	Mean		SD	Mean		SD
2001	998	-0.080	***	0.802	0.055		1.134	-0.135	***	1.265
2002	1,041	-0.063	***	0.687	0.055	*	0.969	-0.118	***	1.034
2003	1,072	-0.057	***	0.512	-0.016		0.913	-0.041		0.981
2004	1,078	-0.164	***	0.858	-0.007		1.411	-0.157	***	1.469
2005	1,120	-0.259	***	1.028	-0.122	***	1.513	-0.136	***	1.546
2006	1,098	-0.239	***	1.089	-0.108	**	1.481	-0.131	***	1.391
2007	1,179	-0.275	***	1.136	0.032		1.416	-0.307	***	1.569
2008	1,228	-0.062	***	0.899	0.104	**	1.489	-0.165	***	1.587
2009	1,174	-0.142	***	0.752	0.015		1.476	-0.157	***	1.543
2010	1,109	-0.123	***	0.715	-0.046		1.123	-0.077	**	1.035
2001-2010	11,097	-0.148	***	0.875	-0.003		1.321	-0.144	***	1.372

Note: *** Significant the 0.01 level. ** Significant the 0.05 level. * Significant the 0.10 level.

Table 3: Descriptive statistics of explanatory variables

Variable	Obs.	Mean	SD	P5	P50	P95
Firm age (logged)	11,097	3.92	0.560	2.77	4.043	4.53
Firm size (logged sales)	11,097	11.11	1.54	8.834	10.92	14.04
Firm scope (1- Herfindahl index)	11,097	0.349	0.218	0.022	0.351	0.701
Profitability (EBITDA/sales)	11,097	0.081	0.065	0.005	0.071	0.201
Investment (CAPEX/sales)	11,097	0.046	0.048	0.002	0.032	0.142
Leverage (debt/asset)	11,097	0.276	0.182	0.007	0.264	0.602
Foreign ownership	7,926	0.090	0.102	0.000	0.052	0.303
Main bank ownership	7,912	0.023	0.018	0.000	0.023	0.049
Independent director ratio	7,929	0.046	0.088	0.000	0.000	0.250
Stock options (dummy)	7,920	0.297	0.457	0.000	0.000	1.000
Bond market access (dummy)	11,097	0.467	0.499	0.000	0.000	1.000
# Representative officers	8,745	1.953	1.180	1.000	2.000	4.000
Headquarter size	6,491	0.081	0.066	0.010	0.064	0.221
CEO age	8,745	63.14	8.134	47.00	64.00	76.00
Employee age	10,938	39.21	3.516	32.00	40.00	44.00

Note: Herfindahl index is based on three-digit segmental revenue. P5, P50, and P 95 denote the 5th, 50th, and 95th percentiles, respectively.

Table 4: Comparisons of young and old firms

	Young	Old	Young minus Old
RVA	-0.063	-0.215	0.151 ***
	(3,737)	(3,848)	
RRVA	0.102	-0.066	0.169 ***
	(3,737)	(3,848)	
Foreign ownership	0.079	0.108	-0.028 ***
	(2,647)	(2,807)	
Main bank ownership	0.016	0.027	-0.011 ***
	(2,643)	(2,800)	
Independent director ratio	0.052	0.045	0.007 ***
	(2,650)	(2,807)	
Stock options (dummy)	0.476	0.190	0.286 ***
	(2,643)	(2,806)	
Bond market access (dumn	0.423	0.525	-0.102 ***
	(3,737)	(3,848)	
# Representative directors	1.607	2.228	-0.621 ***
	(2,918)	(3,096)	
Headquarter size	0.099	0.069	0.029 ***
	(1,823)	(2,468)	
CEO age	60.33	64.98	-4.656 ***
	(2,918)	(3,096)	
Employee age	37.19	40.57	-3.380 ***
	(3,667)	(3,806)	

Note: This table compares the mean value of ICM efficiency and other firm attributes between young and old firms, which are defined as firms in the bottom and top terciles of age distribution, respectively. The number of observations is reported in parentheses. *** denotes significant at the 0.01 level.

Table 5: Regression results on the effect of firm age on ICM efficiency

	(1)	(2)	(3)	(4)
Dependent variable	RVA	RVA	RVA	RRVA
Firm age (logged)	-0.105 ***	0.256		-0.117 ***
	(0.028)	(0.174)		(0.039)
Firm age (logged, squared)		-0.056 **		
		(0.027)		
Firm age in the 2nd Quintile (dummy)			-0.105 **	
			(0.043)	
Firm age in the 3rd Quintile (dummy)			-0.148 ***	
			(0.043)	
Firm age in the 4th Quintile (dummy)			-0.162 ***	
			(0.043)	
Firm age in the 5th Quintile (dummy)			-0.171 ***	
			(0.049)	
Firm size	0.025 **	0.031 ***	0.028 ***	0.011
	(0.010)	(0.011)	(0.011)	(0.015)
Firm scope	-0.012	-0.005	-0.018	0.208 **
	(0.065)	(0.065)	(0.065)	(0.100)
Profitability	-0.945 ***	-0.983 ***	-0.990 ***	0.709
	(0.291)	(0.291)	(0.293)	(0.451)
Investment	1.551 ***	1.570 ***	1.583 ***	-0.210
	(0.417)	(0.417)	(0.417)	(0.613)
Leverage	-0.139	-0.126	-0.139	0.457 ***
	(0.089)	(0.089)	(0.090)	(0.130)
Year fixed effect	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes
# Observations	11,097	11,097	11,097	11,097
R-squared	0.108	0.109	0.108	0.098

Note: Standard errors clustered by firms are reported in parentheses. *** Significant at the 0.01 level. ** Significant at the 0.05 level. * Significant at the 0.10 level.

Table 6: Regressions of ICM efficiency augmented by the covariates of firm age

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variable	RVA	RRVA	RVA	RRVA	RVA	RRVA	RVA	RRVA	RVA	RRVA	RVA	RRVA
Firm age (logged)	-0.094 ***	-0.091 **	-0.105 ***	-0.117 ***	-0.097 ***	-0.119 ***	-0.120 ***	-0.172 ***	-0.096 ***	-0.118 ***	-0.102 ***	-0.113 ***
	(0.032)	(0.043)	(0.028)	(0.039)	(0.031)	(0.042)	(0.037)	(0.061)	(0.030)	(0.042)	(0.029)	(0.040)
Foreign ownership	-0.158	-0.037										
	(0.201)	(0.323)										
Main bank ownership	0.622	-1.207										
	(0.908)	(1.261)										
Independent director ratio	0.127	0.282										
	(0.164)	(0.281)										
Stock options (dummy)	0.076 **	0.089										
	(0.034)	(0.054)										
Bond market access (dummy)			-0.008	0.059								
			(0.024)	(0.037)								
# Representative directors					-0.015	-0.013						
					(0.015)	(0.020)						
Headquarter size							-0.367	-0.534				
							(0.229)	(0.399)				
CEO age									-0.001	-0.001		
									(0.002)	(0.003)		
Employee age											-0.003	-0.001
											(0.005)	(0.007)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# Observations	7,899	7,899	11,097	11,097	8,745	8,745	6,491	6,491	8,745	8,745	10,938	10,938
R-squared	0.136	0.123	0.108	0.099	0.129	0.116	0.162	0.142	0.128	0.116	0.109	0.101

Note: Standard errors clustered by firms are reported in parentheses. *** Significant at the 0.01 level. ** Significant at the 0.05 level. * Significant at the 0.10 level.

Table 7: Regression results on how reorganization moderates the association between firm age and ICM efficiency

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	RVA	RRVA	RVA	RRVA	RVA	RRVA	RVA	RRVA
Firm age (logged)	-0.137 ***	-0.148 ***	-0.147 ***	-0.172 ***	-0.138 ***	-0.165 ***	-0.652 **	-0.823 **
	(0.036)	(0.051)	(0.039)	(0.054)	(0.037)	(0.051)	(0.324)	(0.381)
Holding company dummy (hd)	-0.397 *	-0.460	-0.444 *	-0.566 *			-2.199 *	-2.958 *
	(0.221)	(0.317)	(0.228)	(0.332)			(1.311)	(1.619)
Firm age×hd	0.113 *	0.168 **	0.126 **	0.193 **			0.562 *	0.752 *
	(0.059)	(0.085)	(0.061)	(0.089)			(0.325)	(0.388)
Pre-hd (dummy)			-0.436	-0.955				
			(0.413)	(0.734)				
Firm age × Pre-hd			0.123	0.236				
			(0.103)	(0.181)				
Psuedo-hd (dummy)					1.593	2.592 *		
					(1.199)	(1.469)		
Firm age × Psuedo-hd					-0.414	-0.625 *		
					(0.295)	(0.350)		
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.108	0.099	0.109	0.099	0.111	0.101	0.063	0.052
# Observations	11,097	11,097	11,097	11,097	10,626	10,626	710	710

Note: Pre-hd denotes a dummy for firms that transited to a holding company for the pretransition period. Pseudo-hd denotes a dummy for firms that are matched to a firm transiting to a holding company for the matched and ensuring years. Standard errors clustered by firms are reported in parentheses. *** Significant at the 0.01 level. ** Significant at the 0.05 level. * Significant at the 0.10 level.